



**HINDUSTAN**  
INSTITUTE OF TECHNOLOGY & SCIENCE  
(DEEMED TO BE UNIVERSITY)

**B. TECH. COMPUTER SCIENCE AND ENGINEERING**

**(Duration: 4 Years)**

**CURRICULUM and SYLLABUS**

**(Applicable for Students admitted from Academic Year 2018-19)**

**B. Tech. Computer Science and Engineering**

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

**SCHOOL OF COMPUTING SCIENCES**

**HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE**

# HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

**Motto:**

*To Make Every Man a Success and No Man a Failure*

**Vision:**

*To be an International Institute of Excellence, providing a conducive environment for education with a strong emphasis on innovation, quality, research and strategic partnership blended with values and commitment to society.*

**Mission:**

- *To create an ecosystem that promotes learning and world class research.*
- *To nurture creativity and innovation.*
- *To instill highest ethical standards and values.*
- *To pursue activities for the development of the Society.*
- *To develop national and international collaborations with institutes and industries of eminence.*
- *To enable graduates to become future leaders and innovators.*

**Value Statement:**

*Integrity, Innovation, Internationalization.*

## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

### **Vision:**

To excel in Computer Science and Engineering education, research and project management by empowering the students with strong conceptual knowledge.

### **Mission:**

- M1:** To educate the students with basic foundation blocks of core and allied disciplines of Computer Science and Engineering.
- M2:** To provide practical skills in the advancements of the Computer Science and Engineering field required for the growing dynamic IT and ITES industries.
- M3:** To sculpt strong personal, technical, research, entrepreneurial, and leadership skills.
- M4:** To inculcate knowledge in lifelong learning, professional ethics and contribution to the society.

### **PROGRAMME'S EDUCATIONAL OBJECTIVES (PEO'S):**

The Program Educational Objectives (PEOs) of the **Computer Science and Engineering** are listed below:  
The graduate after 3-5 years of programme completion will

- PEO1:** Excel in his/her professional career and/or pursue higher education including research by applying the knowledge of Computer Science and Engineering.
- PEO2:** Demonstrate the technical skills to analyze and design appropriate solutions for problems with social consciousness and ethical values.
- PEO3:** Adapt themselves to organizational needs by understanding the dynamically changing technologies.

**PROGRAM OUTCOMES (ALIGNED WITH GRADUATE ATTRIBUTES) (PO)**

*(To be achieved by the student after every semester/year/and at the time of graduation)*

At the end of this program, graduates will be able to

- PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2: Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

- PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

#### **PROGRAM SPECIFIC OUTCOMES (PSO)**

On completion of the B.Tech. Computer Science & Engineering degree the graduates will be able to

- PSO1:** Apply mathematical, conceptual knowledge of computing and analytical skills to solve complex problems.
- PSO2:** Design and develop computer systems based on the domains of Cyber Physical Systems, Algorithm Design Techniques and Enterprise systems security.
- PSO3:** Do innovative system design with analytical knowledge by developing modern tools and techniques.

B.TECH.–COMPUTER SCIENCE AND ENGINEERING									
(165 CREDIT STRUCTURE)									
SEMESTER–I									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	HS/ES	ELA4101/ MEA4101	Professional English and Soft Skills /Engineering Graphics and Computer Aided Design	1	1	2	3	1	4
2	BS	MAA4101	Matrices and Calculus	3	0	2	4	0	5
3	BS	PHA4102/ CYA4101	Engineering Physics/Engineering Materials	3	0	0	3	1	3
4	PC	CSA4101	Problem Solving Using C	2	0	2	3	1	4
5	ES	EEB4101 /CSB4101	Introduction to Digital Systems /Engineering and Design	2	0	2	3	1	4
7	ES	GEA4131	Engineering Immersion Lab	0	0	2	0.5	2	2
8	BS	PHA4131/ CYA4131	Engineering Physics Lab/Materials Chemistry Lab	0	0	2	1	0	2
<b>Total</b>				11	1	12	17.5	6	24

SEMESTER–II									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	BS	MAA4117	Analytical Mathematics	3	0	2	4	1	5
2	BS	PHA4102/C YA4101	Engineering Physics/ Engineering Materials	3	0	0	3	1	3
3	HS/ES	ELA4101/ MEA4101	Professional English and Soft Skills /Engineering Graphics and Computer Aided Design	1	1	2	3	1	4
4	ES	EEB4101 /CSB4101	Introduction to Digital Systems/Engineering and Design	2	0	2	3	1	4
5	ES	GEA4102	Sustainable Engineering Systems	2	0	0	2	1	3
6	PC	CSB4117	Data Structures using C	3	0	0	3	1	3

7	PC	CSB4118	Object Oriented Programming using C++	3	0	2	4	1	5
8	PC	CSB4146	Data Structures Lab	0	0	3	1	0	3
9	ES	GEA4131	Engineering Immersion Lab	0	0	2	0.5	2	2
10	BS	PHA4131/C YA4131	Engineering Physics Lab/Materials Chemistry Lab	0	0	2	1	0	2
<b>Total</b>				17	1	15	24.5	9	34

**B. TECH–COMPUTER SCIENCE AND ENGINEERING****(165 CREDIT STRUCTURE)****SEMESTER–III**

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TC H
1	BS	MAA4201	Partial Differential Equations and Transforms	3	0	2	4	0	5
2	PC	CSB4201	Design and Analysis of Algorithms	2	1	2	4	1	5
3	PC	CSB4202	Database Management Systems	3	0	0	3	1	3
4	PC	CSB4203	Java Programming	3	0	2	4	0	5
5	DE	CSC42**	Department Elective-I	3	0	0	3	0	3
6	NE	CSD42**	Non-Department Elective-I	2	0	0	2	0	2
7	PC	CSB4231	Python Programming Lab	0	0	3	1	0	3
8	PC	CSB4232	Database Management Systems Lab	0	0	3	1	0	3
<b>Total</b>				16	1	12	22	2	29

**SEMESTER–IV**

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TC H
1	BS	MAA4219	Discrete Mathematics	3	1	0	4	0	4
2	PC	CSB4216	Computer Organization and Architecture	3	0	0	3	1	3

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3	PC	CSB4217	Computer Networks	3	0	0	3	1	3
4	PC	CSB4218	Operating Systems	3	0	0	3	1	3
5	DE	CSC42**	Department Elective-II	2	0	2	3	0	4
6	NE	CSD42**	Non-Department Elective–II	2	0	0	2	0	2
7	PC	CSB4241	Networking Lab	0	0	3	1	0	3
8	PC	CSB4242	Operating Systems Lab	0	0	3	1	0	3
9	PC	CSB4243	Design Project-I	0	0	2	1	0	2
10	PC	CSB4244	Internship	0	0	0	1	0	0
<b>Total</b>				16	1	10	22	3	27

<b>B. TECH–COMPUTER SCIENCE AND ENGINEERING</b>									
<b>(165 CREDIT STRUCTURE)</b>									
<b>SEMESTER–V</b>									
<b>SL. NO</b>	<b>COURSE CATEGORY</b>	<b>COURSE CODE</b>	<b>NAME OF THE COURSE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>S</b>	<b>TC H</b>
1	BS	MAA4302	Probability and Statistics	3	0	2	4	0	5
2	PC	CSB4301	Web Technology	2	0	2	3	1	4
3	PC	CSB4302	Theory of Computation	3	1	0	4	1	4
4	PC	CSB4303	Artificial Intelligence	3	0	0	3	0	3
5	HS	GEA4216	Professional Ethics and Life Skills	2	0	0	2	1	2
6	DE	CSC43**	Department Elective-III	2	0	2	3	0	4
7	NE	CSD43**	Non-Department Elective–III	2	0	0	2	0	2
8	PC	CSB4331	Skill Development in Programming	0	0	2	1	0	2
9	PC	CSB4332	Design Project with IoT	0	0	3	1	0	3
<b>Total</b>				17	1	11	23	3	29



SEMESTER-VI									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	PC	CSB4316	Principles of Compiler Design	3	1	0	4	1	4
2	PC	CSB4317	Machine Learning	3	0	2	4	1	5
3	PC	CSB4318	Data Warehousing and Data Mining	3	0	0	3	1	3
4	PC	CSB4319	Modern Software Engineering	3	0	2	4	1	5
5	HS	GEA4304	Business Economics	2	0	0	2	1	2
6	DE	CSC43**	Department Elective-IV	2	0	2	3	0	4
7	NE	CSD43**	Non-Department Elective-IV	2	0	0	2	0	2
8	PC	CSB4341	Compiler Design lab	0	0	3	1	0	3
9	PC	CSB4342	Design Project-II	0	0	2	1	0	2
10	PC	CSB4343	Internship	0	0	0	1	0	0
Total				18	1	11	25	5	30

B. TECH-COMPUTER SCIENCE AND ENGINEERING									
(165 CREDIT STRUCTURE)									
SEMESTER-VII									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	PC	CSB4401	Software Project Management	3	0	0	3	1	3
2	PC	CSB4402	Big Data and Analytics	3	0	2	4	1	5
3	PC	CSB4403	Applied Cryptography and Network Security	3	1	0	4	1	4
4	PC	CSB4404	Programming Paradigms	3	0	0	3	1	3
5	PC	CSB4405	Cloud Deployment	2	0	2	3	0	4
6	NE	CSC44**	Department Elective-V	2	0	2	3	0	4
7	DE	CSD44**	Non-Department Elective-V	2	0	0	2	0	2
8	PC	CSB4431	Design Project-III	0	0	2	1	0	2
Total				18	1	8	23	4	27

SEMESTER–VIII									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TC H
1	PC	CSB4441	Project & Viva– voce	0	0	16	8	0	16
Total				0	0	16	8	0	16
Total							165		

## LIST OF DEPARTMENTAL ELECTIVES(GENERAL)WITH GROUPING-SEMESTER WISE

SEM	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
3	DE	CSC4251	System Software	3	0	0	3	0	3
3	DE	CSC4252	Computer Graphics	3	0	0	3	0	3
3	DE	CSC4253	Free and Open-Source Software	3	0	0	3	0	3
3	DE	CSC4254	Information Architecture	3	0	0	3	0	3
3	DE	CSC4255	ERP and Enterprise Domains	3	0	0	3	0	3
4	DE	CSC4266	Mobile Application Development	2	0	2	3	0	4
4	DE	CSC4267	Game Design and Programming	2	0	2	3	0	4
4	DE	CSC4268	.Net Framework and Programming	2	0	2	3	0	4
4	DE	CSC4269	LINUX Internals	2	0	2	3	0	4
4	DE	CSC4270	Agile Software Development	2	0	2	3	0	4
4	DE	CSC4271	Advanced Java Programming with Frameworks	2	0	2	3	0	4
4	DE	CSC4272	Middleware Technologies	2	0	2	3	0	4
5	DE	CSC4351	Database Security	2	0	2	3	0	4
5	DE	CSC4352	Multicore Architecture	2	0	2	3	0	4
5	DE	CSC4353	Soft Computing	2	0	2	3	0	4
5	DE	CSC4354	Digital Image Processing	2	0	2	3	0	4
5	DE	CSC4355	Software and Application Security	2	0	2	3	0	4
5	DE	CSC4356	Distributed Database Management Systems	2	0	2	3	0	4
5	DE	CSC4357	Augmented and Virtual Reality	2	0	2	3	0	4
6	DE	CSC4366	Software Testing	2	0	2	3	0	4
6	DE	CSC4367	Cyber Physical Systems	2	0	2	3	0	4
6	DE	CSC4368	Scripting Languages	2	0	2	3	0	4
6	DE	CSC4369	Parallel Programming	2	0	2	3	0	4
6	DE	CSC4370	Cyber forensics and Laws	2	0	2	3	0	4
6	DE	CSC4371	Service Oriented Architecture	2	0	2	3	0	4
6	DE	CSC4372	Object Oriented System Design	2	0	2	3	0	4
6	DE	CSC4373	Block chain Technology	2	0	2	3	0	4
7	DE	CSC4452	High performance Computing	2	0	2	3	0	4
7	DE	CSC4453	Computer Vision	2	0	2	3	0	4
7	DE	CSC4455	Security Governance Risk and Compliance	2	0	2	3	0	4

7	DE	CSC4456	Software Quality Management	2	0	2	3	0	4
7	DE	CSC4457	Software Design and System Integration	2	0	2	3	0	4
7	DE	CSC4458	MobileTechnology	2	0	2	3	0	4

**LIST OF DEPARTMENTAL ELECTIVES FOR SPECIALIZATION IN DATA ANALYTICS**

S.No.	COURSE CATEGORY	COURSE CODE	NAMEOFTHECOURSE	L	T	P	C	S	TCH
<b>DEPARTMENT ELECTIVE-II (SEMESTER IV)</b>									
1	DE	CSC4273	Python for DataScience	2	0	2	3	0	4
2	DE	CSC4274	R for DataScience	2	0	2	3	0	4
<b>DEPARTMENT ELECTIVE-III (SEMESTER V)</b>									
3	DE	CSC4358	Statistical Inference for DataScience	2	0	2	3	0	4
4	DE	CSC4359	Predictive Modeling and Analytics	2	0	2	3	0	4
<b>DEPARTMENT ELECTIVE-IV (SEMESTER VI)</b>									
5	DE	CSC4374	Tools and Techniques for DataScience	2	0	2	3	0	4
6	DE	CSC4375	Business Intelligence and Analytics	2	0	2	3	0	4
<b>DEPARTMENT ELECTIVE-V (SEMESTER VII)</b>									
7	DE	CSC4451	Deep Learning	2	0	2	3	0	4
8	DE	CSC4454	Natural Language Processing	2	0	2	3	0	4
9	DE	CSC4459	Time series analysis and Forecasting	2	0	2	3	0	4

**LIST OF DEPARTMENTAL ELECTIVES FOR SPECIALIZATION IN IOT**

S.NO	COURSE CATEGORY	COURSE CODE	NAMEOFTHECOURSE	L	T	P	C	S	TCH
<b>DEPARTMENT ELECTIVE-II (SEMESTERIV)</b>									
1	DE	CSC4280	Introduction to IoT	2	0	2	3	0	4
2	DE	CSC4276	IoT Sensor Technologies	2	0	2	3	0	4
3	DE	CSC4277	Smart Sensor Technologies	2	0	2	3	0	4
<b>DEPARTMENT ELECTIVE-III (SEMESTER V)</b>									
3	DE	CSC4360	IoT for Architects	2	0	2	3	0	4
4	DE	CSC4361	Interfacing and Programming with IoT Gateway	2	0	2	3	0	4
<b>DEPARTMENT ELECTIVE-IV (SEMESTER VI)</b>									
5	DE	CSC4376	IoTcloud and data analytics	2	0	2	3	0	4

6	DE	CSC4377	IoT System Design	2	0	2	3	0	4
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DEPARTMENT ELECTIVE–V (SEMESTER VII)									
7	DE	CSC4460	IoT Infrastructure management	2	0	2	3	0	4
8	DE	CSC4461	Industrial IoT4.0	2	0	2	3	0	4
9	DE	CSC4462	Internet of Medical Things	2	0	2	3	0	4

LIST OF DEPARTMENTAL ELECTIVES FOR SPECIALIZATION IN CYBER SECURITY									
S.NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
DEPARTMENT ELECTIVE–II (SEMESTER IV)									
1	DE	CSC4278	Fundamentals of CyberSecurity	2	0	2	3	0	4
2	DE	CSC4279	Cyber Security Algorithms	2	0	2	3	0	4
DEPARTMENT ELECTIVE–III (SEMESTER V)									
3	DE	CSC4362	Cybersecurity Risk Management and Mitigation	2	0	2	3	0	4
4	DE	CSC4363	Cyber Security in Critical Infrastructure	2	0	2	3	0	4
DEPARTMENT ELECTIVE–IV (SEMESTER VI)									
5	DE	CSC4378	Cyber Forensics, Investigations and Laws	2	0	2	3	0	4
6	DE	CSC4379	Blockchain & Cryptocurrencies Fundamentals	2	0	2	3	0	4
DEPARTMENT ELECTIVE–V (SEMESTER VII)									
7	DE	CSC4463	Offensive, Defensive Cyber Security Techniques	2	0	2	3	0	4
8	DE	CSC4464	Cyber Security Standards, Policies and Practices	2	0	2	3	0	4

LIST OF DEPARTMENTAL ELECTIVES FOR SPECIALIZATION IN BLOCKCHAIN									
S.NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
DEPARTMENT ELECTIVE–II (SEMESTER IV)									
1	DE	CSC4281	Cryptography and Network Security	2	0	2	3	0	4
2	DE	CSC4282	Cryptocurrency and Cyber Security	2	0	2	3	0	4
DEPARTMENT ELECTIVE–III (SEMESTER V)									

3	DE	CSC4382	Fundamentals of Blockchain Technology	2	0	2	3	0	4
4	DE	CSC4383	Bitcoin Essentials and Use-Cases	2	0	2	3	0	4
<b>DEPARTMENT ELECTIVE–IV (SEMESTER VI)</b>									
5	DE	CSC4384	Building Private Blockchain	2	0	2	3	0	4
6	DE	CSC4385	Blockchain Business Models	2	0	2	3	0	4
<b>DEPARTMENT ELECTIVE–V (SEMESTER VII)</b>									
7	DE	CSC4468	Blockchain and IoT	2	0	2	3	0	4
8	DE	CSC4469	Blockchain and AI	2	0	2	3	0	4

<b>LIST OF NON-DEPARTMENTAL ELECTIVES OFFERED BY CSE DEPARTMENT WITH GROUPING- SEMESTER WISE</b>									
SEM	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	T C H
3	NE	CSD4281	Internet of Things	2	0	0	2	0	2
3	NE	CSD4282	Python Programming	2	0	0	2	0	2
3	NE	CSD4283	Web Design and Development	2	0	0	2	0	2
4	NE	CSD4291	Android Application Development	2	0	0	2	0	2
4	NE	CSD4292	Cloud Computing	2	0	0	2	0	2
4	NE	CSD4293	Java Programming	2	0	0	2	0	2
5	NE	CSD4381	Digital Image Processing using MATLAB	2	0	0	2	0	2
5	NE	CSD4382	Ethical Hacking	2	0	0	2	0	2
5	NE	CSD4383	Artificial Intelligence	2	0	0	2	0	2
6	NE	CSD4391	Big Data Analytics	2	0	0	2	0	2
6	NE	CSD4392	CyberForensics, Investigations and Laws	2	0	0	2	0	2
6	NE	CSD4393	Machine Learning	2	0	0	2	0	2
7	NE	CSD4481	Business Intelligence	2	0	0	2	0	2
7	NE	CSD4482	Computer Vision	2	0	0	2	0	2
7	NE	CSD4483	Deep Learning	2	0	0	2	0	2

## SEMESTER I

COURSE TITLE	PROFESSIONAL ENGLISH AND SOFT SKILLS			CREDITS	3
COURSE CODE	ELA4101	COURSE CATEGORY	HS	L-T-P-S	1- 1- 2- 1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20 %		50%	
Course Description	This course is to provide a theoretical input towards nurturing accomplished learners who can function effectively in the English language skills; to cultivate in them the ability to indulge in rational thinking, independent decision-making and lifelong learning; to help them become responsible members or leaders of the society in and around their workplace or living space; to communicate successfully at the individual or group level on engineering activities with the engineering community in particular, and on multi-disciplinary activities in general, with the world at large.				
Course Objective	<div>1. To widen the capacity of the learners to listen to English language at the basic level and understand its meaning.</div> <div>2. To enable learners to communicate in an intelligible English accent and pronunciation.</div> <div>3. To assist the learners in reading and grasping a passage in English.</div> <div>4. To learn the art of writing simple English with correct spelling, grammar and punctuation.</div> <div>5. To cultivate the ability of the learners to think and indulge in divergent and lateral thoughts.</div>				
Course Outcome	<div>Upon completion of this course, the students will be able to</div> <div>1. Elaborate the importance of professional communication and applying the knowledge.</div> <div>2. Integrate the knowledge of phonetics, enhancing the listening skills in formal and real-life situations, enhance pronunciation skills based on the knowledge of phonetics.</div> <div>3. Construct appropriate sentences in English Language, applying grammatical rules and mastery in syntax. Develop reading skills and derive the contextual meaning, case studies and analyzing problems.</div> <div>4. Integrate creativity in the writing skills both in formal and informal situations, related to environment, society and multidisciplinary environments.</div> <div>5. To imbibe soft skills to excel in interpersonal skills essential for workplace.</div>				

**Prerequisites:** Plus Two English-Intermediate Level

CO, PO AND PSO MAPPING															
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -1	PSO -2	PSO -3
CO-1	-	-	-	-	-	2	-	3	2	1	-	-	-	-	-
CO-2	-	-	-	-	-	2	-	3	2	1	-	-	-	-	-
CO-3	-	-	-	-	-	2	-	3	2	1	-	-	-	-	-
CO-4	-	-	-	-	-	2	-	3	2	1	-	-	-	-	-
CO-5	-	-	-	-	-	2	-	3	2	1	-	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: THE ELEMENTS OF COMMUNICATION (9)															
Importance of communication through English -Process of communication and factors that influence speaking- Importance of audience and purpose- Principles of Communication-comparing general communication and business Communication-Professional Communication-barriers to communication – strategies to overcome communication barriers-formal and informal communication. <b>Suggested Activities:</b> Self-introduction-short Conversations-Situational communication-dialogue writing -Language Functions-analyse the speech and comment-distinguish formal and informal style of communication-using bias-free language- news reports. <b>Suggested Reading:</b> <ul style="list-style-type: none"><li>Rogerson, Trish Stott &amp; Derek Utley.2011</li><li>Elements of Effective Communication: 4th Edition, Plain and Precious Publishing, USA, by Randal S. Chase (Author), Wayne Shamo (Author)</li></ul> Effective Communication Skills, MTD Training & Ventus Publishing (e book)													CO-1  BTL-2		
MODULE 2: AURAL –ORAL COMMUNICATION IN ENGLISH (9)															
Vowels- diphthongs- consonants - International Phonetic Alphabet (IPA) ; phonemic transcription (simple words)-syllable division and word stress – enunciation-GIE script(General Indian English)- neutral accent- sentence rhythm and weak forms - contrastive stress in sentences to highlight different words - intonation varieties of Spoken English : Standard Indian, American and British-Speaking to Communicate-speech acts - Language Patterns													CO-2  BTL-2		



<p><b>(Note: This unit should be taught in a simple, non-technical manner, avoiding technical terms as far as possible).</b></p> <p><b>Suggested activities:</b> (Audio CD) Listen and repeat, listen to the sentences and fill in the blanks, Listening to passages and answering questions, marking the stressed syllable, phonemic script of simple words, sentence rhythm and intonation (rising tone and falling tone), short speeches. Individual presentations-dynamics of a group discussion</p> <p><b>Suggested sources:</b> Cambridge IELTS, Professional Speaking Skills by Aruna Koneru, Oxford Press, Face to face series Cambridge University Press, Speaking Effectively, Cambridge University Press, Jeremy Comfort, Pamela.</p>	
<b>MODULE 3: GRAMMAR AND DEVELOPMENT OF READING SKILLS (9)</b>	
<p>Noun Phrase, Verb Phrase, Tense and Aspect, Articles, Pronouns and determiners, Sentence Pattern, interrogative and negative sentences-subject verb agreement -Vocabulary-word formation: prefixes and suffixes, reading passages-inductive vs deductive reading-newspaper articles- comprehension passages –cloze reading-annotating-editing</p> <p><b>Suggested Activities:</b> Identify the errors in sentences, grammar exercises, book reviews, mini project on suggested reading activity - reading technical passages based on student's area of specialization answering questions- reading passage for identifying the contextual meaning</p> <p><b>Suggested sources:</b> Skills for the TOEFL IBT Test, Collins IELTS, Cambridge books Practical English Usage by Michael Swan, Cambridge University Press</p>	<p><b>CO-3</b> <b>BTL-3</b></p>
<b>MODULE 4: EFFECTIVE WRITING AND BUSINESS COMMUNICATION (9)</b>	
<p>Paragraph writing- topic sentence-connectives - process writing-Memoranda-Business letters-Resumes /Visumes and job applications-drafting a report-agenda and minutes of the meeting-ATR-project proposals-email etiquette-interpreting visual data (bar chart, pie chart, line graphs).</p> <p><b>Suggested activities:</b> Writing short paragraph based on environment protection, societal issues, health, cultural contexts etc., identifying topic sentences, linking pairs of sentences, cause and effect exercises, formal letters, e mails, drafting project proposals, drafting agenda, minutes of the meeting</p> <p><b>Suggested sources:</b> Cambridge Advanced English, Newspapers, library books, IELTS, IELTS Academic Writing 1, New Insights into IELTS, CUP.</p>	<p><b>CO-4</b> <b>BTL-2</b></p>
<b>MODULE 5: SOFT SKILLS (9)</b>	
<p>Introducing Soft Skills &amp;Life Skills- Myers Briggs Type Indicator – the Big Five Model Personality - Employability Skills- Workplace Etiquette- Professional Ethics -Time Management-Stress Management- Lateral Thinking (De Bono's Six Thinking Hats) and Problem Solving Skills</p> <p><b>Suggested Activities:</b></p>	<p><b>CO-5</b> <b>BTL-2</b></p>

Mock interviews, GD's, short oral presentation, lateral thinking puzzles, Case analysis and self-study assignments, Worksheet activities.	
<b>Suggested Sources:</b> Soft Skills and Employability Skills by Sabina Pillai and Agna Fernandez, Cambridge University Press, 2018. Soft Skills for Everyone by Jeff Butterfield, Cengage Learning Education and personality development, K. Manoharan English for Life and the Workplace through the LSRW&T skills, Lateral Thinking skills by Edward De Bono.	
<b>TEXT BOOKS</b>	
1	An Introduction to Profession English and Soft Skills with audio CD by Dr. Bikram K. Das et al. Published by Cambridge University Press, 2009.
<b>REFERENCE BOOKS</b>	
1	Sabina Pillai and Agna Fernandez,"Soft Skills & Employability Skills", Cambridge University Press 2018.
2	Steve Hart et al."Embark, English for Undergraduates", Cambridge University Press, 2016
3	Skills for the TOEFL IBT Test, Collins, 2012 edition
<b>E BOOKS</b>	
1	<a href="https://www.britishcouncil.in/english/courses-business">https://www.britishcouncil.in/english/courses-business</a>
2	<a href="http://www.bbc.co.uk/learningenglish/english/features/pronunciation">http://www.bbc.co.uk/learningenglish/english/features/pronunciation</a>
<b>MOOC</b>	
1.	<a href="http://www.cambridgeenglish.org/learning-english/free-resources/mooc/">http://www.cambridgeenglish.org/learning-english/free-resources/mooc/</a>

COURSE TITLE	ENGINEERING GRAPHICS AND COMPUTER AIDED DESIGN			CREDITS	3
COURSE CODE	MEA4101	COURSE CATEGORY	ES	L-T-P-S	1 -1- 2 -1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	

Course Description	To develop graphical skills for communicating concepts, ideas and designs of engineering products and to give exposure to national standards relating to technical drawings using Computer Aided Design and Drafting practice														
Course Objective	1. To introduce drawing standards and use of drawing instruments. 2. To introduce first angle projection. 3. To practice of engineering hand sketching and introduce to computer aided drafting. 4. To familiarize the students with different type of projections. 5. To introduction to Solid modelling 6. To introduce the process of design from sketching to parametric 3D CAD and 2D orthographic drawings to BIS.														
Course Outcome	Upon completion of this course, the students will be able to 1. Understand drafting and computer aided drafting. Remember the commands used in AutoCAD to generate simple drawings. 2. Explain details in a drawing and apply the knowledge to solve simple problems involving straight lines, planes and solids. 3. Apply the 3D model commands to generate and solid object. 4. Apply the viewing AutoCAD commands to generate top view, front view and additional or sectional views. 5. Develop any graphical model of geometrical and simple mechanical objects in AutoCAD software.														
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO -1	PO -2	PO- 3	PO -4	PO -5	PO -6	PO -7	PO- 8	PO -9	PO -10	PO- 11	PO -12	PSO -1	PSO -2	PSO -3
CO-1	3	2	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-2	3	2	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-3	3	2	-	-	1	1	-	-	-	-	-	-	-	-	-
CO-4	3	2	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-5	3	2	-	-	1	-	-	-	-	-	-	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: BASICS OF ENGINEERING GRAPHICS AND PLANE CURVES														(12)	

Importance of graphics – BIS conventions and specifications – drawing sheet sizes – Lettering – Dimensioning – Scales. Drafting methods – introduction to Computer Aided Drafting – Computer Hardware – Workstation – Printer and Plotter – Introduction to software for Computer Aided Design and Drafting – Exposure to Solid Modelling software – Geometrical Construction-Coordinate Systems/Basic Entities – 3D printer. <b>Self-Study:</b> Solid modelling Software commands	<b>CO-1 BTL-2</b>
<b>MODULE 2: VISUALIZATION, ORTHOGRAPHIC PROJECTIONS AND FREE HAND SKETCHING (15)</b>	
Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Pictorial Projection methods – Layout of views- Free hand sketching of multiple views from pictorial views of objects. Drafting of simple Geometric Objects/Editing. General principles of presentation of technical drawings as per BIS – Introduction to Orthographic projections – Naming views as per BIS – First angle projection method. Conversion to orthographic views from given pictorial views of objects, including dimensioning – Drafting of Orthographic views from Pictorial views. <b>Self-study:</b> CAD software commands for sketching a drawing.	<b>CO-2 BTL-2</b>
<b>MODULE 3: GEOMETRICAL MODELING ISOMETRIC VIEWS AND DEVELOPMENT OF SURFACES(15)</b>	
Principles of isometric projection and solid modelling. Isometric drawing – IsoPlanes and 3D Modelling commands. Projections of Principal Views from 3-D Models. Solid Modeling – Types of modelling – Wire frame model, Surface Model and Solid Model – Introduction to graphic software for solid modelling. Development of Surfaces. <b>Self-study:</b> Surface modelling and solid modelling commands	<b>CO-3 BTL-3</b>
<b>MODULE 4: COMPUTER AIDED DESIGN AND DRAFTING(15)</b>	
Preparation of solid models of machine components like slide block, solid bearing block, bushed bearing, gland, wall bracket, guide bracket, shaft bracket, jig plate, shaft support (open type), vertical shaft support etc using appropriate modelling software. 2D views and sectional view, computer aided drafting and dimensioning. Generate 2D drawing from the 3D models – generate and develop the lateral surfaces of the objects. Presentation Techniques of Engineering Drawings – Title Blocks – Printing/Plotting the 2D/3D drawing using printer and printing solid object using 3D printer. <b>Self-study:</b> CAD commands for modelling and views generation	<b>CO-4 BTL-3</b>
<b>MODULE 5: SIMPLE DESIGN PROJECTS – COMPUTER AIDED DESIGN AND DRAFTING (15)</b>	
Creation of engineering models and their presentation in standard 2D form, 3D Wire-Frame and shaded solids, meshed topologies for engineering analysis, tool-path generation for component manufacture, geometric dimensioning and tolerancing. Use of solid-modelling software for creating associative models at the components and assembly levels in their respective branch of engineering like building floor plans that include: windows, doors, fixtures such as WC, Sink, shower, slide block, etc. Applying colour coding according to drawing practice.	<b>CO-5 BTL-2</b>

<b>Self-study:</b> CAD commands for modelling and views generation	
<b>TEXT BOOKS</b>	
1	Jeyapoovan T, Engineering Drawing and Graphics Using AutoCAD, 7 <sup>th</sup> Edition, Vikas Publishing House Pvt Ltd., New Delhi, 2016.
<b>REFERENCE BOOKS</b>	
1	Introduction to AutoCAD – 2D and 3D Design, A.Yarmwood, Newnes, 2017.
2	Engineering Drawing and Graphic Technology-International Edition, Thomas E, 2012.
3	Engineering Drawing and Design, Sixth Edition, C. Jensen, J.D. Helsel, D.R., 2007.
<b>EBOOK</b>	
1	<a href="http://keralatechnologicaluniversity.blogspot.in/2015/06/engineering-graphics-j-benjamin-pentex-free-ebook-pdf-download.html">http://keralatechnologicaluniversity.blogspot.in/2015/06/engineering-graphics-j-benjamin-pentex-free-ebook-pdf-download.html</a>
2	<a href="http://keralatechnologicaluniversity.blogspot.in/2015/06/engineering-graphics-p-i-varghese.html">http://keralatechnologicaluniversity.blogspot.in/2015/06/engineering-graphics-p-i-varghese.html</a>
<b>MOOC</b>	
1.	<a href="http://nptel.ac.in/courses/112103019/">http://nptel.ac.in/courses/112103019/</a>
2.	<a href="http://nptel.ac.in/courses/105104148/">http://nptel.ac.in/courses/105104148/</a>

COURSE TITLE	MATRICES AND CALCULUS			CREDITS	4
COURSE CODE	MAA4101	COURSE CATEGORY	DE	L-T-P-S	3-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	The course is aimed at developing the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering subject and to visualize the concepts learnt.				
Course Objective	1. To find out algebraic Eigen value problems from practical areas and obtain the Eigen solutions. 2. To diagonalize a matrix which would render the Eigen solution procedure very simple.				

	3. To understand effectively the basic concepts of differentiation and partial differentiation and their applications. 4. To understand effectively the methods of integration and their applications. 5. To solve differential equations of certain type, that they might encounter in the same or higher semesters.														
Course Outcome	Upon completion of this course, the students will be able to 1. Gain knowledge on the different applications of Eigen Values problems 2. Able to study the concepts of matrices and apply them in related engineering problems. 3. Capable to use the features of Differential Calculus in optimization problems. 4. Able to extend the concepts of integral calculus in finding area and volume. 5. Skilled to solve ordinary differential equations in engineering problems.														
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	-	1	-	2	-	-	-	3	-	-	-	-	-
CO-2	3	2	-	1	-	-	-	-	-	-	-	-	-	-	-
CO-3	3	2	-	1	-	-	2	-	-	3	-	-	-	-	-
CO-4	3	2	-	1	-	-	-	-	-	2	-	-	-	-	-
CO-5	3	2	-	1	-	2	-	-	-	-	2	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: MATRICES (15)															
Characteristic equation – Eigenvalues and Eigenvectors – Properties – Cayley Hamilton theorem (Statement only) – Verification and inverse of the matrix using Cayley Hamilton theorem- Diagonalization of matrices using similarity transformation. <b>Suggested Reading:</b> Basics of Matrices <b>Lab 1:</b> Eigenvalues and Eigenvectors, Verification and inverse using Cayley Hamilton theorem- Diagonalization														CO-1 BTL-2	
MODULE 2: DIFFERENTIAL CALCULUS (15)															
Methods of differentiation of functions – Product and Quotient rules – Inverse trigonometric functions – Implicit function – parametric form. Partial differentiation – Total differentiation- Taylor’s series – Maxima and minima of functions of two variables. <b>Suggested Reading:</b> Basics of Differentiation <b>Lab 2:</b> Taylor’s series – Maxima and minima of functions of two variables														CO-2 BTL-2	
MODULE 3: INTEGRAL CALCULUS (15)															

Integration – Methods of integration – Substitution method – Integration by parts – Integration using partial fraction – Bernoulli’s formula. Applications of Integral Calculus: Area, Surface and Volume. <b>Suggested Reading:</b> Basics of Integrations <b>Lab 3:</b> Applications of Integral Calculus: Area, Surface area and Volume		<b>CO-3</b> <b>BTL-3</b>
<b>MODULE 4: ORDINARY DIFFERENTIAL EQUATIONS (15)</b>		
Second order differential equations with constant coefficients – Particular integrals – $e^{ax}$ , $\sin ax$ , $\cos ax$ , $x^m$ , $e^{ax} \cos bx$ , $e^{ax} \sin bx$ . Solutions of homogeneous differential equations with variable coefficients – Variation of parameters. <b>Suggested Reading:</b> Basics of Differential Equations. <b>Lab 4:</b> Solution of Second order differential equations.		<b>CO-4</b> <b>BTL-2</b>
<b>TEXT BOOKS</b>		
1	Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43 <sup>rd</sup> Edition, 2014.	
2	Bali N. P and Manish Goyal, “A Text book of Engineering Mathematics”, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.	
3	Chandrasekaran A, “A Text book of Engineering Mathematics I”, Dhanam Publications, Chennai, 2017.	
<b>REFERENCE BOOKS</b>		
1.	Srimantha Pal and Bhunia, S.C, “Engineering Mathematics” Oxford University Press, 2015.	
2.	Weir, M.D and Joel Hass, Thomas’ Calculus, 12 <sup>th</sup> Edition, Pearson India, 2016.	
3.	Advanced Engineering Mathematics With Matlab, Third Edition, 2011 by CRC Press.	
<b>E BOOKS</b>		
1	<a href="http://nptel.ac.in/courses/111105035/">http://nptel.ac.in/courses/111105035/</a>	
2	<a href="https://www.edx.org/.../introduction-engineering-mathematics-utarlingtonx-engr3">https://www.edx.org/.../introduction-engineering-mathematics-utarlingtonx-engr3</a>	
<b>MOOC</b>		
1.	<a href="https://www.mooc-list.com/tags/engineering-mathematics">https://www.mooc-list.com/tags/engineering-mathematics</a>	

COURSE TITLE	ENGINEERING PHYSICS			CREDITS	3
COURSE CODE	PHA4102	COURSE CATEGORY	BS	L-T-P-S	3-0-0-1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
<b>ASSESSMENT SCHEME</b>					

First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE										
15%	15%	10%	5%	5%	50%										
Course Description	To impart fundamental knowledge in various fields of Physics and its applications.														
Course Objective	1. To develop strong fundamentals of properties and behavior of the materials 2. To enhance theoretical and modern technological aspects in acoustics and ultrasonics. 3. To correlate the theoretical principles with application-oriented study of optics. 4. To provide a strong foundation in the understanding of solids and materials testing. 5. To enrich the knowledge of students in modern engineering materials.														
Course Outcome	Upon completion of this course, the students will be able to 1. Solve basic problems in mechanics and also understand the properties of matter. 2. Have knowledge of acoustics and ultrasonics which would facilitate in acoustical design of buildings and also be able to employ ultrasonics as an engineering tool. 3. Knowledge on fundamental concepts of Quantum physics. 4. Have fundamental knowledge on semiconductors and discrete devices. 5. Understand the concept, working and application of lasers and fiber optics.														
Prerequisites: Knowledge in fundamentals of physics at higher secondary level.															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO -4	PO -5	PO -6	PO -7	PO- 8	PO -9	PO -10	PO- 11	PO -12	PSO -1	PSO -2	PSO -3
CO-1	3	2	1	2	-	-	-	-	2	-	-	-	-	-	-
CO-2	3	2	-	-	-	2	-	1	-	-	-	-	-	-	-
CO-3	3	1	1	2	-	-	-	-	1	2	-	-	-	-	-
CO-4	3	2	-	-	-	1	-	-	-	-	-	-	-	-	-
CO-4	3	1	-	2	-	-	-	-	-	-	-	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: PROPERTIES OF MATTER & HEAT (9)															
Elasticity – Hooke’s law – Elastic Moduli – Young’s modulus – Rigidity modulus – Bulk modulus - Twisting couple on a wire – Torsional pendulum – determination														CO-1 BTL-2	



of rigidity modulus of a wire – Depression of a cantilever – Young's modulus by cantilever – uniform and non-uniform bending. Thermal conductivity – experimental determination of thermal conductivity of good and bad conductors – Forbe's method – theory and experiment – Lee's disc method for bad conductors.	
<b>MODULE 2: ACOUSTICS AND ULTRASONICS</b> (9)	
Classification of sound – characteristics of musical sound – intensity – loudness – Weber Fechner law – Decibel – Reverberation – Reverberation time, derivation of Sabine's formula for reverberation time(Jaeger's method) – absorption coefficient and its determination – factors affecting acoustics of building (Optimum reverberation time, loudness, focusing, echo, echelon effect, resonance and noise) and their remedies – Ultrasonics- production – Magnetostriction and Piezoelectric methods – properties – applications.	<b>CO-2 BTL-2</b>
<b>MODULE 3: QUANTUM PHYSICS</b> (9)	
Black body radiation- Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jean's law from Planck's theory – Compton effect – Theory and experimental verification – Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box Extension to 3 dimension (no derivation)	<b>CO-3 BTL-3</b>
<b>MODULE 4: CRYSTAL PHYSICS AND MAGNETISM</b> (9)	
Crystal –Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – 'd' spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – coordination number – Packing factor for SC, BCC, FCC and HCP structures. Magnetic dipole moment – atomic magnetic moments- magnetic permeability and susceptibility – Types of magnetism: diamagnetism – paramagnetism – ferromagnetism – antiferromagnetism – ferrimagnetism – domain structure – hysteresis – hard and soft magnetic materials – applications.	<b>CO-4 BTL-2</b>
<b>MODULE 5: PHOTONICS AND FIBRE OPTICS</b> (9)	
Principle of lasers – Stimulated absorption – Spontaneous emission, stimulated emission – population inversion – pumping action – active medium – laser characteristics – Nd-Yag laser -CO <sub>2</sub> laser – Semiconductor laser – applications – optical fiber – principle and propagation of light in optical fibers – Numerical aperture and acceptance angle – types of optical fibers – single and multimode, step index and graded index fibers – fiber optic communication system.	<b>CO-5 BTL-2</b>
<b>TEXT BOOKS</b>	

1	P.Mani, “Engineering Physics”, Vol-I & II, Dhanam Publications, Chennai. (2011)
2	Gaur R.K. and Gupta S.L., “Engineering Physics”, 8 <sup>th</sup> edition, Dhanpat Rai publications (P) Ltd., New Delhi. (2010)
<b>REFERENCE BOOKS</b>	
1.	Arthur Beiser, “Concepts of Modern Physics”, Tata Mc Graw – Hill Publications. (2007)
2.	Rajendran V. Marikani A., “Applied Physics for engineers”, 3 <sup>rd</sup> edition, Tata Mc Graw –Hill publishing company Ltd., New Delhi. (2003)
<b>EBOOK</b>	
1	<a href="https://www.bookyards.com/en/book/details/13921/Elements-Of-Properties-Of-Matter">https://www.bookyards.com/en/book/details/13921/Elements-Of-Properties-Of-Matter</a>
2	<a href="http://iopscience.iop.org/book/978-1-6817-4585-5">http://iopscience.iop.org/book/978-1-6817-4585-5</a>
3	<a href="https://www.springer.com/in/book/9783319206295">https://www.springer.com/in/book/9783319206295</a>
<b>MOOC</b>	
1.	<a href="http://nptel.ac.in/courses/115106061/">http://nptel.ac.in/courses/115106061/</a>
2.	<a href="http://nptel.ac.in/courses/117101054/12">http://nptel.ac.in/courses/117101054/12</a>

COURSE TITLE	ENGINEERING MATERIALS			CREDITS	3
COURSE CODE	CYA4101	COURSE CATEGORY	BS	L-T-P-S	3-0-0-1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	In this course you will have the opportunity to learn something about the fundamentals of the structure/ properties and relationships of all types of materials (ceramics, metals and their alloys, polymers and composites thereof).				
Course Objective	1. To understand the concepts of atomic bonding, crystal structures, imperfections, diffusion, mechanical properties, electron energy, and dislocations as related to processing and performance of engineering materials.				

	2. To understand the relationship between structure-processing-properties for selection of existing materials and development of new materials in the design of parts, structures, and devices. 3. To understand the microstructure characteristics, electronic properties, materials formation, and manipulation of microstructure for application in engineering design and materials processing. 4. To understand the properties of nanomaterials with their applications. 5. To understand materials for electronic applications.														
<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. Suggest suitable metals for alloying. 2. Identify the materials apt for engineering applications. 3. Select high temperature materials for engineering applications. 4. Map the properties of nanomaterials with their applications. 5. Suggest suitable materials for electronic applications.														
<b>Prerequisites:</b> Knowledge in fundamentals of chemistry at higher secondary level.															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
<b>CO-1</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>CO-2</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>CO-3</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>CO-4</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>CO-5</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: CRYSTAL STRUCTURE AND PHASE RULE (9)</b>															
Basic Crystal Systems – Types, characteristics, examples – Space lattice, Unit cell – types – X-ray diffraction and crystal structure. Basic terminology - Derivation of Gibbs Phase rule- Phase diagrams: One component system (water), Two component system — Reduced phase rule: Simple Eutectic system, examples, Phase diagram: Ag-Pb system, Pb-Sn system – Applications of phase rule.													<b>CO-1 BTL-2</b>		
<b>MODULE 2: POWDER METALLURGY, INORGANIC MATERIALS AND COMPOSITES. (9)</b>															
Steel – Composition, types, heat-treatment, Abrasives – Classification, Properties, Uses - Refractories – Classification, Properties, Applications. Glasses – Properties, Types, Specialty glasses. Composites - Introduction - Definition – Constituents – Classification - Fiber-reinforced Composites –Types and Applications. <b>Powder Metallurgy</b> – Preparation of metal/alloy– Advantages and limitations													<b>CO-2 BTL-2</b>		

MODULE 3: NANOMATERIALS AND MOLECULAR SIEVES		(9)
Introduction – Synthesis of Nanomaterials - Bottom-up and Top-down approaches – Methods of preparation – Sol-gel process, Gas-phase condensation, Chemical Vapour Deposition. Properties – Optical, Electrical, Magnetic, Chemical properties (introduction only). Characterization – FE-SEM, TEM (Principle and Applications only). <b>Zeolite Molecular sieves</b> – composition, structure, classification - applications – ion exchange, adsorption, separation, laundry, catalysis.		<b>CO-3 BTL-3</b>
MODULE 4: MATERIALS FOR ELECTRONIC APPLICATIONS		(9)
Liquid Crystals- Introduction – Characteristics – Classification- Thermotropic crystals- Polymorphism in Thermotropic Liquid Crystals – Molecular arrangement in various states of Liquid Crystals, Lyotropic Liquid Crystals- Applications. Conducting and Super conducting Organic electronic materials - Applications. Engineering plastics: Polycarbonate – Properties and uses- Conducting Polymers: Classification, Intrinsic Conducting Polymers, Extrinsic Conducting Polymers, Applications - Biodegradable Polymers, examples and applications.		<b>CO-4 BTL-2</b>
MODULE 5: LUBRICANTS, ADHESIVES AND EXPLOSIVES		(9)
Lubricants – Mechanism of Lubrication, Classification and Properties, Semi Solid Lubricants, Solid Lubricants, MoS <sub>2</sub> and Graphite - Adhesives – Development of Adhesive strength, Physical and Chemical factors influencing adhesive action, Classification of Adhesives – Epoxy Resin (Preparation, Properties and Applications). Explosives – Requisites, Classification, Precautions during storage – Rocket propellants – Requisites - Classification.		<b>CO-5 BTL-3</b>
TEXT BOOKS		
1	P.C. Jain and Monicka Jain, Engineering Chemistry, Dhanpat Raj Publishing Company (P) Ltd, New Delhi – 2012	
2	Puri, Sharma and Pathania, Principles of Physical Chemistry, Vishal Publishing Co. Jalandar, 2004.	
3	Composite materials, K.K. Chawala, 3 <sup>rd</sup> ed., (2012) Springer-Verlag, New York	
4	Nanocomposite Science and Technology, P. M. Ajayan, L. S. Schadler, P. V. Braun, (2003), Wiley-VCH Verlag GmbH Co. KGaA, Weinheim.	
5	Mechanics and Analysis of Composite Materials, V.V. Vasiliev and E.V. Morozov, (2001), Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, UK.	
EBOOK		
1	<a href="http://www.erforum.net/2016/01/engineering-chemistry-by-jain-and-jain-pdf-free-ebook.html">http://www.erforum.net/2016/01/engineering-chemistry-by-jain-and-jain-pdf-free-ebook.html</a>	
2	<a href="https://abmpk.files.wordpress.com/2014/02/book_material-science-callister.pdf">https://abmpk.files.wordpress.com/2014/02/book_material-science-callister.pdf</a>	
MOOC		
1.	<a href="https://www.edx.org/course/materials-science-engineering-misix-mse1x">https://www.edx.org/course/materials-science-engineering-misix-mse1x</a>	

2. <https://www.mooc-list.com/tags/materials-science>

COURSE TITLE		PROBLEM SOLVING USING C										CREDITS		3	
COURSE CODE		CSA4101				COURSE CATEGORY				PC		L-T-P-S		2-0-2-0	
Version		1.0				Approval Details						LEARNING LEVEL		BTL-4	
ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment				Practical Component						ESE			
15%		15%				20%						50%			
Course Description		To introduce computers and programming in C and also explore the power of computational techniques that are currently used by engineers and scientists and to develop programming skills with reasonable complexity.													
Course Objective		1. To acquire the basic knowledge in computer hardware, programming languages and Problem-solving techniques. 2. To learn the fundamentals of C programming. 3. To gain knowledge in Functions, arrays and strings in C programming. 4. To understand the pointers, Structures and Union in C programming 5. To gain Knowledge on Embedded Programming													
Course Outcome		Upon completion of this course, the students will be able to 1. Describe the basics of digital computer and programming languages. 2. Demonstrate problem solving techniques using flowchart, algorithm/pseudo code to solve the given problem. 3. Design and Implement C program using Control Statements and Functions. 4. Design and Implement C program using Pointers and File operations. 5. Identify the need for embedded C in real-time applications.													
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO -1	PSO -2	PSO

															-3
CO-1	2	2	2	-	-	2	-	2	-	-	1	2	2	-	-
CO-2	3	3	3	2	2	1	-	2	2	1	-	1	2	3	2
CO-3	3	3	3	2	2	2	-	1	3	3	2	1	2	3	3
CO-4	3	3	3	2	-	-	-	-	-	-	1	-	1	2	1
CO-5	1	1	1	-	1	2	-	1	-	-	-	2	1	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: PROGRAMMING LANGUAGES AND PROBLEM SOLVING TECHNIQUES (6L+6L=12)															
Introduction – Fundamentals of digital computers - Programming languages - Programming Paradigms – Types of Programming Languages – Language Translators – Problem Solving Techniques: Algorithm – Flow Chart - Pseudo code. <b>Practical Component:</b> Drawing Flowcharts using E- Chart & Writing pseudo code for the following problems (i) Greatest of three numbers (ii) Sum of N numbers (iii) Computation of nCr														CO-1  BTL-1	
MODULE 2: FUNDAMENTALS OF C(6L+6L=12)															
Evolution of C -Why C language - Applications of C language - Data Types in C – Operators and Expressions – Input and Output statements in C – Decision Statements – Loop Control Statements. <b>Practical Component:</b> (i) Program to illustrate arithmetic and logical operators (ii) Program to read and print data of different types (iii) Program to calculate area and volume of various geometrical shapes (iv) Program to compute biggest of three numbers (v) Program to print multiplication table (vi) Program to convert days to years, months and days (vii) Program to find sum of the digits of an integer														CO-2  BTL-3	
MODULE 3: FUNCTIONS, ARRAYS AND STRINGS(6L+6L=12)															
Functions – Storage Class – Arrays – Strings and standard functions - Pre-processor Statements. <b>Practical Component:</b> (i) Program to compute Factorial, Fibonacci series and sum of n numbers using recursion (ii) Program to compute sum and average of N Numbers stored in an array (iii) Program to sort the given n numbers stored in an array (iv) Program to search for the given element in an array (v) Program to do word count (vi) Program to insert a substring in a string														CO-3  BTL-4	

(vii) Program to concatenate and compare two strings		
(viii) Program using pre-processor statements		
MODULE 4: POINTERS, STRUCTURES AND UNION(6L+6L=12)		
Pointers – Dynamic Memory allocation – Structure and Union – Files. <b>Practical Component:</b> (i) Program to compute sum of integers stored in a 1-D array using pointers and dynamic memory allocation (ii) Program to read and print records of a student/payroll database using structures (iii) Program to simulate file copy (iv) Program to illustrate sequential access file (v) Program to illustrate random access file		CO-4 BTL-3
MODULE 5: INTRODUCTION TO EMBEDDED C(6L+6L=12)		
Structure of embedded C program - Data Types - Operators - Statements - Functions - Keil C Compiler. <b>Practical component:</b> Simple programs using embedded C		CO-5 BTL-2
TEXT BOOKS		
1	Jeyapoovan T, “Fundamentals of Computing and Programming in C”, Vikas Publishing house, 2015.	
2	Mark Siegesmund, "Embedded C Programming", first edition, Elsevier publications, 2014.	
REFERENCE BOOKS		
1.	Ashok Kamthane, “Computer Programming”, Pearson Education, 7 <sup>th</sup> Edition, Inc 2017.	
2.	Yashavant Kanetkar, “Let us C”, 15th edition, BPP publication, 2016.	
3.	S.Sathyalakshmi, S.Dinakar, “Computer Programming Practicals – Computer Lab Manual”, Dhanam Publication, First Edition, July 2013.	
EBOOK		
1.	<a href="https://en.wikibooks.org/wiki/C_Programming">https://en.wikibooks.org/wiki/C_Programming</a>	
MOOC		
1.	<a href="https://onlinecourses.nptel.ac.in/noc18-cs10/preview">https://onlinecourses.nptel.ac.in/noc18-cs10/preview</a>	
2.	<a href="http://nptel.ac.in/courses/106105085/2">http://nptel.ac.in/courses/106105085/2</a>	
3.	<a href="https://www.udemy.com/c-programming-for-beginners/">https://www.udemy.com/c-programming-for-beginners/</a>	
4.	<a href="https://www.coursera.org/specializations/c-programming">https://www.coursera.org/specializations/c-programming</a>	

COURSE TITLE	INTRODUCTION TO DIGITAL SYSTEMS			CREDITS	3
COURSE CODE	EEB4101	COURSE CATEGORY	ES	L-T-P-S	2- 0- 2- 1

Version	1.0	Approval Details		LEARNING LEVEL	BTL-3										
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment	Practical Component			ESE										
15%	15%	20%			50%										
Course Description	To learn the fundamental concepts used in the design of digital systems.														
Course Objective	<div>1. To learn number systems, codes, basic postulates of Boolean algebra and shows the correlation between Boolean expressions.</div> <div>2. To gain knowledge of the methods for simplifying Boolean expressions.</div> <div>3. To outline the formal procedures for the analysis and design of combinational circuits,</div> <div>4. To learn about several structural and behavioral models for synchronous sequential circuits.</div> <div>5. To provide knowledge of the concept of memories and programmable logic devices.</div>														
Course Outcome	<div>Upon completion of this course, the students will be able to</div> <div>1. Describe basic operation in digital systems and instruments.</div> <div>2. Discuss on basic functioning of sensors and display units.</div> <div>3. Illustrate the concepts of signal processing and converting elements.</div> <div>4. Explain the role of microcontrollers and its applications in real-time</div> <div>5. Elaborate the consumer electronics and communication devices.</div>														
Prerequisites: Physics and Mathematics															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO -4	PO -5	PO -6	PO -7	PO- 8	PO -9	PO -10	PO- 11	PO -12	PSO -1	PSO -2	PSO -3
CO-1	3	3	-	2	-	1	-	-	-	-	-	-	1	1	-
CO-2	3	3	-	2	-	1	-	-	-	1	-	-	1	1	-
CO-3	3	3	-	2	-	1	-	-	-	-	-	-	1	1	-
CO-4	3	3	-	2	-	1	-	-	-	-	-	-	1	1	-
CO-5	3	3	-	2	-	1	-	-	-	-	-	-	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															



<b>MODULE 1: INTRODUCTION TO DIGITAL SYSTEMS (12)</b>	
<p>Analog&amp; Digital signals - Need for digital instruments – Elements of digital instruments – Number systems: - Binary, Hexadecimal - Logic gates - Boolean algebra (Identities and Properties) - Digital controllers (ON-OFF).</p> <p><b>Suggested Reading:</b> Basics of number systems.</p> <p><b>Applications:</b> All digital systems in consumer and industrial electronics.</p> <p><b>Lab:</b> - <i>(To be done in Simulation environment)</i></p> <ol style="list-style-type: none"> <li>1. Logic gates simulation</li> <li>2. Boolean Identities and Property verification</li> <li>3. Digital controller design</li> </ol>	<p><b>CO-1</b></p> <p><b>BTL-2</b></p>
<b>MODULE 2: SENSORS AND DISPLAYS (16)</b>	
<p>Sensors and Transducers –Classification, Potentiometer, Strain Gauge, Piezoelectric Sensor, Linear Variable Differential Transformer, Resistance temperature detectors (RTD), Thermocouples, Tactile transducers - Displays: - Light Emitting Diode (including OLED) displays.</p> <p><b>Suggested Reading:</b> Primary sensing elements, introduction to displays.</p> <p><b>Applications:</b> Measurements and Instrumentation.</p> <p><b>Lab:</b> - <i>(To be done in Simulation environment)</i></p> <ol style="list-style-type: none"> <li>1. Simulation of Sensor characteristics- potentiometer</li> <li>2. Simulation of Sensor Characteristics-Strain Gauge</li> <li>3. Simulation of Sensor characteristics-LVDT</li> <li>4. Simulation of Sensor characteristics-RTD</li> </ol> <p>Simulation of Sensor Characteristics-Thermocouple</p>	<p><b>CO-2</b></p> <p><b>BTL-2</b></p>
<b>MODULE 3: SIGNAL CONDITIONING CIRCUITS (10)</b>	
<p>D.C. Bridge- Unbalanced, Push-Pull configuration, Operational amplifiers- Inverting, Non-Inverting, Instrumentation Amplifier, Active filters: - Low pass, High pass - Analog to Digital Converter – Successive Approximation, Digital to Analog Converter - Weighted Resistor.</p> <p><b>Suggested Reading:</b> Basic network theorems.</p> <p><b>Applications:</b> Instrumentation</p> <p><b>Lab:</b> - <i>(To be done in Simulation environment)</i></p> <ol style="list-style-type: none"> <li>1. Simulation of DC bridges</li> <li>2. Operational amplifier applications</li> <li>3. Active filter simulation</li> </ol> <p>ADC- DAC simulation.</p>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: INTRODUCTION TO MICRO CONTROLLERS (16)</b>	
<p>Introduction: Memory types, peripheral devices- Microcontroller (8 bit), Architecture, Graphics Processing Unit (GPU) - Applications: -Interfacing of Digital Input/Output, Analogue Input/Output, Display. Introduction to Programmable Logic Controller (PLC) and PID (Proportional + Integral + Derivative) Controller.</p> <p><b>Suggested Reading:</b> Hobby electronics with Microcontroller interface.</p> <p><b>Applications:</b> Control system.</p> <p><b>Lab:</b> - <i>(To be done in Simulation environment)</i></p> <ol style="list-style-type: none"> <li>1. PLC Ladder logic simulation.</li> </ol>	<p><b>CO-4</b></p> <p><b>BTL-2</b></p>

2. Proportional controller simulation.		
3. Proportional + Integral controller simulation.		
4. Proportional + Derivative controller simulation.		
Proportional +Integral + Derivative controller simulation.		
<b>MODULE 5: CONSUMER ELECTRONICS AND COMMUNICATION SYSTEM</b> (6)		
Consumer Electronics: Television, Mobile Phones, Air conditioners, Refrigerators, Washing Machine. (Block diagram approach only.) Communication System: Satellite communication, Global Positioning Systems, Global System for Mobile. (Block diagram approach only.) <b>Suggested Reading:</b> Consumer Electronics User Manuals. <b>Applications:</b> Home Appliances, Modern communication		<b>CO-5</b> <b>BTL-2</b>
<b>TEXT BOOKS</b>		
1.	Digital Fundamentals, Thomas I. Floyd, 11th edition, Pearson 2014.	
2.	Op-amps and Linear Integrated Circuits, Ramakant A. Gayakwad, 4th edition, Prentice Hall, 2015.	
3.	Electronic Instrumentation and Measurements, David A. Bell, Oxford University Press, 2013.	
4.	The 8051 Microcontroller and Embedded Systems Using Assembly and C, Sepehr Naimi, Sarmad Naimi, Muhammad Ali Mazidi, Second edition, 2017.	
5.	Programmable Logic Controllers, Frank D. Petruzella, McGraw-Hill Education, 2016.	
<b>REFERENCE BOOKS</b>		
1.	Digital Logic and Computer Design, M. Morris Mano, Prentice-Hall, 2016	
2.	Linear Integrated Circuits, Roy Choudhury, New Age International Publishers, 4th edition, 2011	
3.	C and 8051, Thomas W. Schultz, Thomas W. Schultz Publishers, 4 <sup>th</sup> edition, 2008	
4.	Consumer Electronics, S.P Bali, Pearson Education Asia Pvt., Ltd., 2008 Edition	
5.	Global Mobile Satellite Communications Applications (For Maritime, Land and Aeronautical Applications Volume 2), 2 <sup>nd</sup> edition, Springer, 2018	
<b>EBOOK</b>		
1.	<a href="http://www.ee.iitm.ac.in/~giri/pdfs/EE4140/textbook.pdf">http://www.ee.iitm.ac.in/~giri/pdfs/EE4140/textbook.pdf</a>	
2.	<a href="https://electronics.howstuffworks.com/home-audio-video-channel.htm">https://electronics.howstuffworks.com/home-audio-video-channel.htm</a>	
<b>MOOC</b>		
1.	<a href="http://nptel.ac.in/courses/106108099/Digital%20Systems.pdf">http://nptel.ac.in/courses/106108099/Digital%20Systems.pdf</a>	
2.	<a href="http://nptel.ac.in/courses/112103174/pdf/mod2.pdf">http://nptel.ac.in/courses/112103174/pdf/mod2.pdf</a>	
3.	<a href="http://www.nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/pdf/Teacher_Slides/mod3/M3L6.pdf">http://www.nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/pdf/Teacher_Slides/mod3/M3L6.pdf</a>	

4.	<a href="http://nptel.ac.in/courses/108105063/pdf/L-09(SS)(IA&amp;C)%20((EE)NPTEL).pdf">http://nptel.ac.in/courses/108105063/pdf/L-09(SS)(IA&amp;C)%20((EE)NPTEL).pdf</a>
5.	<a href="http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/micro/ui/Course_home2_5.html">http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/micro/ui/Course_home2_5.html</a>

COURSE TITLE	Engineering Immersion Lab			CREDITS	0.5
COURSE CODE	GEA4131	COURSE CATEGORY	BS	L-T-P-S	0-0-2-2
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
Continuous Internal Assessment				ESE	
80%				20%	
Course Description	The Immersion Lab contains embedded systems and individual equipment and platforms, as well as data capacity to support new modes of teaching and applications such as creating and experiencing immersive environments, human motion capture, 3D scanning for digital assets, 360-degree modeling of spaces.				
Course Objective	<div>1. To be able to Identify and use the tools, accessories and perform troubleshooting.</div> <div>2. To perform software installations, assembling, fabrication techniques.</div> <div>3. To gain knowledge on cables, wiring and Measurement of energy related to electrical.</div> <div>4. To Study logic circuits, active and passive components and also to measure parameters for signal related to electronics.</div> <div>5. To study sensors, actuators and gain knowledge on Interfacing &amp; Measurements related to mechatronics.</div>				

Course Outcome	Upon completion of this course, the students will be able to														
	1. Identify and use the tools, accessories and perform troubleshooting.														
	2. Perform software installations, assembling, and fabrication techniques.														
	3. Gain knowledge on cables, wiring and Measurement of energy.														
	4. Apprise logic circuits, active and passive components and also to measure parameters for signal.														
5. Comprehend sensors, actuators and gain knowledge on Interfacing & Measurements.															
Prerequisites: - Knowledge in basic chemistry practical at higher secondary level.															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO -4	PO -5	PO -6	PO -7	PO- 8	PO -9	PO -10	PO- 11	PO -12	PSO -1	PSO -2	PSO -3
CO-1	-	-	2	-	1	1	-	-	2	-	-	3	-	-	-
CO-2	-	-	2	-	-	-	-	-	2	2	-	3	-	-	-
CO-3	-	-	2	-	-	1	-	-	3	-	-	2	-	-	-
CO-4	2	-	2	-	-	1	-	-	3	-	-	2	-	-	-
CO-5	-	-	3	-	-	1	-	-	3	-	-	2	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
LIST OF EXPERIMENTS															
I. MECHANICAL ENGINEERING WORKSHOP															
1. Welding: Arc welding: Butt joints															
2. Lap joints.															
3. Machining: Facing															
4. Turning															
II. AUTOMOBILE ENGINEERING															
1. Dismantling and Studying of two stroke gasoline engine.															
2. Assembling of two stroke gasoline engine.															
3. Dismantling and Studying of four stroke gasoline engine															
4. Assembling of four stroke gasoline engine.															
III. AERONAUTICAL ENGINEERING															
1. Study of Flow Pattern around Various Objects.															
2. Force measurement on Aircraft Model															
3. Determination of Young's Modulus for Aluminum Cantilever Beam															
4. Binary Addition & Subtraction using Microprocessor															
IV. CIVIL ENGINEERING															
1. Plumbing- Basic Pipe Connection using valves, couplings and elbows.															

2. Carpentry – Sowing, Planning and making common Joints.
3. Bar Bending
4. Construction of a 50 cm height brick wall without mortar using English Bond.

### SLOT X -LIST OF EXPERIMENTS

#### V.ELECTRICAL ENGINEERING

1. Study of tools and accessories.
2. Study of cables.
3. Staircase wiring, Tube light and Fan connection.
4. Measurement of energy using single phase energy meter.

#### VI. ELECTRONICS ENGINEERING

1. Study of Active and Passive Components.
2. Study of Logic Circuits.
3. Making simple circuit using Electronic Components.
4. Measuring of parameters for signal using CRO.

#### VII. COMPUTER SCIENCE

1. Troubleshooting different parts of the computer peripherals, Monitor, Keyboard & CPU.
2. Installation of various operating systems, their capabilities, Windows, Unix, Linux.
3. Installation of commonly used software like MS Office
4. Assembling digital computer.

#### VIII. MECHATRONICS ENGINEERING

1. Study of Key Elements of Mechatronics Systems
2. Sensors – Load Cell, Thermocouple
3. Actuators – Linear & Rotary Actuators
4. Interfacing & Measurements – Virtual Instrumentation

#### REFERENCE BOOKS

1	Jeyapoovan T and Saravanapandian M., Engineering practices lab manual, 4th Edition, Vikas publishing House, New Delhi, 2015.
2	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3	Ibrahim Zeid, CAD/CAM Theory and Practice, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2011
4	Robert Quesada, Jeyapoovan T., Computer Numerical Control Machining and Turning Centers, Pearson Education, New Delhi, 2006

#### METHOD OF ALLOCATION FOR ENGINEERING IMMERSION LAB

**SLOT X : MECH, AERO, AUTO, CIVIL EXPERIMENTS**

**SLOT Y : EEE, ELECTRONICS, CSE, MECHATRONICS EXPERIMENTS**

## ➤ EVERY CLASS OF

- GROUP A (AERO, AUTO, MECH, MCT, CHEM, BIO, CIVIL)
- GROUP B (CSE, IT, ECE, EEE, AEROSPACE)

GETS DIVIDED INTO 4 SUB - GROUPS NAMELY a, b, c, d -- EACH CONSISTING OF 15 TO 20 STUDENTS MAX.

➤ FOR EXAMPLE: **GROUP A STUDENTS WILL OCCUPY SLOT X**

- WEEK 1 : SLOT X ---  
✓ a – MECH; b – AUTO; c – AERO ; d – CIVIL
- WEEK 2 : SLOT X ---  
✓ b – MECH; c – AUTO; d – AERO ; a – CIVIL

## ➤ THE ABOVE SCHEDULE WILL BE ON ROTATION EVERY MONTH (ONE CYLCE PER MONTH)

➤ **GROUP B STUDENTS WILL OCCUPY SLOT Y**

- WEEK 1 : SLOT Y ---  
✓ a – EEE; b – ECE; c – CSE ; d – MCT
- WEEK 2 : SLOT Y ---  
✓ b – EEE; c – ECE; d – CSE ; a – MCT

THE ABOVE SCHEDULE WILL BE ON ROTATION EVERY MONTH (ONE CYLCE PER MONTH)

COURSE TITLE	Engineering Physics Lab			CREDITS	1
COURSE CODE	PHA4131	COURSE CATEGORY	BS	L-T-P-S	0-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
Continuous Internal Assessment				ESE	
80%				20%	
Course Description	Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations. Design new instruments with practical knowledge. Understand measurement technology, usage of new instruments and real time applications in engineering studies				
Course Objective	1. To be able to Analyze material’s elastic properties. 2. To be able to Determine thermal conductivity of bad conductor. 3. To classify and Measure coefficient of viscosity of liquids. 4. To Determine wavelength of laser. 5. To Describe V-I characteristics of diode.				

<b>Course Outcome</b>	Upon completion of this course, the students will be able to														
	1. Analyze material's elastic properties.														
	2. Determine thermal conductivity of bad conductor.														
	3. Measure coefficient of viscosity of liquids.														
	4. Determine wavelength of laser.														
5. Describe V-I characteristics of diode.															
<b>Prerequisites:</b> - Knowledge in basic chemistry practical at higher secondary level.															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO -1</b>	<b>PO- 2</b>	<b>PO- 3</b>	<b>PO -4</b>	<b>PO -5</b>	<b>PO -6</b>	<b>PO -7</b>	<b>PO- 8</b>	<b>PO -9</b>	<b>PO -10</b>	<b>PO- 11</b>	<b>PO -12</b>	<b>PSO -1</b>	<b>PSO -2</b>	<b>PSO -3</b>
<b>CO-1</b>	-	-	-	-	<b>1</b>	-	-	-	-	-	-	-	-	-	-
<b>CO-2</b>	-	-	-	-	-	-	-	-	-	<b>2</b>	-	-	-	-	-
<b>CO-3</b>	-	-	-	-	-	<b>1</b>	-	-	-	-	-	-	-	-	-
<b>CO-4</b>	<b>2</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>CO-5</b>	-	-	<b>3</b>	-	-	-	-	-	-	-	-	-	-	-	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>LAB / MINI PROJECT/FIELD WORK</b>															
1. Torsional Pendulum – Determination of rigidity modulus of the material of a wire.															
2. Non-Uniform Bending – Determination of Young's Modulus.															
3. Uniform Bending – Determination of Young's Modulus.															
4. Viscosity – Determination of co-efficient of viscosity of a liquid by Poiseuille's flow.															
5. Lee's Disc – Determination of thermal conductivity of a bad conductor.															
6. Air – Wedge – Determination of thickness of a thin wire															
7. Spectrometer – refractive index of a prism															
8. Semiconductor laser – Determination of wavelength of laser using grating															
9. Semiconductor diode – VI characteristics															
<b>REFERENCE BOOKS</b>															
1.	Glenn V.Lo, Jesus Urrechaga - Aituna, Introductory Physics Laboratory Manual, Part-I, Fall 2005 Edition.														
2.	P. Kulkarni, Experiments in Engineering Physics Bachelor of Engineering and Technology, Edition 2015														
<b>E-BOOKS</b>															
1.	<a href="http://www.aurora.ac.in/images/pdf/departments/humanities-and-sciences/engg-phy-lab-manual.pdf">http://www.aurora.ac.in/images/pdf/departments/humanities-and-sciences/engg-phy-lab-manual.pdf</a>														
<b>TEXT BOOK</b>															
1.	P. Mani, engineering Physics Practicals, Dhanam Publications, Chennai, 2005														

COURSE TITLE		MATERIALS CHEMISTRY LAB										CREDITS		1	
COURSE CODE		CYA4131		COURSE CATEGORY		BS						L-T-P-S		0-0-2-0	
Version		1.0		Approval Details								LEARNING LEVEL		BTL-3	
ASSESSMENT SCHEME															
Continuous Internal Assessment												ESE			
80%												20%			
Course Description		The course covers principles and applications of chemical laboratory techniques, including preparation and analysis of chemical materials, measurement of pH, gas and liquid chromatography, visible-ultraviolet spectrophotometry, infrared spectroscopy, nuclear magnetic resonance, mass spectrometry, polarimetry, X-ray.													
Course Objective		1. To be able to Characterize basic properties of refractory ceramics. 2. To be able to Prepare resins and composites. 3. To classify and Estimate metal ions present in samples using instrumental techniques. 4. To understand and Develop adsorption isotherm. 5. To Find properties of lubricants and other oil samples.													
Course Outcome		Upon completion of this course, the students will be able to 1. Characterize basic properties of refractory ceramics. 2. Prepare resins and composites. 3. Estimate metal ions present in samples using instrumental techniques. 4. Develop adsorption isotherm. 5. Find properties of lubricants and other oil samples.													
Prerequisites: - Knowledge in basic chemistry practical at higher secondary level.															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO -4	PO -5	PO -6	PO -7	PO- 8	PO -9	PO -10	PO- 11	PO -12	PSO -1	PSO -2	PSO -3
CO-1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5															
1: Weakly related, 2: Moderately related and 3: Strongly related															



LAB / MINI PROJECT/FIELD WORK	
<ol style="list-style-type: none"> <li>1. Construction of Phenol-Water Phase diagram.</li> <li>2. Determination of viscosity of polymer using Ostwald Viscometer.</li> <li>3. Preparation of urea-formaldehyde resin.</li> <li>4. Determination of porosity of a refractory.</li> <li>5. Determination of Apparent Density of porous solids.</li> <li>6. Determination of Viscosity Index of lubricants.</li> <li>7. Estimation of dye content in the effluent by UV-Visible spectrophotometry.</li> <li>8. Determination of viscosity of oil using Red-Wood Viscometer.</li> <li>9. Determination of Copper / iron content in the alloy by colorimetry.</li> <li>10. Estimation of sodium and potassium ions by Flame Photometry.</li> <li>11. Verification of Beer-Lambert's law using gold nanoparticles.</li> <li>12. Determination of adsorption isotherm for acetic acid on activated charcoal.</li> </ol>	
REFERENCE BOOKS	
1.	J. Mendham, R.C. Denney, J.D. Barnes and N.J.K. Thomas, Vogel's Textbook of Quantitative Chemical Analysis, 6 <sup>th</sup> Edition, Pearson Education, 2009.
2.	D.P. Shoemaker and C.W. Garland, Experiments in Physical Chemistry, 8 <sup>th</sup> edition, McGraw Hill, London, 2008
3.	S. Sumathi, Laboratory work book for Engineering Chemistry Practical, 2015
4.	Laboratory Manual of Testing Materials, William Kendrick Hatt and Herbert Henry Scofield, Andesite Press, 2017
E-BOOKS	
1.	<a href="http://www.erforum.net/2016/01/engineering-chemistry-by-jain-and-jain-pdf-free-ebook.html">http://www.erforum.net/2016/01/engineering-chemistry-by-jain-and-jain-pdf-free-ebook.html</a>
MOOC	
1.	<a href="https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/lecture-32/">https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/video-lectures/lecture-32/</a>
2.	<a href="https://www.coursetalk.com/providers/coursera/courses/introduction-to-chemistry-1">https://www.coursetalk.com/providers/coursera/courses/introduction-to-chemistry-1</a>

COURSE TITLE	ANALYTICAL MATHEMATICS			CREDITS	4
COURSE CODE	MAA4117	COURSE CATEGORY	BS	L-T-P-S	3- 0- 2- 1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment			Practical Component						ESE				
15%		15%			20%						50%				
Course Description		This is a course suitable for B.Tech students of various disciplines. It deals with some advanced topics in Engineering Mathematics usually covered with Integrals, Vector Calculus, Fourier series and Laplace transform in a degree course.													
Course Objective		<ol style="list-style-type: none"><li>1. To understand the Elementary Logic.</li><li>2. To Describe several areas of mathematics beyond calculus</li><li>3. To apply transformations and use symmetry to analyse mathematical situations.</li><li>4. To use appropriate modern technology to explore calculus concepts.</li><li>5. To understand and solve complex variable theory, applications of analytic function and harmonic conjugate.</li></ol>													
Course Outcome		<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"><li>1. Evaluate surface and volume integrals.</li><li>2. Perform vector operations and interpret the results geometrically.</li><li>3. Solve the system of ordinary differential equations using Laplace Transform.</li><li>4. Know that any periodic function satisfying Dirichlet's conditions can be expressed as a Fourier series.</li><li>5. Understand complex variable theory, applications of analytic function and harmonic conjugate.</li></ol>													
Prerequisites: NIL															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO -4	PO -5	PO -6	PO -7	PO- 8	PO -9	PO -10	PO- 11	PO -12	PSO -1	PSO -2	PSO -3
CO-1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO-2	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-3	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO-4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: MULTIPLE INTEGRALS												(6L+6L=12)			
Double integration – Cartesian and polar co-ordinates – Change of order of integration. Area as a double integral – Triple integration in Cartesian coordinates														CO-1 BTL-2	

<p>– Volume as a triple integral – Change of variables between Cartesian and polar coordinates.</p> <p><b>Practical component:</b> Area and Volume of double integration and triple integration.</p> <p><b>Suggested Readings:</b> Line Integrals</p>	
<b>MODULE 2: VECTOR CALCULUS(6L+6L=12)</b>	
<p>Gradient, Divergence and Curl – Unit normal vector, Directional derivative – angle between surfaces – Solenoidal and Irrotational vector fields. Green's theorem - Gauss divergence theorem and Stoke's theorem (without proof) – Verification and evaluation of the above theorems - Simple applications to regions such as square, rectangle, triangle, cuboids and rectangular parallelepiped.</p> <p><b>Practical component:</b> Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields</p> <p><b>Suggested Readings:</b> Basics of Vectors</p>	<p><b>CO-2</b> <b>BTL-2</b></p>
<b>MODULE 3: LAPLACE TRANSFORMS (6L+6L=12)</b>	
<p>Laplace transform – Conditions of existence – Transform of elementary functions – properties – Transforms of derivatives– Initial and final value theorems – Transform of periodic functions. Inverse Laplace transforms using partial fraction and convolution theorem. Solution of linear ODE of second order with constant coefficients.</p> <p><b>Practical component:</b> Solutions of differential equations using Laplace transform</p> <p><b>Suggested Readings:</b> Basics of Transform</p>	<p><b>CO-3</b> <b>BTL-3</b></p>
<b>MODULE 4: FOURIER SERIES (6L+6L=12)</b>	
<p>Dirichlet's Conditions – General Fourier Series – Odd and even functions – Half range sine and cosine series –Harmonic Analysis.</p> <p><b>Practical component:</b> Expansion of functions using Fourier series.</p> <p><b>Suggested Readings:</b> Basics of series</p>	<p><b>CO-4</b> <b>BTL-2</b></p>
<b>MODULE 5: COMPLEX VARIABLES (6L+6L=12)</b>	
<p>Functions of a complex variable – Analytic function – Cauchy - Riemann equations (Statement only) – Properties of analytic function (Statement only) – Construction of Analytic functions by Milne – Thomson method.</p> <p><b>Practical component:</b> Complex Numbers</p> <p><b>Suggested Readings:</b> Verification of Analytic Function</p>	<p><b>CO-5</b> <b>BTL-2</b></p>
<b>TEXT BOOKS</b>	

1	Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2	A.P.Santhakumaran, P.Titus, Engineering Mathematics - II, NiMeric Publications, Nagercoil, 2012.
3	Chandrasekaran A, Engineering Mathematics- II, Dhanam Publication, 2014.
4	Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma, "MATLAB and its Applications in Engineering", Pearson Publication, Second Edition, 2016.
<b>REFERENCE BOOKS</b>	
1.	Sastry, S.S. (2014). <i>Engineering Mathematics</i> , Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi.
2.	Wylie, R.C. and Barrett, L.C. (2012). <i>Advanced Engineering Mathematics</i> —Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi.
3.	Dean G. Duffy. (2013). <i>Advanced Engineering Mathematics with MATLAB</i> , CRC Press, Third Edition.
<b>EBOOKS</b>	
1.	<a href="http://nptel.ac.in/courses/122104017/28">http://nptel.ac.in/courses/122104017/28</a>
2.	<a href="https://www.khanacademy.org/.../double-integrals.../double-integral">https://www.khanacademy.org/.../double-integrals.../double-integral</a>
3.	<a href="http://nptel.ac.in/courses/115101005/downloads/lectures-doc/Lecture-1.p">nptel.ac.in/courses/115101005/downloads/lectures-doc/Lecture-1.p</a>
<b>MOOC</b>	
1.	<a href="https://www.edx.org/course/introduction-engineering-mathematics-utarlingtonx-engr3-0x">https://www.edx.org/course/introduction-engineering-mathematics-utarlingtonx-engr3-0x</a>

COURSE TITLE	ENGINEERING AND DESIGN			CREDITS	3
COURSE CODE	CSB4101	COURSE CATEGORY	ES	L-T-P-S	2-0-2-1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	To Explore design and engineering problems and solutions that will stretch the students’ creativity and to solve complex user problems with design thinking and technical engineering skills.				

Course Objective	1. To excite the student on creative design and its significance 2. To make the student aware of the processes involved in design 3. To make the student understand the interesting interaction of various segments of humanities, sciences and engineering in the evolution of a design 4. To get an exposure as to how to engineer a design. 5. To understand the need of User Centered Designs.														
Course Outcome	Upon completion of this course, the students will be able to 1. Identify the different elements involved in good designs and to apply them in practice when called for. 2. Interpret the product oriented and user-oriented aspects that make the design a success. 3. Think of innovative designs incorporating different segments of knowledge gained in the course 4. Have a broader perspective of design covering function, cost, environmental sensitivity, safety and other factors other than engineering analysis. 5. Learn economic and environmental Issues, trade aspects and IPR.														
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO - 1	PO-2	PO- 3	PO -4	PO -5	PO -6	PO -7	PO-8	PO -9	PO -10	PO- 11	PO -12	PSO -1	PSO -2	PS O -3
CO-1	3	3	2	-	2	-	-	-	-	-	-	-	-	-	-
CO-2	3	3	2	-	2	-	-	-	-	-	-	-	-	-	-
CO-3	3	3	2	-	2	-	-	-	-	-	-	-	-	-	-
CO-4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5	3	3	2	-	-	2	1	-	-	-	-	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO COMPUTER ENGINEERING DESIGN (9)															
Design and its objectives; Design constraints, Design functions, Design means and Design from; Role of Science, Engineering and Technology in design; Engineering as a business proposition; Functional and Strength Designs. Design form, function and strength; How to initiate creative designs? Initiating the thinking process for designing a product of daily use. Need identification; Problem Statement; Market survey-customer requirements; Design attributes and objectives; Ideation; Brain storming approaches; arriving at solutions; Closing on to the Design needs. <b>Project:</b> An Exercise in the process of design initiation. A simple problem is to be taken up to examine different solutions- Ceiling fan, Group Presentation and discussion.													CO-1  BTL-2		
MODULE 2: PROCESSES IN DESIGN FOR COMPUTER SCIENCE ENGINEERING (9)															

<p>Design process- Different stages in design and their significance; Defining the design space; Analogies and “thinking outside of the box”; Quality function deployment-meeting what the customer wants; Evaluation and choosing of a design. Design Communication; Realization of the concept into a configuration, drawing and model. Concept of “Complex is Simple”. Design for function and strength.</p> <p>Design detailing- Material selection, Design visualization- Solid modelling; Detailed 2D drawings; Tolerance; Use of standard items in design; Research needs in design; Energy needs of the design, both in its realization and in the applications.</p> <p><b>Project:</b> An exercise in the detailed design of any two products.</p>	<p><b>CO-2</b> <b>BTL-2</b></p>
<p><b>MODULE 3: PROTOTYPING IN COMPUTER ENGINEERING DESIGN (9)</b></p>	
<p>Prototyping- rapid prototyping; testing and evaluation of design; Design modifications; Freezing the design; Cost analysis.</p> <p>Engineering the design – From prototype to product. Planning; Scheduling; Supply chains; inventory; handling; manufacturing/construction operations; storage; packaging; shipping; marketing; feed-back on design</p> <p><b>Project:</b> List out the standards organizations. Prepare a list of standard items used in any engineering specialization. Develop any design with over 50% standard items as parts.</p>	<p><b>CO-3</b> <b>BTL-3</b></p>
<p><b>MODULE 4: QUALITY ASPECTS IN COMPUTER ENGINEERING DESIGN (9)</b></p>	
<p>Design for “X”; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc.</p> <p><b>Project:Example:</b> List out the design requirements(x) for designing a rocket shell of 3-meter diameter and 8-meter length. Design mineral water bottles that could be packed compactly for transportation.</p>	<p><b>CO-4</b> <b>BTL-2</b></p>
<p><b>MODULE 5: USER CENTRED DESIGNS IN COMPUTER SCIENCE ENGINEERING (9)</b></p>	
<p>Product centered and user centered design. Product centered attributes and user centered attributes. Bringing the two closer. Example: Smart phone. Aesthetics and ergonomics. Value engineering, Concurrent engineering, Reverse engineering in design; Culture based design; Architectural designs; Motifs and cultural background; Tradition and design; Study the evolution of Wet grinders; Printed motifs; Role of colours in design. Make sharp corners and change them to smooth curves-check the acceptance. Design as a marketing tool; Intellectual Property rights – Trade secret; patent; copy-right; trademarks; product liability. Group presentation of any such products covering all aspects that could make or mar it.</p> <p><b>Project:</b> Examine the possibility of value addition for an existing product.</p>	<p><b>CO-5</b> <b>BTL-2</b></p>
<p><b>TEXT BOOKS</b></p>	

1	Balmer, R. T., Keat, W. D., Wise, G., and Kosky, P., Exploring Engineering, Third Edition: An Introduction to Engineering and Design - [Part 3 - Chapters 17 to 27], ISBN13: 978-0124158917 ISBN-10: 0124158919
2	Dym, C. L., Little, P. and Orwin, E. J., Engineering Design - A Project based introduction - Wiley, ISBN-978-1-118-32458-5
3	Eastman, C. M. (Ed.), Design for X Concurrent engineering imperatives, 1996, XI, 489 p. ISBN 978-94-011-3985-4 Springer
4	Haik, Y. And Shahin, M. T., Engineering Design Process, Cengage Learning, ISBN-13: 978-0-495-66816-9
5	Pahl, G., Beitz, W., Feldhusen, J. and Grote, K. H., Engineering Design: A Systematic Approach, 3rd ed. 2007, XXI, 617p., ISBN 978-1-84628-319-2
6	Voland, G., Engineering by Design, ISBN 978-93-325-3505-3, Pearson India
<b>REFERENCE BOOK</b>	
1	<a href="https://www.elsevier.com/books/introduction-to-engineering-design/samuel/978-0-7506-4282-8">https://www.elsevier.com/books/introduction-to-engineering-design/samuel/978-0-7506-4282-8</a>
<b>MOOC</b>	
1.	Design: Creation of Artifacts in Society (Coursera)
2.	Planning & Design of Sanitation Systems and Technologies (Coursera)
3.	Decision Making in Engineering Design (edX)

COURSE TITLE	SUSTAINABLE ENGINEERING SYSTEMS (Common to ALL Branches of Engineering)			CREDITS	2
COURSE CODE	GEA4102	COURSE CATEGORY	ES	L-T-P-S	2-0-0-1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

Course Description	This is a course suitable for B.Tech students of various disciplines. It deals with some advanced topics in Technology development and lifecycle assessments. This course gives an idea about green engineering, wastewater systems and also behavioral aspects and feedbacks in a degree course.														
Course Objective	<ol style="list-style-type: none"><li>1. To explain the principles of Sustainable Design and engineering.</li><li>2. To elaborate on the Life Cycle Assessment (LCA) methodology and metrics.</li><li>3. To identify E-waste stream management and also sustainable technologies.</li><li>4. To interpret the water treatment systems Metrics for assessment of water management technologies.</li><li>5. To develop decision making techniques and human factor in sustainability paradigm.</li></ol>														
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"><li>1. Articulate the technical and economic fundamentals of key existing and emerging sustainable technologies.</li><li>2. Demonstrate how the economic and technical performance of various technologies can be measured and compared.</li><li>3. Identify the technical, economic, and social obstacles to the implementation of sustainable technologies.</li><li>4. Choose social, environmental, and economic metrics to assess sustainable technologies for long-term promise and commercialization.</li><li>5. Develop a realistic scenario for sustainable technology implementation at a specific location or facility.</li></ol>														
Prerequisites: Knowledge in fundamentals of chemistry at higher secondary level.															
CO, PO AND PSO MAPPING															
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	-	-	-	-	3	-	-	-	-	-	-	-	-	-
CO-2	3	-	2	-	-	2	3	-	-	-	-	-	-	-	-
CO-3	1	-	-	-	-	3	2	-	-	-	-	-	-	-	-
CO-4	2	-	-	-	-	3	2	-	-	-	-	-	-	-	-
CO-5	1	1	3	-	-	-	2	3	2	-	-	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: PRINCIPLES OF SUSTAINABLE SYSTEMS															(5)



Sustainability Definitions - Principles of Sustainable Design, Sustainable Engineering - Frameworks for Applying Sustainability Principles - Summary & Activities.		CO-1 BTL-2
MODULE 2: TECHNOLOGY DEVELOPMENT AND LIFECYCLE ASSESSMENT (5)		
Technology as a part of anthropogenic environment - Technology readiness levels (TRL) – technical metrics - Emerging, converging, disruptive technologies - Life Cycle Assessment (LCA) methodology - Summary & Activities.		CO-2 BTL-2
MODULE 3: GREEN ENGINEERING (5)		
Principles of Green Engineering - Frameworks for assessment of alternatives - Green Engineering examples - Multifunctional Materials and Their Impact on Sustainability - Summary & Activities.		CO-3 BTL-3
MODULE 4: RESOURCE MANAGEMENT TECHNOLOGIES (5)		
Waste management purpose and strategies - Recycling: open-loop versus closed-loop thinking - Recycling efficiency - Management of food waste and composting technologies - E-waste stream management - Reuse and redistribution programs - LCA approach to waste management systems - Summary and Activities.		CO-4 BTL-2
MODULE 5: SUSTAINABLE WATER AND WASTEWATER SYSTEMS (5)		
Water cycle - Water conservation and protection technologies - Water treatment systems Metrics for assessment of water management technologies-Summary & Activities.		CO-5 BTL-2
TEXT BOOKS		
1.	Vanek, F.M., and L.D. Albright. (2008). <i>Energy Systems Engineering, Evaluation and Implementation</i> , McGraw Hill.	
2.	Becker, C.U. (2012). <i>Sustainability Ethics and Sustainability Research</i> , Springer.	
3.	J.B. Guinee et al. (2011). Life Cycle Assessment: Past, Present, and Future, Environ. Sci. Technol., 45, 90-96.	
4.	Anastas, P.T., Zimmerman, J.B. (2013). <i>Innovations in Green Chemistry and Green Engineering</i> , Springer.	
5.	Christensen, T., Ed., Wiley and Sons. (2010). <i>Solid Waste Technology &amp; Management</i> , Volume 1 & 2,	
6.	Stermann, J.D. (2012). <i>in Sustainability Science: The Emerging Paradigm</i> , Weinstein, M.P. and Turner, R.E. (Eds.), Springer Science+Business Media, LLC.	
REFERENCE BOOKS		
1.	David T. Allen, David R. Shonnard. (2011). <i>Sustainable Engineering Concepts, Design and Case Studies</i> , Pearson Education, December. (ISBN: 9780132756587)	

2.	Gerald Jonker Jan Harmsen. (2012). <i>Engineering for Sustainability</i> 1st Edition, A Practical Guide for Sustainable Design, Elsevier. (ISBN: 9780444538475).
<b>MOOC</b>	
1.	<a href="https://www.coursera.org/learn/sustainability">https://www.coursera.org/learn/sustainability</a>
2.	<a href="https://www.academiccourses.com/Certificate/Sustainability-Studies/India/">https://www.academiccourses.com/Certificate/Sustainability-Studies/India/</a>
3.	<a href="https://onlinecourses.nptel.ac.in/noc18_ce08/preview">https://onlinecourses.nptel.ac.in/noc18_ce08/preview</a>
4.	<a href="https://www.coursera.org/learn/ecosystem-services">https://www.coursera.org/learn/ecosystem-services</a>

COURSE TITLE	DATA STRUCTURES USING C			CREDITS	4
COURSE CODE	CSB4117	COURSE CATEGORY	PC	L-T-P-S	3- 0- 0- 1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This is a course suitable for B.Tech students. It deals with basic data structures, arrays, heaps etc. This course develops the knowledge in the graphs, algorithm, creation, deletion, insertion. Also gives an idea about developing the projects in the data structures.				
Course Objective	1. To develop the knowledge in the basic designing of algorithms 2. To apply the concept of algorithms for the creation, insertion, deletion, searching, and sorting of each data structure. 3. To understand the concept of Sort, arrays, linked lists etc. 4. To define the idea of graphs and its traversal. 5. To develop the implementation knowledge in the projects.				
Course Outcome	Upon completion of this course, the students will be able to 1. Compute and analyse the algorithms for efficiency using Asymptotic Notations. 2. Develop knowledge of basic data structures such as arrays, linked lists, binary trees, heaps, and hash tables for storage and retrieval of ordered or unordered data. 3. Solve problems by applying suitable data structures with the algorithms for the creation, insertion, deletion, searching, and sorting of each data structure. 4. Define graphs and illustrate graph traversals. 5. Design and develop projects requiring the implementation of the data structures.				
Prerequisites: CSA4101 - C Programming Language					

CO, PO AND PSO MAPPING															
CO	PO - 1	PO- 2	PO -3	PO -4	PO -5	PO -6	PO -7	PO- 8	PO -9	PO -10	PO -11	PO -12	PS O -1	PSO -2	PSO -3
CO-1	3	3	3	3	-	-	-	-	-	-	-	3	1	1	-
CO-2	3	3	3	-	1	-	1	2	-	-	-	-	1	1	-
CO-3	3	3	3	-	-	-	-	-	-	-	3	-	1	1	-
CO-4	3	3	3	-	1	-	1	-	-	2	-	-	1	1	-
CO-5	3	3	3	-	2	-	-	-	-	-	-	-	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: LINEAR DATA STRUCTURES (6L+6L=12)															
Introduction to Data Structures – Fundamental Elements – Asymptotic Notations: Big-Oh, Omega and Theta – Best, Worst and Average case Analysis: Definition and an example -Arrays and its representations – Stacks and Queues – Linked lists - Singly Linked List - Doubly linked list - Linked list-based implementation of Stacks and Queues – Evaluation of Expressions.													CO-1 BTL-2		
MODULE 2: NON-LINEAR DATA STRUCTURES(6L+6L=12)															
<b>Trees:</b> Introduction to Trees – Basic concepts - Binary Trees – Binary tree representations (Array and list) and Traversals Techniques (Preorder, Inorder, Postorder) – Succinct Data Structures: Overview – Level order representation of Binary Trees – Rank and Select – Subtrees. <b>Graphs:</b> Definitions, Terminologies, Matrix and Adjacency List Representation Of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search.													CO-2 BTL-2		
MODULE 3: SEARCH TREE STRUCTURES AND PRIORITY QUEUES(6L+6L=12)															
Binary Search Trees – AVL Trees – Splay Trees - Fusion Data Structures: Sketching- Approximating the sketch - Parallel comparison – Desk etching – Application of Fusion Tree Structures - Priority Queues – Heaps implementations – Binary Heap.													CO-3 BTL-3		
MODULE 4: SORTING AND SEARCHING (6L+6L=12)															
<b>Sorting Algorithms:</b> Basic concepts - Bubble Sort - Insertion Sort - Selection Sort - Quick Sort – Shell sort - Heap Sort - Merge Sort - External Sorting. <b>Searching:</b> Linear Search, Binary Search.													CO-4 BTL-3		
MODULE 5: INDEXING AND DISJOINT SETS (6L+6L=12)															
Indexing: Hashing - Hash Functions – Separate Chaining – Open Addressing: Linear Probing- Quadratic Probing- Double Hashing- Rehashing – Extendible Hashing. Disjoint Sets: Basic data structure - Smart Union Algorithms - Path Compression.													CO-5 BTL-3		

TEXT BOOKS	
1.	Ellis Horowitz, S. Sahni, Freed. (2015). <i>Fundamentals of Data Structures in C</i> , 2nd edition.
REFERENCE BOOKS	
1.	Langsam, Y., Augenstein, M. J. And Tanenbaum A. M. (2004). <i>Data Structures using C</i> , Pearson Education Asia.
E BOOKS	
1.	<a href="https://pdfs.semanticscholar.org/54eb/d5fbd450c745ffb1a5a126d975aa0a53c2e1.pdf">https://pdfs.semanticscholar.org/54eb/d5fbd450c745ffb1a5a126d975aa0a53c2e1.pdf</a> (Succinct Data Structures)
2.	<a href="https://courses.csail.mit.edu/6.851/spring12/scribe/lec12.pdf">https://courses.csail.mit.edu/6.851/spring12/scribe/lec12.pdf</a> (Fusion Data Structures)
3.	<a href="http://lib.mdp.ac.id/ebook/Karya%20Umun/Dsa.pdf">http://lib.mdp.ac.id/ebook/Karya%20Umun/Dsa.pdf</a>
MOOC	
1.	<a href="https://www.mooc-list.com/tags/data-structures">https://www.mooc-list.com/tags/data-structures</a>
2.	<a href="https://nptel.ac.in/courses/106102064/">https://nptel.ac.in/courses/106102064/</a>
3.	<a href="https://www.udemy.com/algorithm/">https://www.udemy.com/algorithm/</a>

COURSE TITLE	OBJECT ORIENTED PROGRAMMING USING C++			CREDITS	4
COURSE CODE	CSB4118	COURSE CATEGORY	PC	L-T-P-S	3- 0- 2- 1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME			
First Periodical Assessment	Second Periodical Assessment	Practical Component	ESE
15%	15%	20%	50%
<b>Course Description</b>	This is a course suitable for B.Tech students. It deals with basic C++ programs, classes and objects. This course develops applications using friend function. Also, from this course students are able to understand the concepts of inheritance, polymorphism, exception handling, streaming and file handling mechanisms.		
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To understand the basics of oops concepts.</li> <li>2. To develop small programs using classes and objects.</li> <li>3. To develop the applications using functions and overloading concepts.</li> <li>4. To create the reusable code using inheritance and polymorphism.</li> <li>5. To understand the file handling mechanisms.</li> </ol>		

Course Outcome	Upon completion of this course, the students will be able to														
	1. Write basic C++ programs to solve the given problem.														
	2. Identify and implement the simple Object-Oriented programming concepts using classes.														
	3. Develop applications using friend functions, constructors and overloading mechanisms.														
	4. Build re-usable code using Inheritance and Runtime Polymorphism.														
5. Implement exception handling, streaming and file handling mechanisms.															
Prerequisites: CSA4101 - C Programming Language															
CO, PO AND PSO MAPPING															
CO	PO -1	PO-2	PO-3	PO -4	PO -5	PO -6	PO -7	PO-8	PO -9	PO -10	PO-11	PO -12	PSO -1	PSO -2	PSO -3
CO-1	3	3	3	-	1	-	-	-	-	-	-	2	1	1	-
CO-2	3	3	3	-	-	-	-	-	-	-	-	2	1	1	-
CO-3	3	3	3	-	3	-	-	-	-	-	-	-	1	1	-
CO-4	3	3	3	-	2	-	-	-	-	-	-	2	1	1	-
CO-5	3	3	3	-	-	-	-	-	-	-	-	2	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO C++ and OOP													(9L+6P)		
Object-Oriented Paradigm – Features of Object Oriented Programming – C++ Fundamentals – Variables - Data types – Operators - Arrays - Strings – Default arguments -Inline Functions, Reference Variables and Pointers, Dynamic Memory Management. Introduction to C++ classes –Class Objects- Access Specifiers –Accessing Class Members- Defining Member functions–Arrays of Objects - Objects as Arguments. <b>Practical component:</b> (i) Search a given number in an array. (ii) Perform various string manipulation functions. (iii) Swap two numbers using call by value and call by reference (Using pointers and reference variables). (iv) Create a class to read and display student/account/employee details. (v) Handle multiple student/account/employee records using array of objects. <b>Suggested Readings:</b> Classes and Objects - <a href="http://nptel.ac.in/courses/106105151/20">http://nptel.ac.in/courses/106105151/20</a>													CO-1 BTL-2		
MODULE 2: FUNCTIONS AND COMPILE-TIME POLYMORPHISM													(9L+6P)		

<p>Working with Friend functions and Friend Classes – Static Data and Member Functions          -Constructors - Parameterized Constructors - Constructors with Default Arguments-          Copy Constructors- Constructor overloading- Destructors.          Polymorphism- Types of Polymorphism – Compile time and Runtime - Function          Overloading - Rules of Operator Overloading- Overloading of Unary and Binary          Operators as Member function/Friend function.</p> <p><b>Practical component:</b></p> <ul style="list-style-type: none"> <li>(i) Add two complex numbers using friend function.</li> <li>(ii) Calculate the area of different shapes using various constructor types.</li> <li>(iii) Find average of variables with different types using function overloading.</li> <li>(iv) Overload unary arithmetic operators using member and friend function.</li> <li>(v) Overload binary arithmetic operators using member and friend function.</li> </ul> <p><b>Suggested readings:</b>          Operator Overloading - <a href="http://nptel.ac.in/courses/106105151/15">http://nptel.ac.in/courses/106105151/15</a></p>	<b>CO-2</b> <b>BTL-3</b>
<b>MODULE 3: INHERITANCE AND RUN TIME POLYMORPHISM (9L+6P)</b>	
<p>Inheritance- Types of Inheritance – Single, Multilevel, Hierarchical, Multiple, Hybrid,          Multipath and Virtual base class - Accessing Overridden Function - Constructors and          Destructors in derived classes.          Understanding Runtime polymorphism - Memory Management operators, Pointers to          objects, Virtual Functions (concept of VTABLE), pure virtual functions, Abstract Class.</p> <p><b>Practical component:</b></p> <ul style="list-style-type: none"> <li>(i) Manipulate employee/account/student information using various Inheritance          types.</li> <li>(ii) Implement constructors and destructors in derived classes.</li> <li>(iii) Read and display book details using pointers to objects.</li> <li>(iv) Implement the concept of virtual and pure virtual functions.</li> </ul> <p><b>Suggested Readings:</b>          Dynamic Binding - <a href="http://nptel.ac.in/courses/106105151/41">http://nptel.ac.in/courses/106105151/41</a></p>	<b>CO-3</b> <b>BTL-3</b>
<b>MODULE 4: EXCEPTION HANDLING, STREAMS AND FILES (9L+6P)</b>	
<p>Understanding of working and implementation of Exception Handling.          Streams- Unformatted and formatted console I/O operations – Manipulators, User-          Defined Manipulators - Implementation of Files, Writing and Reading Objects.</p> <p><b>Practical component:</b></p> <ul style="list-style-type: none"> <li>(i) Handle arithmetic and array index out of bounds exceptions.</li> <li>(ii) Read and display the given text using unformatted I/O operations.</li> <li>(iii) Create a user-defined manipulator function.</li> <li>(iv) Write details of n number of books to a file, then read and display the same.</li> <li>(v) Handle two files simultaneously to copy/append the content of one file to          another</li> </ul> <p><b>Suggested Readings:</b>          Exceptions - <a href="http://nptel.ac.in/courses/106105151/52">http://nptel.ac.in/courses/106105151/52</a></p>	<b>CO-4</b> <b>BTL-3</b>
<b>MODULE 5: TEMPLATES AND STANDARD TEMPLATE LIBRARY (9L+6P)</b>	
<p>Generic Programming with Templates - Function Templates- Function Templates with          Multiple Arguments - Overloaded Function Templates - Class Templates - Class          Templates with Multiple Arguments.</p>	<b>CO-5</b> <b>BTL-3</b>

Standard Template Library (STL) – Components of Standard Template Library - Containers, Algorithms and Iterators -Implementation of Sequence and Associative containers for different Algorithms using Iterator.		
<b>Practical component:</b>		
(i) Sort n numbers using function template.		
(ii) Perform stack operations using class template.		
(iii) Perform queue operations using containers in STL.		
(iv) Perform searching and sorting using algorithms in STL.		
<b>Suggested Readings:</b>		
Templates - <a href="http://nptel.ac.in/courses/106105151/54">http://nptel.ac.in/courses/106105151/54</a>		
<b>TEXT BOOKS</b>		
1.	Venugopal, K.R., Rajkumar Buyya. (2017). <i>Mastering C++</i> , 2nd Edition, McGraw Hill Education.	
2.	Herbert Schildt. (2017). <i>C++: The Complete Reference</i> , 4th Edition, McGraw Hill Education.	
<b>REFERENCE BOOKS</b>		
1.	Bjarne Stroustrup. (2013). <i>The C++ Programming Language</i> , 4th Edition, Addison-Wesley Professional.	
2.	Nell Dale, Chips Weems. (2009). <i>Programming and Problem Solving with C++</i> , Jones and Bartlett Learning, 5th Edition.	
3.	Nicolai Josuttis, M. (2012). <i>The C++ Standard Library: A Tutorial and Reference</i> , 2nd Edition, Addison Wesley.	
<b>E BOOKS</b>		
1	<a href="http://fac.ksu.edu.sa/sites/default/files/ObjectOrientedProgramminginC4thEdition.pdf">http://fac.ksu.edu.sa/sites/default/files/ObjectOrientedProgramminginC4thEdition.pdf</a>	
<b>MOOC</b>		
1.	<a href="https://www.edx.org/course/introduction-c-microsoft-dev210x-5">https://www.edx.org/course/introduction-c-microsoft-dev210x-5</a>	
2.	<a href="https://www.coursera.org/learn/c-plus-plus-a#syllabus">https://www.coursera.org/learn/c-plus-plus-a#syllabus</a>	

COURSE TITLE	DATA STRUCTURES LAB			CREDITS	1
COURSE CODE	CSB4146	COURSE CATEGORY	PC	L-T-P-S	0-0-3-0
Version	1.0	Approval Details		LEARNIN G LEVEL	BTL-3
ASSESSMENT SCHEME					
Continuous Internal Assessment				ESE	
80%				20%	
Course Description	This is a lab course suitable for B.Tech students. It helps to implement the basic concept of data structures. This course used to learn and implement the algorithms like sorting, searching, merging etc. Also students are able to design their own data structure to solve a problem.				

<b>Course Objective</b>	1. To solve the simple basic problems using data structures. 2. To design the efficient data structure to solve a given problem. 3. To implement the concept of sorting, searching, merging concepts. 4. To analyse the design solutions for the given problem. 5. To understand the concept of basic algorithms.														
<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. Implement the common operations such as creation, insertion, deletion, searching, and sorting for each data structure. 2. Identity the appropriate data structure for given problem. 3. Analyse and design solutions for the given the problem with appropriate data structure. 4. Choose/Design an efficient data structure to solve a problem. 5. Able to construct an expression tree and print the traversal order.														
<b>Prerequisites: CSA4101- C Programming Language</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
<b>CO-1</b>	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
<b>CO-2</b>	1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
<b>CO-3</b>	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-
<b>CO-4</b>	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
<b>CO-5</b>	1	2	3	-	-	-	-	-	-	-	-	-	-	-	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>LIST OF EXPERIMENTS:</b>															
1. 1 Write a C program using functions to perform the following: a) Create a singly linked list of integers. b) Delete the given integer from the above linked list. c) Display the contents of the linked list before and after deletion. 2. Write a C program using functions to perform the following: a) Create a doubly linked list of strings. b) Delete the given string from the above linked list. c) Display the contents of the linked list before and after deletion. 3. Search for the given element in a matrix. 4. Binary search using recursion. 5. Infix to postfix conversion and evaluation of postfix. 6. Implement the process of issuing tickets based on first come first served basis. 7. Sort the list of integers using the following sorting methods: a) Shell Sort b) Heap Sort														<b>CO-1,2,3,4,5</b> <b>BTL-2,3</b>	



c) Quick Sort 8. Construct an expression tree and print the postfix and prefix using suitable traversal. 9. Create a binary search tree of integers and display the integers in ascending order using a traversal algorithm. 10. Write a C program to implement all the functions of a dictionary (ADT) using hashing. 11. Construct a Minimum spanning Tree using Prim's and Kruskal's algorithm. 12. Construct the shortest path in a graph using Dijkstra's algorithm.		
<b>REFERENCE BOOKS</b>		
1.	Ellis Horowitz, Sahni, Freed, S. (2015). <i>Fundamentals of Data Structures in C</i> , 2nd edition.	
2.	Langsam, Y., Augenstein, M. J. and Tanenbaum, A. M. (2004). <i>Data Structures using C</i> , Pearson Education Asia, 2004.	

## SEMESTER III

COURSE TITLE	PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS			CREDITS	4
COURSE CODE	MAA4201	COURSE CATEGORY	BS	L-T-P-S	3-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	To provide the concepts and the understanding of basics in Partial Differential Equations and Transforms. To give the analytical methods for solving PDEs like applying Separation of Variables to solve elementary problems in linear second order Partial Differential Equations (heat and wave equations).				
Course Objective	1. To be able to solve problems involving partial differential equations. 2. To be able to solve wave and heat equations. 3. To classify and solve 2 dimensional heat equations. 4. To understand and solve problems related to engineering applications by using fourier transform techniques. 5. To clearly understand the discrete transform applied to engineering problems.				

Course Outcome	Upon completion of this course, the students will be able to														
	1. Formulate and solve some of the physical problems involving partial differential equations														
	2. Classify and solve the Wave and Heat equations.														
	3. Classify and solve two-dimensional heat equations.														
	4. Solve problems related to engineering applications by using Fourier Transform techniques.														
5. Gain knowledge on the discrete transform applied to engineering problems.															
Prerequisites: C and C++ Programming Language															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	2	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-2	2	2	-	-	-	-	-	-	-	2	-	-	-	-	-
CO-3	2	2	-	-	-	1	-	-	-	-	-	-	-	-	-
CO-4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: PARTIAL DIFFERENTIAL EQUATIONS (12)															
Formation of partial differential equations by elimination of arbitrary constants, arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange’s linear equation – Linear partial differential equations of second order with constant coefficients.  Suggested Reading: Partial Differentiation  Lab: Solution of standard types of first order partial differential equations													CO-1  BTL-2		
MODULE 2: ONE DIMENSIONAL WAVE AND HEAT FLOW EQUATION (12)															
Classification of second order linear partial differential equations – Solutions of one dimensional wave equation (without proof) – One dimensional heat flow equation (without proof) and application in string and rod problems.  Suggested Reading: Partial Differential Equations, Half range sine series.  Lab: One dimensional wave equation – One dimensional heat flow equation.													CO-2 BTL-2		
MODULE 3: TWO DIMENSIONAL HEAT FLOW EQUATION (12)															
Steady state solution of two-dimensional heat equations and applications in finite plates and infinite plates problems.													CO-3		

<b>Suggested Reading:</b> Partial Differential Equations, Half range sine series. <b>Lab:</b> Two-dimensional heat flow equation.		<b>BTL-3</b>
<b>MODULE 4: FOURIER TRANSFORM</b>		<b>(12)</b>
Fourier Integral Theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of Simple functions – Convolution theorem – Parseval’s identity. <b>Suggested Reading:</b> Basic integration. <b>Lab:</b> Fourier transform problems		<b>CO-4</b> <b>BTL-3</b>
<b>MODULE5: TRANSFORM AND DIFFERENCE EQUATIONS</b>		<b>(12)</b>
Z-Transform – Elementary Properties – Inverse Z-Transform – Convolution theorem – Formation of Difference equations – Solution of difference equations using Z-Transform <b>Suggested Reading:</b> Basic calculus <b>Lab:</b> Z-Transform, Solution of difference equations using Z-Transform		<b>CO-5</b> <b>BTL-2</b>
<b>TEXT BOOKS:</b>		
1.	P. Sivarama Krishna Das, C. Vijayakumari., “Transforms and partial differential equations”, Pearson Publication, 2016.	
2.	Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012..	
3.	Chandrasekaran A, “A Text Book of Transforms and Partial Differential Equations”, Dhanam Publication, 2015	
4.	Raj Kumar Bansal,Ashok Kumar Goel, Manoj Kumar Sharma, “MATLAB and its Applications in Engineering”, Pearson Publication, Second Edition, 2016.	
<b>REFERENCE BOOKS</b>		
1.	Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd , 2007.	
2.	Datta.K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.	
3.	Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.	
4.	Dean G. Duffy., “Advanced Engineering Mathematics with MATLAB”, CRC Press, Third Edition 2013.	
<b>E BOOKS</b>		
1.	<a href="http://nptel.ac.in/courses/122107037/">http://nptel.ac.in/courses/122107037/</a>	
2.	<a href="http://nptel.ac.in/courses/122107037/22">http://nptel.ac.in/courses/122107037/22</a>	
<b>MOOC</b>		
1.	<a href="https://www.mooc-list.com/tags/laplace-transforms">https://www.mooc-list.com/tags/laplace-transforms</a>	
2.	<a href="https://www.edx.org/course/introduction-differential-equations-bux-math226-1x-1">https://www.edx.org/course/introduction-differential-equations-bux-math226-1x-1</a>	

COURSE TITLE	DESIGN AND ANALYSIS OF ALGORITHMS				CREDITS	3									
COURSE CODE	CSB4201	COURSE CATEGORY	PC	L-T-P-S	2- 1- 2- 1										
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3										
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment	Practical Component			ESE										
15%	15%	20%			50%										
Course Description	Algorithms are the soul of computing. This course introduces basic methods for the design and analysis of efficient algorithms emphasizing methods useful in practice. Different algorithms for a given computational task are presented and their relative merits evaluated based on performance measures.														
Course Objective	<div>1. To analyze worst case and average case running times using asymptotic notation.</div> <div>2. To identify limitation of algorithm.</div> <div>3. To get awareness about various algorithmic techniques and real time applications.</div> <div>4. To solve real world problems.</div> <div>5. To identify efficient algorithm for NP hard problems.</div>														
Course Outcome	<div>Upon completion of this course, the students will be able to</div> <div>1. Use the asymptotic notations to analyze worst-case and average case running times of algorithms.</div> <div>2. Identify the limitations of algorithms in problem solving.</div> <div>3. Describe the various algorithmic techniques and its real time applications.</div> <div>4. Solve the real-time problem using graphs.</div> <div>5. Determine an efficient algorithms NP hard problem.</div>														
Prerequisites: C Programming and Data Structures															
CO, PO AND PSO MAPPING															
CO	PO -1	PO -2	PO -3	PO -4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO -3
CO-1	3	3	3	3	1	-	-	-	-	-	-	1	1	1	-
CO-2	3	2	3	3	-	-	-	-	-	2	-	-	1	1	-
CO-3	3	3	3	2	-	1	-	-	-	-	-	-	1	1	-
CO-4	3	3	2	3	-	-	-	-	-	-	-	1	1	1	-
CO-5	2	3	3	3	-	-	-	-	-	-	-	-	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															

<b>MODULE 1: INTRODUCTION (9L+6P)</b>	
<p>Introduction and motivation-Input size, worst case, average case. Quantitative efficiency Big O, Big omega and Big theta-Basic Efficiency classes. Recurrences-The substitution method -The recursion-tree method, and Master method.</p> <p><b>Suggested Activities:</b></p> <ol style="list-style-type: none"> <li>1. Calculate complexity of algorithms using step count method.</li> <li>2. Solve the recurrences using three different methods a) substitution method, b) recursion tree, c) master method</li> </ol> <p><b>Suggested reading:</b><a href="https://onlinecourses.nptel.ac.in/noc18_cs20">https://onlinecourses.nptel.ac.in/noc18_cs20</a></p>	<b>CO-1 BTL-2</b>
<b>MODULE 2: BRUTE FORCE AND DIVIDE-AND-CONQUER (9L+6P)</b>	
<p>Brute Force:- Travelling Salesman Problem - Knapsack Problem - Assignment Problem - Divide and Conquer Approach:- Binary Search - Quick Sort - Merge Sort.</p> <p><b>Suggested Activities:</b></p> <ol style="list-style-type: none"> <li>1. Solve problems using brute force approach and analyze its complexity</li> <li>2. Solve problems using divide and conquer approach and analyze its complexity</li> </ol> <p><b>Suggested reading:</b><a href="https://onlinecourses.nptel.ac.in/noc18_cs20">https://onlinecourses.nptel.ac.in/noc18_cs20</a></p>	<b>CO-2 BTL-2</b>
<b>MODULE 3: GREEDY APPROACH AND DYNAMIC PROGRAMMING(9L+6P)</b>	
<p>Greedy Approach:- An activity-selection problem, Huffman codes. Dynamic Programming:- Matrix-chain multiplication-- Optimal Binary Search Algorithms</p> <p><b>Suggested Activities:</b></p> <ol style="list-style-type: none"> <li>1. Solve problem using Greedy approach and analyze its complexity</li> <li>2. Solve problem using dynamic programming approach and analyze its complexity</li> </ol> <p><b>Suggested reading:</b><a href="https://onlinecourses.nptel.ac.in/noc18_cs20">https://onlinecourses.nptel.ac.in/noc18_cs20</a></p>	<b>CO-3 BTL-3</b>
<b>MODULE 4: GRAPH ALGORITHMS (9L+6P)</b>	
<p>Representing Graphs-Breadth First Search (BFS)-Depth First Search (DFS)- Single source shortest-path-Dijkstra's algorithm-All pair shortest-path algorithm- Floyds and Warshalls algorithm -Minimum cost spanning tree Prim's algorithm-and Kruskal's algorithm.</p> <p><b>Suggested Activities:</b></p> <ol style="list-style-type: none"> <li>1. Implement Single source shortest path algorithm and Analyze its complexity</li> <li>2. Implement All source shortest path algorithm and Analyze its complexity</li> <li>3. Implement Minimum spanning tree algorithm and analyze its complexity</li> </ol> <p><b>Suggested reading :</b><a href="https://onlinecourses.nptel.ac.in/noc18_cs20">https://onlinecourses.nptel.ac.in/noc18_cs20</a></p>	<b>CO-4 BTL-3</b>
<b>MODULE5:Back Tracking AND Approximation Algorithm(9L+6P)</b>	
<p>Backtracking:- 8 Queens - Hamiltonian Circuit Problem - Branch and Bound - Assignment Problem - Knapsack Problem: Intractability: NP completeness- Approximation algorithms for NP-hard problems – Travelling salesman problem – Knapsack problem</p> <p><b>Suggested Activities:</b></p> <ol style="list-style-type: none"> <li>1. Implement Approximation algorithms for Traveling salesman problem and analyze its complexity</li> <li>2. Implement Approximation algorithms for Knapsack problem and analyze its complexity</li> </ol>	<b>CO-5 BTL-3</b>

<b>Suggested reading:</b> <a href="https://www.edutechlearners.com/design-analysis-algorithms">https://www.edutechlearners.com/design-analysis-algorithms</a> .	
<b>TEXT BOOKS</b>	
1.	Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Third Edition, PHI Learning Private Limited, 2012.
<b>REFERENCE BOOKS</b>	
1.	Anany Levitin, “Introduction to the Design and Analysis of Algorithms”,Third Edition, Pearson Education,2017.
2.	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.
3.	Donald E. Knuth, “The Art of Computer Programming”, Volumes 1&3 Pearson Education, 2009. Steven S. Skiena, “The Algorithm Design Manual”, Second Edition, Springer, 2008.
<b>E BOOKS</b>	
1.	<a href="https://www.edutechlearners.com/design-analysis-algorithms">https://www.edutechlearners.com/design-analysis-algorithms</a> .
<b>MOOC</b>	
1.	<a href="https://www.edutechlearners.com/design-analysis-algorithms">https://www.edutechlearners.com/design-analysis-algorithms</a> .

COURSE TITLE	DATABASE MANAGEMENT SYSTEMS			CREDITS	3
COURSE CODE	CSB4202	COURSE CATEGORY	PC	L-T-P-S	3- 0-0- 1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	Focuses on concepts and structures necessary to design and implement a database management system. Various modern data models, data security and integrity, and concurrency are discussed. An SQL database system is designed and implemented as a group project.				
Course Objective	<ol style="list-style-type: none"> <li>1. To Understand the basic concepts of Db systems.</li> <li>2. To know about SQL Queries.</li> <li>3. To Apply the concept of relational DB theory and to write relational algebra expressions for queries.</li> <li>4. To get Awareness about various data storage devices and the types of indexes.</li> <li>5. To be able to demonstrate the Transaction Processing and Concurrency Control.</li> <li>6. To be aware about Object Oriented DB, Distributed Db , XML, Data Warehousing and Mobile database.</li> </ol>				

Course Outcome	Upon completion of this course, the students will be able to 1. Recall the basic concepts of database systems. 2. Identify the SQL Queries for a given scenario. 3. Illustrate relational database theory, and be able to write relational algebra expressions for queries. 4. Demonstrate transaction processing and concurrency control. 5. Explain Object oriented dB, Distributed dB, XML, data warehousing and Mobile database.														
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	1	-	-	-	-	-	-	-	1	-	-
CO-2	3	3	2	-	-	-	-	3	-	2	-	-	1	-	-
CO-3	3	3	2	-	-	1	3	-	-	-	-	-	1	-	-
CO-4	3	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO-5	3	3	2	-	-	-	3	-	-	-	-	-	1	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION AND CONCEPTUAL MODELING (9)															
Introduction to File and Database systems- Database system structure – Data Models – Introduction to Network and Hierarchical Models – ER model – Relational Model – Relational Algebra and Calculus.  Suggested reading : <a href="http://nptel.ac.in/courses/106106093/1">http://nptel.ac.in/courses/106106093/1</a>														CO-1  BTL-2	
MODULE 2: RELATIONAL MODEL (9)															
SQL – Data definition- Queries in SQL- Updates- Views – Integrity and Security – Relational Database design – Functional dependencies and Normalization for Relational Databases (up to BCNF).  Suggested reading : <a href="http://nptel.ac.in/courses/106106093/4">http://nptel.ac.in/courses/106106093/4</a>														CO-2  BTL-3	
MODULE 3: DATA STORAGE AND QUERY PROCESSING(9)															
Record storage and Primary file organization- Secondary storage Devices- Operations on Files- Heap File- Sorted Files- Hashing Techniques – Index Structure for files –Different types of Indexes- B-Tree - B+Tree – Query Processing.  Suggested reading : <a href="http://nptel.ac.in/courses/106106093/11">http://nptel.ac.in/courses/106106093/11</a>														CO-3  BTL-3	

MODULE 4: TRANSACTION MANAGEMENT		(9)
Transaction Processing – Introduction- Need for Concurrency control- Desirable properties of Transaction- Schedule and Recoverability- Serializability and Schedules – Concurrency Control – Types of Locks- Two Phases locking- Deadlock- Recovery Techniques. <b>Suggested reading :</b> <a href="http://nptel.ac.in/courses/106106093/18">http://nptel.ac.in/courses/106106093/18</a>		<b>CO-4</b> <b>BTL-3</b>
MODULE 5: CURRENT TRENDS		(9)
Object Oriented Databases – Need for Complex Data types- OO data Model- Nested relations- Complex Types- Inheritance Reference Types - Distributed databases- Distributed data Storage – Querying and Transformation. – Data Mining and Data Warehousing and Mobile Database. <b>Suggested reading :</b> <a href="http://nptel.ac.in/courses/106106093/31">http://nptel.ac.in/courses/106106093/31</a>		<b>CO-5</b> <b>BTL-3</b>
TEXT BOOKS		
1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan- —Database System Concepts  , Sixth Edition, McGraw-Hill, 2011.	
REFERENCE BOOKS		
1.	Ramez Elmasri and Shamkant B. Navathe, —Fundamental Database Systems  , Seventh Edition, Pearson Education,2016.	
2.	Raghu Ramakrishnan, —Database Management System, Tata McGraw-Hill Publishing Company, Third Edition, 2014.	
3.	Jiawei Han, Micheline Kamber, Jian Pei -Data Mining Concepts and Techniques, Morgan Kaufmann, Third Edition, 2012.	
E BOOKS		
1.	<a href="https://inspirit.net.in/books/database/Database%20System%20Concepts.pdf">https://inspirit.net.in/books/database/Database%20System%20Concepts.pdf</a>	
MOOC		
1.	<a href="https://www.udemy.com/database-management-system/">https://www.udemy.com/database-management-system/</a>	
2.	<a href="https://www.edx.org/course/database-systems-concepts-design-gtx-cs6400x-1">https://www.edx.org/course/database-systems-concepts-design-gtx-cs6400x-1</a>	

COURSE TITLE	JAVA PROGRAMMING			CREDITS	4
COURSE CODE	CSB4203	COURSE CATEGORY	PC	L-T-P-S	3- 0- 2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					



First Periodical Assessment	Second Periodical Assessment	Practical Component				ESE									
15%	15%	20%				50%									
Course Description	This course introduces computer programming using the JAVA programming language with object-oriented programming principles. Emphasis is placed on event-driven programming methods, including creating and manipulating objects, classes, and using object-oriented tools such as the class debugger.														
Course Objective	1. To solve low complexity problems using Java code. 2. To solve medium complexity problems using OO Features in Java. 3. Awareness about Exception Handling in Java. 4. To develop Multi-Threaded Java Applications. 5. To solve IO Related Problems using Java Stream Classes. 6. To learn about GUI based applications using Applets and AWT.														
Course Outcome	Upon completion of this course, the students will be able to 1. Apply Java based code for solving low complexity problems 2. Utilize Object Oriented Features in Java for solving medium complexity problems. 3. Exploit Exception Handling Feature in Java. 4. Develop Multi-Threaded Java Applications. 5. Develop GUI based applications using Applet and AWT														
Prerequisites: C and C++ Programming Language															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	2	2	-	-	1	-	-	-	-	-	-	-	1	1	-
CO-2	2	2	-	-	-	-	-	-	-	2	-	-	1	1	-
CO-3	2	2	-	-	-	1	-	-	-	-	-	-	1	1	-
CO-4	2	2	3	-	-	-	-	-	-	-	-	-	1	1	-
CO-5	2	2	3	-	-	-	-	-	-	-	-	-	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO JAVA and OOP (9L+6P)															
Object-Oriented Languages: Introduction to Java - Importance of Java for the Internet - Byte-code and its Features, Object-Oriented Programming in Java, Java Program Structure and Java Class Library - Data Types - Variables and Operators - Operator Precedence - Selection Statements - Iterative Statement, Defining Classes & Methods – Constructors - Creating Objects of a Class - Assigning object Reference Variables - ‘this’ Keyword - Automatic Garbage Collection. Arrays: Declaration and usage of Arrays - Arrays of Characters, String: String as a class - String Handling Using String Class - Operations on String.														CO-1 BTL-2	

<b>Practical Component:</b> <ol style="list-style-type: none"> <li>1. a) Write a program to print the individual digits of any 3-digit number. b) Write a program to read N numbers and find the largest and smallest numbers.</li> <li>2. Write a program to read an email as input and verify whether the email is in the correct <b>format</b> (<b>***@***.***</b>) using String functions</li> </ol> <p>Write a program to display total marks of 5 students using student class. Given the following attributes: Regno(int), Name(string), Marks in subjects(Integer Array), Total (int).</p>	
<b>MODULE 2: INHERITANCE, PACKAGES AND INTERFACE(9L+6P)</b>	
<p>Inheritance - Inheriting Classes- Type of Inheritance, Polymorphism - Overloading – Overriding, Abstract Classes - Access Modifier: Final.</p> <p>Package - Understanding Packages - Defining a package - Packaging up multiple classes - Importing and Using Packages - Understanding CLASSPATH - Standard Packages - Access Protection in Packages, Scope of Variable - Access specifiers - Using Inbuilt packages.</p> <p>Interfaces - Declaring Interfaces - Implementing Interfaces - Using inbuilt interfaces.</p> <b>Practical Component:</b> <ol style="list-style-type: none"> <li>1. Write a program to create a player class. Inherit the classes Cricket_player, Football_player and Hockey_player form player class.</li> <li>2. Write a program to show how a class implements two interfaces.</li> <li>3. Write a program to create a package for Book details giving Book Name, Author Name, Price, year of publishing</li> </ol>	<b>CO-2</b> <b>BTL-3</b>
<b>MODULE 3: EXCEPTION HANDLING AND MULTITHREADING(9L+6P)</b>	
<p>Exception Handling - The concept of Exceptions in Java - Types of Exceptions - Exception Objects - Try - Catch and Finally blocks - Multiple Catch blocks - Understanding 'Throws' and 'Throw' - Defining Your Own Exceptions.</p> <p>Multithreading Programming - The Java Thread Model, Understanding Threads - The Main Thread - Creating a Thread - Creating Multiple Threads - Thread Priorities – Synchronization - Inter thread communication - Deadlocks.</p> <b>Practical Component:</b> <ol style="list-style-type: none"> <li>1. Write a Java program to catch more than one exception.</li> <li>2. Write a Java program for generating two threads, one for printing even umbers and other for printing odd numbers.</li> <li>3. Write a Java program for producer and consumer problem using Thread.</li> </ol>	<b>CO-3</b> <b>BTL-3</b>
<b>MODULE 4: INPUT/OUTPUT STREAMS (9L+6P)</b>	
<p>Input/Output in Java - I/O Basic - Byte Streams - Character Streams- Stream Chaining – Reading and writing to Console - Reading and Writing on Files - Special Streams – Input Stream Reader and Output Stream Writer – Pushback Input Streams.</p> <b>Practical Component:</b> <ol style="list-style-type: none"> <li>1. Write a java program to copy the contents of one file to another file.</li> <li>2. Write a Java program to read input from the standard input and write to a byte array</li> </ol>	<b>CO-4</b> <b>BTL-3</b>
<b>MODULE5: Working With AWT Classes Swing, Applet And Graphics (9L+6P)</b>	
<p>AWT Classes- AWT Controls - Applet Basics - Applet Architecture - Applet Life Cycle - Paint and Repaint methods - Swing – Swing Components, Working with Graphics and Texts - Working with Colours and Font – Event Handling – Adapter Classes.</p> <b>Practical Component:</b>	<b>CO-5</b> <b>BTL-3</b>

1.Create an Applet to read the RGB components as input and create an appropriate colour using the RGB values. Fill a rectangle using the obtained colour.		
2.Create an applet for simple calculator to perform Addition, Subtraction, Multiplication and Division using Button, label and Text field classes		
TEXT BOOKS		
1.	Herbert Schildt, “JAVA The Complete Reference”, 10 <sup>th</sup> Edition, McGraw Hill Education, 2017.	
2.	Cay S. Horstman and Gary Cornell,“Core Java Volume I—Fundamentals”, 11th Edition, Prentice Hall, 2018.	
REFERENCE BOOKS		
1.	Cay Horstman, “Big Java: Early Objects”, 6 <sup>th</sup> Edition, Wiley Publications, 2016	
2.	Ken Arnold, James Gosling, and David Holmes, “The Java Programming Language”, 4th edition, Addison-Wesley, 2005.	
E BOOKS		
1.	<a href="https://zimslifeintcs.files.wordpress.com/2011/12/java-2-the-complete-reference-5th-ed-herbert-schildt.pdf">https://zimslifeintcs.files.wordpress.com/2011/12/java-2-the-complete-reference-5th-ed-herbert-schildt.pdf</a>	
MOOC		
1.	<a href="https://onlinecourses.nptel.ac.in/noc19_cs07/">https://onlinecourses.nptel.ac.in/noc19_cs07/</a>	
2.	<a href="https://www.coursera.org/learn/java-programming">https://www.coursera.org/learn/java-programming</a> <a href="https://www.coursera.org/specializations/object-oriented-programming">https://www.coursera.org/specializations/object-oriented-programming</a>	

COURSE TITLE	PYTHON PROGRAMMING LAB			CREDITS	1
COURSE CODE	CSB4231	COURSE CATEGORY	PC	L-T-P-S	0-0-3-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
Continuous Internal Assessment				ESE	
80%				20%	
Course Description	Python is a highly productive scripting language that can be used in almost all use cases. The students will be shown the different approaches to invoking and executing Python scripts. Also, they will be required to complete each of the following Python coding exercises.				

<b>Course Objective</b>	1. To be able to Identify and execute basic syntax and programs in Python . 2. To be able to solve problems using Python built-in data types and their methods. 3. To classify and Create user-defined functions and modules. 4. To understand and Implement exception and file handling operations. 5. To Design an application using OOP concept in Python.																								
<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. Identify and execute basic syntax and programs in Python. 2. Solve problems using Python built-in data types and their methods. 3. Create user-defined functions and modules. 4. Implement exception and file handling operations. 5. Design an application using OOP concept in Python.																								
<b>Prerequisites: -</b>																									
<b>CO, PO AND PSO MAPPING</b>																									
<b>CO</b>	<b>PO -1</b>	<b>PO- 2</b>	<b>PO- 3</b>	<b>PO- 4</b>	<b>PO- 5</b>	<b>PO- 6</b>	<b>PO- 7</b>	<b>PO- 8</b>	<b>PO- 9</b>	<b>PO -10</b>	<b>PO- 11</b>	<b>PO- 12</b>	<b>PSO- 1</b>	<b>PSO- 2</b>	<b>PSO- 3</b>										
CO-1	2	2	-	-	1	-	-	-	-	-	-	-	-	-	-										
CO-2	2	2	-	-	-	-	-	-	-	2	-	-	-	-	-										
CO-3	2	2	2	-	-	1	-	-	-	-	-	-	-	-	-										
CO-4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-										
CO-5	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-										
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>																									
<b>LIST OF EXPERIMENTS:</b>																									
1. Basic Python programs for reading input from console. a) Calculate area of a circle by prompting the user to enter radius value. b) Compute average of three numbers using simultaneous assignment. c) Convert pounds into kilograms by reading input value in pounds (One pound is 0.454 kilograms).																									
2. Python built-in data types – Numeric, Sequences (String, List, Tuple), Set and Dictionary-Operations and type conversions.																									
3. Programs using the Decision statements. a) Write a program that prompts the user to enter a weight value in kilogram and height in metres and then display and interpret the BMI (BMI=weight/height*height).																									
<table><tr><td>BMI</td><td>Interpretation</td></tr><tr><td>Below 18.5</td><td>Underweight</td></tr><tr><td>18.5–24.9</td><td>Normal</td></tr><tr><td>25.0–29.9</td><td>Overweight</td></tr><tr><td>Above 30.0</td><td>Obese</td></tr></table>																BMI	Interpretation	Below 18.5	Underweight	18.5–24.9	Normal	25.0–29.9	Overweight	Above 30.0	Obese
BMI	Interpretation																								
Below 18.5	Underweight																								
18.5–24.9	Normal																								
25.0–29.9	Overweight																								
Above 30.0	Obese																								
b) Check whether the given triangle is equilateral, isosceles or scalene. (Note: An equilateral triangle has three equal sides; A scalene triangle has three unequal sides.																									

An isosceles triangle has (at least) two equal sides).

4. Programs using Looping and Loop Control statements.
  - a) Print those numbers which are divisible by 7 and multiple of 5, between 75 and 200.
  - b) Prints all the numbers from 0 to 10 except 3 ,6 and 9.  
Expected Output: 0 1 2 4 5 7 8 9 10
  - c) Print a list in reverse order (from last to first item) using while and for loops
  - d) Generate Fibonacci series for a given number.
5. Programs for math operations and random number generation.
  - a) Compute area of a triangle, given three sides using math module.
  - b) Generate 50 random numbers from a given range of values, using random module.
  - c) Design a quiz for multiplication of two numbers, where the input (two numbers) is generated randomly and the user is prompted to enter an answer.
6. Basic programs using the following Python built-in data types and their methods- String, List, Tuple, Set and Dictionary.
  - a) Count the number of characters in a given word.
  - b) Remove duplicate words from a given string.
  - c) Count the occurrences of the substring in a given string.
  - d) Implement linear search and binary search using list.
  - e) Matrix operations using Nested List.
  - f) Read employee salary details and calculate gross salary based on overtime hours using tuple. Assume the employer pays Rs. 250 for every extra hour.
  - g) Create and read a dictionary and count the number of values that appear for more than once.
  - h) Create a dictionary comprising of countries and their corresponding capital cities. Prompt the user to enter a country and display the corresponding capital city.
  - i) Perform union, intersection and difference operations using set.
7. Programs using user-defined functions with different types of function arguments.
  - a) Check whether a given number is Prime or not using function.
  - b) Read two numbers and return in ascending order using function (returning multiple values).
  - c) Create a simple calculator that can add, subtract, multiply and divide using functions.
  - d) Implement pass by value and pass by reference.
8. Python programs using Time and Calendar related functions.
  - a) Print the current time using time module.
  - b) Calculate the processing time of any function using time module.
  - c) Display the calendar of given month of the year using calendar module.
9. Creating packages and importing modules from packages.
10. Python programs for File manipulations.
  - a) Count the number of lines in the given file.
  - b) Copy the contents of file1 to file2 and display the contents of both on the screen.
11. Exception Handling and creating user-defined Exceptions.
12. Basic Python programs for Class declaration and Object creation.

- a) Design a class named Rectangle with two data fields' width and height. Define two separate methods each for calculating area and perimeter of rectangle. Read the width and height and display area and perimeter for two Rectangle objects.
- b) Design a class named Account with data fields id, balance and annualInterestRate. Define methods for calculating monthly interest rate and monthly interest. Read the data fields and display monthly interest rate, and monthly interest for at least two Account objects.

13. Python programs using inheritance.

#### REFERENCE BOOKS

1.	Y. Daniel Liang, "Introduction to Programming using Python", Pearson, 2012.
2.	Wesley J. Chun, "Core Python Programming", Prentice Hall, 2006.

#### E BOOKS

1.	<a href="https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf">https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf</a>
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#### MOOC

1.	<a href="https://www.edx.org/learn/python">https://www.edx.org/learn/python</a>
2.	<a href="https://www.coursera.org/learn/python">https://www.coursera.org/learn/python</a>

COURSE TITLE	DATABASE MANAGEMENT SYSTEMS LAB			CREDITS	1
COURSE CODE	CSB4232	COURSE CATEGORY	PC	L-T-P-S	0- 0- 3- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3

#### ASSESSMENT SCHEME

Continuous Internal Assessment				ESE	
80%				20%	

Course Description	Students get practical knowledge on designing and creating relational database systems. Understand various advanced queries execution such as relational constraints, joins, set operations, aggregate functions, trigger, views and embedded SQL.
Course Objective	<ol style="list-style-type: none"> <li>1. To be able to query a database using SQL commands.</li> <li>2. To be able to Declare and enforce integrity constraints on a database using a state-of-the-art RDBMS.</li> <li>3. To classify and Implementing Indexing on table.</li> <li>4. To understand and Implement Programming PL/SQL including stored procedures, stored functions, cursors, packages.</li> <li>5. To Solve basic issues of simple database applications and construct a real time database application using current techniques.</li> </ol>

Course Outcome	Upon completion of this course, the students will be able to														
	1. Populate and query a database using SQL commands.														
	2. Declare and enforce integrity constraints on a database using a state-of-the-art RDBMS.														
	3. Implementing Indexing on table.														
	4. Programming PL/SQL including stored procedures, stored functions, cursors, packages.														
5. Solve basic issues of simple database applications and construct a real time database application using current techniques.															
Prerequisites: -															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO-3	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO-4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
LIST OF EXPERIMENTS:															
1. To study Basic SQL commands (create table, use , drop, insert) and execute the following queries using these commands: (CO1) <ul style="list-style-type: none"><li>Create a table 'Emp' with attributes 'ename','ecity','salary','enumber','eaddress','deptname'.</li><li>Create another table 'Company' with attributes 'cname', 'ccity','empnumber' in the database 'Employee'.</li></ul>															
2. To study the viewing commands (select , update) and execute the following queries using these commands: <ul style="list-style-type: none"><li>Find the names of all employees who live in Delhi.</li><li>Increase the salary of all employees by Rs. 5,000.</li><li>Find the company names where the number of employees is greater than 10,000.</li><li>Change the Company City to Gurgaon where the Company name is 'TCS'.</li></ul>															
3. To study the commands to modify the structure of table (alter, delete) and execute the following queries using these commands: <ul style="list-style-type: none"><li>Add an attribute named ' Designation' to the table 'Emp'.</li><li>Modify the table 'Emp', Change the datatype of 'salary' attribute to float.</li><li>Drop the attribute 'deptname' from the table 'emp'.</li><li>Delete the entries from the table ' Company' where the number of employees are less than 500.</li></ul>															

4. To study the commands that involve compound conditions (and, or, in , not in, between , not between , like , not like) and execute the following queries using these commands:
  - Find the names of all employees who live in 'Gurgaon' and whose salary is between Rs. 20,000 and Rs. 30,000.
  - Find the names of all employees whose names begin with either letter 'A' or 'B'.
  - Find the company names where the company city is 'Delhi' and the number of employees is not between 5000 and 10,000.
  - Find the names of all companies that do not end with letter 'A'.
5. To study the aggregate functions (sum, count, max, min, average) and execute the following queries using these commands:
  - Find the sum and average of salaries of all employees in computer science department.
  - Find the number of all employees who live in Delhi.
  - Find the maximum and the minimum salary in the HR department.
6. To study the grouping commands (group by, order by) and execute the following queries using these commands:
  - List all employee names in descending order.
  - Find number of employees in each department where number of employees is greater than 5.
  - List all the department names where average salary of a department is Rs.10,000.
7. To study the commands involving data constraints and execute the following queries using these commands:
  - Alter table 'Emp' and make 'enumber' as the primary key.
  - Alter table 'Company' and add the foreign key constraint.
  - Add a check constraint in the table 'Emp' such that salary has the value between 0 and Rs.1,00,000
  - Alter table 'Company' and add unique constraint to column cname
  - Add a default constraint to column ccity of table company with the value 'Delhi'
8. To study the commands for joins ( cross join, inner join, outer join) and execute the following queries using these commands:
  - Retrieve the complete record of an employee and its company from both the table using joins.
  - List all the employees working in the company 'TCS'.
9. To study the various set operations and execute the following queries using these commands:
  - List the enumber of all employees who live in Delhi and whose company is in Gurgaon or if both conditions are true.
  - List the enumber of all employees who live in Delhi but whose company is not in Gurgaon.
10. To study the various scalar functions and string functions ( power, square, substring, reverse, upper, lower, concatenation) and execute the following queries using these commands:
  - Reverse the names of all employees.
  - Change the names of company cities to uppercase.
  - Concatenate name and city of the employee.
11. To study the commands involving indexes and execute the following queries:
  - Create an index with attribute ename on the table employee.



- Create a composite index with attributes cname and ccity on table company.
- Drop all indexes created on table company.

12. To study the conditional controls and case statement in PL-SQL and execute the following queries:

- Calculate the average salary from table 'Emp' and print increase the salary if the average salary is less than 10,000.
- Display the deptno from the employee table using the case statement if the deptname is 'Technical' then deptno is 1, if the deptname is 'HR' then the deptno is 2 else deptno is 3.

13. To study procedures and triggers in PL-SQL and execute the following queries:

- Create a procedure on table employee to display the details of employee to display the details of employees by providing them value of salaries during execution.
- Create a trigger on table company for deletion where the whole table is displayed when delete operation is performed.

14. Consider the tables given below. The primary keys are made bold and the data types are specified.

PERSON( driver\_id:string , name:string , address:string )

CAR( regno:string , model:string , year:int )

ACCIDENT( report\_number:int , accd\_date:date , location:string )

OWNS( driver\_id:string , regno:string )

PARTICIPATED( driver\_id:string , regno:string , report\_number:int , damage\_amount:int)

- Create the above tables by properly specifying the primary keys and foreign keys.
- Enter at least five tuples for each relation.
- Demonstrate how you
  - Update the damage amount for the car with specific regno in the accident with report number 12 to 25000.
- Find the total number of people who owned cars that were involved in accidents in the year 2008.

Find the number of accidents in which cars belonging to a specific model were involved.

#### TEXT BOOKS

- |    |  |
|----|--|
| 1. | Abraham Silberschatz, Henry F. Korth and S. Sudarshan- "Database System Concepts", Sixth Edition, McGraw-Hill, 2011. |
|----|--|

#### REFERENCE BOOKS

- |    |   |
|----|---|
| 1. | Ramez Elmasri and Shamkant B. Navathe, "Fundamental Database Systems", Seventh Edition, Pearson Education, 2016 |
|----|---|

#### SEMESTER IV

COURSE TITLE	DISCRETE MATHEMATICS			CREDITS	4
COURSE CODE	MAA4219	COURSE CATEGORY	BS	L-T-P-S	3-1-0-0

Version		1.0		Approval Details				LEARNING LEVEL		BTL-3					
ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment		Seminar/ Assignments/ Project		Surprise Test / Quiz		Attendance		ESE					
15%		15%		10%		5%		5%		50%					
Course Description		The course covers aim to imbibe the concepts of discrete mathematics for computer science students. The course covers the basic concepts like combinatorics and Graphs which will useful for students in developing algorithms and solve various real-life problems.													
Course Objective		1. To determine the argument’s validity through arguments using logical notations. 2. To gain knowledge the ideas of permutations and combinations. 3. To comprehend relations and functions 4. To recognize the principles of the group theory. 5. To model problems in computer science using Graphs.													
Course Outcome		Upon completion of this course, the students will be able to 1. Write arguments using logical notation and determine if the argument is valid or not valid. 2. Use permutations and combinations for various problems. 3. Solve problems of relations and functions 4. Use the principles of the group theory in problem. 5. Apply graph concept in solving problems in computer science.													
Prerequisites:Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	-	-	3	-	-	-	-	-	3	-	-
CO-2	3	3	3	3	-	2	-	-	-	-	-	-	3	-	-
CO-3	3	2	3	3	-	-	3	-	-	-	-	-	3	-	-
CO-4	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO-5	-	3	2	-	-	-	-	-	-	-	-	-	3	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: LOGICS AND PROOFS (12)															

Propositions – Logical connectives – Compound propositions – Conditional and bi-conditional propositions – Truth tables – Tautologies and contradictions – Contra positive – Logic equivalences and implications. Predicates – Statement function – Variables – Free and bound variables – Quantifiers – Universe of discourse – Logical equivalences and implications for quantified statements. <b>Suggested Reading:</b> Basics of logical operators	<b>CO-1 BTL-3</b>
<b>MODULE 2: COMBINATORICS(12)</b>	
Mathematical Induction-Strong induction and well ordering – the basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – inclusion and exclusion and applications. <b>Suggested Reading:</b> Basics of probability	<b>CO-2 BTL-3</b>
<b>MODULE 3: SETS AND FUNCTIONS (12)</b>	
Sets: Relations on sets – Types of relations and their properties – Partitions – Equivalence relations – Partial ordering – Poset – Hasse diagram. Functions: Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions. <b>Suggested Reading:</b> Basic concepts of sets and Functions	<b>CO-3 BTL-3</b>
<b>MODULE 4: ALGEBRAIC SYSTEMS (12)</b>	
Groups, Cyclic Groups, Subgroups, Cosets, Lagrange's theorem, Normal subgroups – Codes and group codes – Decodes. <b>Suggested Reading:</b> Basics of Groups	<b>CO-4 BTL-3</b>
<b>MODULE 5: GRAPHS (12)</b>	
Graphs and graphs models – Graph terminology and special types of graphs – Representing graphs and graph isomorphism – connectivity – Euler and Hamilton paths. <b>Suggested Reading:</b> Basics of Graphs	<b>CO-5 BTL-3</b>
<b>TEXT BOOKS</b>	
1.	A. Singaravelu, M. P. Jeyaraman, "Discrete Mathematics", Meenakshi Agency, 2013.
2.	Kenneth H. Roshan, "Discrete Mathematics and its Applications", Tata McGraw Hill, 2011.
<b>REFERENCE BOOKS</b>	
1.	Tremblay J.P and Monohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, 2003.
2.	Trivedi.K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2nd Edition, 2002.
3.	J. A. Bondy and U.S.R Murty, "Graph Theory", Springer, 2008.
<b>E BOOKS</b>	
1.	<a href="http://nptel.ac.in/courses/106106094/">http://nptel.ac.in/courses/106106094/</a>
2.	<a href="https://onlinecourses.nptel.ac.in/noc16_ma01/preview">https://onlinecourses.nptel.ac.in/noc16_ma01/preview</a>

MOOC	
1.	<a href="https://www.edx.org/course/understanding-queues">https://www.edx.org/course/understanding-queues</a>

COURSE TITLE	COMPUTER ORGANIZATION AND ARCHITECTURE			CREDITS	3
COURSE CODE	CSB4216	COURSE CATEGORY	PC	L-T-P-C	3- 0- 0- 1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3

## ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

<b>Course Description</b>	This course introduces the principles of computer organization and the basic architecture concepts.
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. Recall the basic structure and operation of a computer system.</li> <li>2. Familiarize with arithmetic and logic unit and implementation of different arithmetic operations.</li> <li>3. Explain the concept of pipelining and parallelism.</li> <li>4. Know the difference between Cache and Virtual memory and related performance issues.</li> <li>5. Demonstrate different ways of communicating with I/O devices and standard I/O interfaces.</li> </ol>
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Recall the basic structure and operation of a computer system.</li> <li>2. Familiarize with arithmetic and logic unit and implementation of different arithmetic operations.</li> <li>3. Explain the concept of pipelining and parallelism.</li> <li>4. Know the difference between Cache and Virtual memory and related performance issues.</li> <li>5. Demonstrate different ways of communicating with I/O devices and standard I/O interfaces.</li> </ol>

Prerequisites:

## CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	1	2	-	1	-	-	-	-	-	-	-	1	1	1	-
CO-2	2	2	2	-	-	-	-	-	-	2	-	-	1	1	-
CO-3	2	2	1	-	-	1	-	-	-	-	-	-	1	1	-
CO-4	2	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO-5	2	2	3	-	-	-	-	-	-	-	-	-	1	1	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: INTRODUCTION</b>														<b>(9)</b>	
Eight ideas – Components of a computer system – Technology – Performance – Power wall –Uniprocessors to multiprocessors; Instructions – operations and operands – representing instructions – Addressing and addressing modes.														<b>CO-1 BTL-2</b>	
<b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106102062/1">http://nptel.ac.in/courses/106102062/1</a>															
<b>MODULE 2: ARITHMETIC FOR COMPUTERS</b>														<b>(9)</b>	
ALU - Integer Addition, Integer Subtraction, Dealing/Detecting with Overflow -Designing ALU for MIPS, Multiplication- Multiply Algorithm-Optimized Multiplier-Faster Multiplier, Division-Divide Algorithm-Optimized Divider – Floating Point operations-Standard- IEEE Floating-Point Format.														<b>CO-2 BTL-2</b>	
<b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106102062/4">http://nptel.ac.in/courses/106102062/4</a>															
<b>MODULE 3: MIPS &amp; PIPELINING</b>														<b>(9)</b>	
Basic MIPS implementation – Building data path – Control Implementation scheme – Pipelining – Pipelined data path and control – Handling Data hazards & Control hazards – Exceptions.														<b>CO-3 BTL-3</b>	
<b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106102062/22">http://nptel.ac.in/courses/106102062/22</a>															
<b>MODULE 4 - INSTRUCTION-LEVEL PARALLELISM</b>														<b>(9)</b>	
Instruction-level-parallelism – Parallel processing challenges – Flynn's classification – Hardware multithreading – Multicore processors.														<b>CO-4 BTL-2</b>	
<b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106102062/24">http://nptel.ac.in/courses/106102062/24</a>															
<b>MODULE 5 – MEMORY AND I/O</b>														<b>(9)</b>	
Memory hierarchy - Cache Memory - Virtual memory, TLBs - Input/output system, programmed I/O, DMA and interrupts, I/O processors.														<b>CO-5 BTL-2</b>	
<b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106102062/29">http://nptel.ac.in/courses/106102062/29</a>															

TEXT BOOKS	
1.	David A. Patterson and John L. Hennessy, “Computer organization and design”, Morgan Kaufmann / Elsevier, Fifth edition, 2013.
REFERENCE BOOKS	
1.	William Stallings, “Computer Organization and Architecture”, Tenth Edition, Pearson Education, 2016.
2.	V. Carl Hamacher, Zvonko G. Varanescic and Safat G. Zaky, “Computer Organisation”, VI th edition, Mc Graw-Hill Inc, 2012.
3.	Vincent P. Heuring, Harry F. Jordan, “Computer System Architecture”, Second Edition, Pearson Education, 2005.
E BOOKS	
1.	<a href="https://sites.google.com/site/uopcog/ebooks">https://sites.google.com/site/uopcog/ebooks</a>
2.	<a href="https://inspirit.net.in/books/academic/Computer%20Organisation%20and%20Architecture%208e%20by%20William%20Stallings.pdf">https://inspirit.net.in/books/academic/Computer%20Organisation%20and%20Architecture%208e%20by%20William%20Stallings.pdf</a>
MOOC	
1.	<a href="https://www.mooc-list.com/course/computer-architecture-coursera">https://www.mooc-list.com/course/computer-architecture-coursera</a>
2.	<a href="https://www.mooc-list.com/course/fundamentals-computer-architecture-coursera">https://www.mooc-list.com/course/fundamentals-computer-architecture-coursera</a>
3.	<a href="http://nptel.ac.in/courses/106102062/">http://nptel.ac.in/courses/106102062/</a>
4.	<a href="http://nptel.ac.in/courses/106103068/">http://nptel.ac.in/courses/106103068/</a>

COURSE TITLE	COMPUTER NETWORKS			CREDITS	3
COURSE CODE	CSB4217	COURSE CATEGORY	PC	L-T-P-S	3-0-0-1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course focuses on interconnecting computers to share data and resources. The theoretical models, concepts and real-time implementations behind networking were included.				

<b>Course Objective</b>	1. To learn the functions of computer networks and various layered architectures 2. To comprehend physical and data link layer protocols and functionalities. 3. To elaborate Network Layer functionalities. 4. To learn the transport layer protocols and functionalities. 5. To understand the application layer protocols and functionalities. 6. To understand the real time protocol stack.														
<b>Course Outcome</b>	Upon completion of this course, the students will be able to  1. Identify the protocols running on various OSI layers. 2. Illustrate the various flow and error control techniques and identify the best method for efficient data transmission. 3. Analyze various routing algorithms and apply subnetting for a network. 4. Implement simple client-server applications using TCP and UDP 5. Identify the various application layer protocols and the appropriate application.														
<b>Prerequisites: Digital Concepts</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO -1</b>	<b>PO- 2</b>	<b>PO- 3</b>	<b>PO- 4</b>	<b>PO- 5</b>	<b>PO- 6</b>	<b>PO- 7</b>	<b>PO- 8</b>	<b>PO- 9</b>	<b>PO -10</b>	<b>PO -11</b>	<b>PO -12</b>	<b>PSO -1</b>	<b>PSO -2</b>	<b>PSO -3</b>
CO-1	2	3	-	-	-	-	-	-	-	-	-	-	1	2	-
CO-2	2	3	-	-	-	-	-	-	-	-	-	-	1	2	-
CO-3	2	3	-	-	2	-	-	-	-	-	-	3	1	2	-
CO-4	2	3	3	-	2	-	-	-	-	-	-	-	1	2	-
CO-5	2	3	3	-	-	-	-	-	-	-	-	-	1	2	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: DATA COMMUNICATIONS</b>														<b>(9)</b>	
Components – Direction of Data flow – networks – Components and Categories – types of Connections – Topologies –Protocols and Standards – ISO / OSI model – Transmission Media – Coaxial Cable – Fiber Optics – Line Coding – Modems.  <b>Suggested Reading:</b> <a href="http://nptel.ac.in/courses/106105080/">http://nptel.ac.in/courses/106105080/</a>														<b>CO-1</b>  <b>BTL-3</b>	
<b>MODULE 2: PHYSICAL LAYER AND DATA LINK LAYER</b>														<b>(9)</b>	
Error – detection and correction – Parity – LRC – CRC – Hamming code – Flow Control and Error control - stop and wait – ARQ – selective repeat ARQ- sliding window – HDLC. Ethernet IEEE 802.3 - IEEE 802.11  <b>Suggested Reading:</b> <a href="http://nptel.ac.in/courses/106106091/">http://nptel.ac.in/courses/106106091/</a>														<b>CO-2</b>  <b>BTL-3</b>	
<b>MODULE 3: NETWORK LAYER</b>														<b>(9)</b>	

Internetworks – Packet Switching and Datagram approach – IP addressing methods – Subnetting – Routing – Distance Vector Routing – Link State Routing – Broadcast and Multicast routing  <b>Suggested Reading:</b> nptel.ac.in/courses/106105084/6		<b>CO-3</b> <b>BTL-3</b>
<b>MODULE 4: TRANSPORT LAYER</b> (9)		
Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QOS)  <b>Suggested Reading:</b> nptel.ac.in/courses/106105082/35		<b>CO-4</b> <b>BTL-2</b>
<b>MODULE 5: APPLICATION LAYER</b> (9)		
Domain Name Space (DNS) – SMTP – FTP – HTTP - WWW -Security: Services -Cryptography – Public key Cryptosystems.  <b>Suggested Reading:</b> nptel.ac.in/courses/106105080/32		<b>CO-5</b> <b>BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Behrouz A. Forouzan, “Data communication and Networking”, 5th Ed., Tata McGraw Hill, 2015.	
<b>REFERENCE BOOKS</b>		
1.	James F. Kurose and Keith W. Ross, “Computer Networking: A Top-Down Approach Featuring the Internet”, 5th Ed., Pearson Education, 2013.	
2.	L.Peterson and Peter S. Davie, “Computer Networks”, 5th Ed., Morgan Kaufmann, 2011.	
3.	Andrew S. Tanenbaum, “Computer Networks”, 5th Ed., Prentice Hall, 2011.	
4.	William Stallings, “Data and Computer Communication”, 8th Ed., Pearson, 2007.	
5.	William Stallings, “Cryptography And Network Security – Principles and Practices”, Prentice Hall of India, Fourth Edition, 2005	
<b>E BOOKS</b>		
1.	<a href="https://ia800400.us.archive.org/31/items/Data.Communications.and.Networking.5th.Edition/Data.Communications.and.Networking.5th.Edition.pdf">https://ia800400.us.archive.org/31/items/Data.Communications.and.Networking.5th.Edition/Data.Communications.and.Networking.5th.Edition.pdf</a>	
<b>MOOC</b>		
1.	<a href="https://www.coursera.org/learn/fundamentals-network-communications">https://www.coursera.org/learn/fundamentals-network-communications</a>	
2.	<a href="https://www.udemy.com/computer-networks-course-networking-basics/">https://www.udemy.com/computer-networks-course-networking-basics/</a>	

COURSE TITLE	OPERATING SYSTEMS			CREDITS	3
COURSE CODE	CSB4218	COURSE CATEGORY	PC	L-T-P-S	3-0-0-1



Version	1.0	Approval Details		LEARNING LEVEL	BTL-3										
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE										
15%	15%	10%	5%	5%	50%										
Course Description	This is core course of Computer Science and Engineering and focuses on Operating System concepts.														
Course Objective	1. To understand the basic functions and structure of operating systems 2. To understand process scheduling and synchronization 3. To gain knowledge of dead lock relates issues in OS 4. To understand various memory management techniques 5. To comprehend the File system and disk I/O techniques														
Course Outcome	Upon completion of this course, the students will be able to  1. Explain the basic functions and structure of operating systems. 2. Implement the process scheduling algorithms and process synchronization techniques. 3. Detect and solve Deadlock problems. 4. Implement Memory Management Techniques. 5. Illustrate File system and disk I/O techniques.														
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	-	2	-	1	-	-	-	-	-	2	3	-
CO-2	3	3	3	-	-	-	-	-	-	-	-	-	2	3	1
CO-3	3	3	3	1	-	-	2	-	-	-	-	-	2	3	1
CO-4	3	3	3	-	-	1	-	-	2	-	-	-	2	3	1
CO-5	3	3	3	-	-	2	-	-	-	-	-	-	2	3	1
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION (9)															

Introduction – Computer System Organization - Computer System Architecture - Computer System Structure - Operating System Operations - Process Management – Memory Management - Storage Management – Protection Security - Operating System Services – User Operating System Interface – System Calls – Types of System calls – System Programs - Process Concept – Process Scheduling – Operations on Processes - Inter-process Communication  <b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106106144/">http://nptel.ac.in/courses/106106144/</a>		<b>CO-1</b>  <b>BTL-2</b>
<b>MODULE 2: PROCESS SCHEDULING (9)</b>		
Threads – Overview – Multithreading Models - CPU Scheduling – Basic Concepts – Scheduling Criteria – Scheduling Algorithms – The Critical-Section Problem - Peterson’s Solution – Synchronization Hardware – Semaphores – Classic problems of Synchronization – Monitors.  <b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106106144/19">http://nptel.ac.in/courses/106106144/19</a>		<b>CO-2</b>  <b>BTL-3</b>
<b>MODULE 3: DEADLOCKS (9)</b>		
System Model – Deadlock Characterization – Methods for handling Deadlocks -Deadlock Prevention – Deadlock avoidance – Deadlock detection – Recovery from Deadlocks - Storage Management – Swapping – Contiguous Memory allocation – Paging – Structure of Page table - Segmentation.  <b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106106144/32">http://nptel.ac.in/courses/106106144/32</a>		<b>CO-3</b>  <b>BTL-3</b>
<b>MODULE 4: PAGING AND FILE SYSTEM (9)</b>		
Virtual Memory – Demand Paging – Copy-on Write – Page Replacement – Allocation of frames – Thrashing - File Concept – Access Methods – Directory and Disk Structure – Directory Implementation – Allocation Methods – Free-space Management - Disk Structure – Disk Attachment - Disk Scheduling - RAID Structure.  <b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106106144/6">http://nptel.ac.in/courses/106106144/6</a>		<b>CO-4</b>  <b>BTL-3</b>
<b>MODULE 5: DISTRIBUTED SYSTEMS (9)</b>		
Advantages of Distributed Systems - Types of Network based Operating Systems - Network Structure - Communication Structure -Communication Protocols – TCP/IP - Robustness - Design Issues - Distributed File Systems  <b>Suggested reading:</b> <a href="https://onlinecourses.nptel.ac.in/noc17_cs42/">https://onlinecourses.nptel.ac.in/noc17_cs42/</a>		<b>CO-5</b>  <b>BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, Ninth Edition, 2013.	
<b>REFERENCE BOOKS</b>		
1.	Harvey M. Deitel, “Operating Systems”, Third Edition, Pearson Education, 2004.	
2.	William Stallings, “Operating System”, Ninth Edition, Pearson Education, 2018.	

3.	Andrew S. Tanenbaum, “Modern Operating Systems”, 4 <sup>th</sup> Edition, Pearson Education, 2016.
<b>E BOOKS</b>	
1.	<a href="https://www.goodreads.com/book/show/83833.Operating_System_Concepts">https://www.goodreads.com/book/show/83833.Operating_System_Concepts</a>
<b>MOOC</b>	
1.	<a href="https://onlinecourses.nptel.ac.in/noc16_cs10/preview">https://onlinecourses.nptel.ac.in/noc16_cs10/preview</a>
2.	<a href="https://in.udacity.com/course/introduction-to-operating-systems--ud923">https://in.udacity.com/course/introduction-to-operating-systems--ud923</a>

COURSE TITLE	NETWORKING LAB			CREDITS	1
COURSE CODE	CSB4241	COURSE CATEGORY	LAB	L-T-P-S	0-0-3-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
<b>ASSESSMENT SCHEME</b>					
Continuous Internal Assessment					ESE
80%					20%
<b>Course Description</b>	This course focuses on interconnecting computers to share data and resources. The theoretical models, concepts and real-time implementations behind networking were included.				
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To practice command mode keyword for networking.</li> <li>2. To learn networking algorithms and their implementation.</li> <li>3. To understand OSI layer protocols and their usage.</li> <li>4. To learn how to work with D-Link kit.</li> </ol>				
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to :</p> <ol style="list-style-type: none"> <li>1. Implement client and server concepts in Network system.</li> <li>2. Implement various services of data link layer</li> <li>3. Implement the different protocols.</li> <li>4. Implement the concept of local area networks, their topologies, protocols.</li> <li>5. Practice and configure different switch configuration using D-Link</li> </ol>				

Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	1	-	-	-	2	-	-	3	2	1	1
CO-2	3	3	2	2	2	-	-	-	2	-	-	-	2	1	1
CO-3	3	3	2	2	2	-	-	-	2	-	-	-	2	1	1
CO-4	3	3	2	2	2	-	-	1	2	1	1	1	2	1	1
CO-5	3	3	2	1	2	-	-	1	2	1	1	1	2	1	1
1: Weakly related, 2: Moderately related and 3: Strongly related															
LIST OF EXPERIMENTS															
<div>1. Develop a Client – Server application for chat.</div> <div>2. Simulation of ARP / RARP.</div> <div>3. Develop an application for transferring files over RS232</div> <div>4. Write a program that takes a binary file as input and performs bit stuffing and CRC Computation</div> <div>5. Simulation of Sliding-Window protocol</div> <div>6. Simulation of BGP / OSPF routing protocol</div> <div>7. Develop a Client that contacts a given DNS Server to resolve a given host name</div> <div>8. Write a Client to download a file from a HTTP Server.</div> <div>9. Study of Network Simulators like NS2/Glomosim / OPNET</div> <div>Experiments with D-Link</div> <div>1. To access and configure the Switch for basic Switch operations.</div> <div>2. Creating static V LAN, Dynamic (GVRP) VLANs and configuring Ports.</div> <div>3. To configure routing using two different methods: static and dynamic.</div> <div>4. To understand the fundamentals of networking and the TCP/IP protocol suite to be learnt.</div> <div>5. To access and configure the Switch for basic Switch operations.</div> <div>6. To create and configure a Spanning Tree Protocol (STP).</div> <div>7. To configure stacking using two different methods: physical and virtual.</div> <div>8. To configure routing using two different methods: static and dynamic.</div> <div>9. To configure DHCP, ACL, LLDP, and System Maintenance.</div> <div>10. To learn the topologies for the basic WLAN Design</div> <div>11. To learn the topology in the basic metropolitan area design</div> <div>12. To configure two SSIDs and apply small business and teleworker security</div> <div>13. To configure WPA2 PSK and WPA2-EAP Authentication on unified Access points</div> <div>14. To configure an Air premier NAP for WDS with AP mode</div> <div>CASE STUDIES (Non-Credit) with D-Link</div>														CO1, CO2, CO3, CO4, CO5/BTL3	

<div>1. Data centre - Data Center Racks – Data centre Design – Switch - Stacking – Cascading – Routing – Cooling design – Power Design – Data centre products - Fire Safety</div> <div>2. Wi-Fi Alliance Certifications-Small Business and Teleworker WLAN Security-Basic WLAN Design considerations-Configuration MSSID-Air premier NAP Operation modes-Air premier NAP management-Introduction to unified wireless solution-unified wireless usage</div> <div>3. IP Camera Management: IP Camera Technical specifications-IP Camera form factor-IP Camera Image features – D-Link IP Camera Advanced Configurations</div> <div>Switch Management: Overview of D Link Switches and features - Accessing and configuration the switch - Switch learning process - VLAN and GVRP. Understanding Spanning Tree protocol – Switch life cycle -Basic-Understanding D Link Switching features like DHCP, ACL, LDP and System Maintenance.</div>		
REFERENCE BOOKS		
1.	James F. Kurose and Keith W. Ross, “Computer Networking: A Top-Down Approach Featuring the Internet”, 5th Ed., Pearson Education, 2013.	
2.	L.Peterson and Peter S. Davie, “Computer Networks”, 5th Ed., Morgan Kaufmann, 2011.	
3.	Andrew S. Tanenbaum, “Computer Networks”, 5th Ed., Prentice Hall, 2011.	
4.	William Stallings, “Data and Computer Communication”, 8th Ed., Pearson, 2007.	
E BOOKS		
1.	<a href="https://www.dlink.com/en/business/tools/d-link-network-assistant">https://www.dlink.com/en/business/tools/d-link-network-assistant</a>	
MOOC		
1.	<a href="https://www.coursera.org/learn/fundamentals-network-communications">https://www.coursera.org/learn/fundamentals-network-communications</a>	
2.	<a href="https://www.udemy.com/computer-networks-course-networking-basics/">https://www.udemy.com/computer-networks-course-networking-basics/</a>	

COURSE TITLE	OPERATING SYSTEMS LAB			CREDITS	1
COURSE CODE	CSB4242	COURSE CATEGORY	LAB	L-T-P-S	0-0-3-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
<b>ASSESSMENT SCHEME</b>					
Continuous Internal Assessment					ESE
80%					20%
Course Description	This course focuses on interconnecting computers to share data and resources. The theoretical models, concepts and real-time implementations behind networking were included.				

Course Objective	1. To learn OS Installation and use the same 2. To learn scheduling algorithms and process synchronization techniques. 3. To understand Deadlock problems & to perform memory allocation. 4. To understand Memory Management Techniques. 5. To implement the process and threads.														
Course Outcome	Upon completion of this course, the students will be able to 1. Install and use operating systems with an understanding of professional, ethical and social issues. Windows, Linux etc. 2. Implement the process scheduling algorithms and process synchronization techniques. 3. Solve Deadlock problems & to perform memory allocation. 4. Implement Memory Management Techniques. 5. Able to gain knowledge in the implementation of process and threads.														
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	1	2	3	-	3	-	-	-	-	-	-	3	-	-	3
CO-2	1	2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO-3	1	2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO-4	1	2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO-5	1	2	3	-	-	-	-	-	-	-	-	-	-	-	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
OS Basics															
1. Program to report the behaviour of the OS to get the CPU type and model, kernel version. 2. Shell programming a. command syntax b. write simple functions c. basic tests 3. Shell programming a. loops b. patterns c. expansions d. substitution													CO1/BTL3		
process scheduling and process synchronization															

<ol style="list-style-type: none"> <li>1. Program to get the amount of memory configured into the computer, amount of memory currently available.</li> <li>2. Implement the various process scheduling mechanisms such as FCFS, SJF, Priority, round – robin.</li> <li>3. Implement the solution for reader – writer’s problem</li> </ol>	<b>CO2/BTL3</b>
<b>Deadlock problems</b>	
<ol style="list-style-type: none"> <li>1. Implement the solution for dining philosopher’s problem.</li> <li>2. Implement banker’s algorithm.</li> </ol>	<b>CO3/BTL3</b>
<b>Memory Management Techniques</b>	
<ol style="list-style-type: none"> <li>1. Implement the first fit; best fit and worst fit file allocation strategy.</li> <li>2. Write a program to create processes and threads.</li> </ol>	<b>CO4/BTL3</b>
<b>REFERENCE BOOKS</b>	
1.	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, Ninth Edition, 2013.
2.	Harvey M. Deitel, “Operating Systems”, Third Edition, Pearson Education, 2004.
3.	William Stallings, “Operating System”, Ninth Edition, Pearson Education, 2018.
4.	Andrew S. Tanenbaum, “Modern Operating Systems”, 4 <sup>th</sup> Edition, Pearson Education, 2016.
<b>E BOOKS</b>	
1.	<a href="https://www.goodreads.com/book/show/83833.Operating_System_Concepts">https://www.goodreads.com/book/show/83833.Operating_System_Concepts</a>
<b>MOOC</b>	
1.	<a href="https://onlinecourses.nptel.ac.in/noc16_cs10/preview">https://onlinecourses.nptel.ac.in/noc16_cs10/preview</a>
2.	<a href="https://in.udacity.com/course/introduction-to-operating-systems--ud923">https://in.udacity.com/course/introduction-to-operating-systems--ud923</a>

COURSE TITLE	Design Project-I			CREDITS	1
COURSE CODE	CSB4243	COURSE CATEGORY	LAB	L-T-P-S	0-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
<b>ASSESSMENT SCHEME</b>					
First Review (Concept)	Second Review (Design)	Third Review (Experiment/ Analysis)	Project Report and Vivo- voce (Results and Conclusion)		ESE
20%	30%	20%	30%		---

Course Description	This course is mainly focused on team building and product development as it will make them industry ready. To apply the concepts, principles and algorithms learnt in the field of computer science and build products/tools/applications addressing the needs of real-world societal issues.														
Course Objective	<ol style="list-style-type: none"><li>1. To analyse, design and develop products/tools/applications to solve the issues related to real world problems.</li><li>2. To apply the concepts, principles and algorithms learnt in the field of computer science.</li><li>3. To exercise the lifecycle of project development by following the principles of software engineering.</li><li>4. To inculcate the qualities of team building and develop the skills of technical document writing.</li><li>5. To examine the various algorithms of study and thus to evaluate and compare the output generated.</li></ol>														
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"><li>1. Analyse, design and develop products/tools/applications to address the societal needs.</li><li>2. Design, develop and test program segments that constitute a software/hardware product</li><li>3. Demonstrate the software engineering principles and improve the project management skills</li><li>4. Appraise the hardware/software product developed in the form of technical presentations, demonstrations and report generation through team work.</li><li>5. Examine and make a comparative analysis of the algorithms involved in the course of the project work.</li></ol>														
Prerequisites: Basic programming knowledge															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	-	2	-	-	3	3	3	2	3	3	2
CO-2	3	3	3	3	-	2	-	3	3	3	3	2	3	3	2
CO-3	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3
CO-4	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3
CO-5	3	3	3	3	3	2	-	3	3	-	3	2	3	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
Note															



<ul style="list-style-type: none"><li>• The students in convenient groups of not more than 3 members have to identify a product for design and fabrication.</li><li>• Every project work shall have a guide who is the member of the faculty of the Department.</li><li>• Design, develop, test and implement a hardware/software system that is demonstratable with required data set.</li><li>• Assessment is based on creativity, applicability to the society, project development skills, team work.</li><li>• Technical communication, presentation and report writing skills form an essential component in assessment.</li></ul>					CO1, CO2, CO3, CO4, CO5 /BTL3
COURSE TITLE	INTERNSHIP			CREDITS	1
COURSE CODE	CSB4244	COURSE CATEGORY	LAB	L-T-P-S	0-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
Technical report/ Certificate		Presentation and Vivo- voce			ESE
30%		70%			---
Course Description	This course is mainly focused on providing links to classroom learning with industry. To apply the concepts, principles and algorithms learnt in the field of computer science and build products/tools/applications addressing the needs of real-world societal issues.				
Course Objective	<ol style="list-style-type: none"><li>1. To analyse, design and develop products/tools/applications to solve the issues related to real world problems.</li><li>2. To learn critical thinking and problem-solving knowledge in an applied work setting</li><li>3. To get professional behaviour and knowledge.</li><li>4. To develop the skills of technical document writing and presentation.</li><li>5. To develop communication skills and technical knowledge.</li></ol>				

Course Outcome	Upon completion of this course, the students will be able to														
	1. Analyse, design and develop products/tools/applications to address the societal needs.														
	2. Design, develop and test program segments that constitute a software/hardware product														
	3. Demonstrate the software engineering principles and improve the project management skills														
	4. Appraise the hardware/software product developed in the form of technical presentations, demonstrations and report generation through team work.														
5. Display his communication skills and elaborate on his skillset achieved.															
Prerequisites: Basic programming knowledge															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	-	2	-	-	3	3	3	2	3	3	2
CO-2	3	3	3	3	-	2	-	3	3	3	3	2	3	3	2
CO-3	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3
CO-4	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3
CO-5	3	3	3	3	3	2	-	3	3	-	3	2	3	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
Note															
<ul style="list-style-type: none"><li>A student has to compulsorily attend Summer / Winter internship during 3rd year for a minimum period of one month.</li><li>In lieu of Summer / Winter internship, the student is permitted to register for undertaking case study / project work under an engineering faculty of the Institute and carry out the project for minimum period of one month.</li><li>In both the cases, the internship report in the prescribed format duly certified by the faculty in-charge shall be submitted to the HoD.</li><li>Assessment is based on creativity, applicability to the society, project development skills, team work.</li><li>Technical communication, presentation and report writing skills form an essential component in assessment.</li></ul>														CO1, CO2, CO3, CO4, CO5 /BTL3	

## SEMESTER V

COURSE TITLE	PROBABILITY AND STATISTICS			CREDITS	4
COURSE CODE	MAA4302	COURSE CATEGORY	PC	L-T-P-S	3-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment				Practical Component						ESE			
15%		15%				20%						50%			
Course Description		This course introduces the concepts of probability and statistical concept to CSE students. These concepts are helpful in the various fields of computer science, Artificial Intelligence, Machine Learning and heuristics are to name a few.													
Course Objective		1. To understand the concept of probability and one-dimensional random variable. 2. To understand the importance of discrete and continuous distributions. 3. To explore the random experiments specified by two dimensional random variables. 4. To understand hypothesis and calculation of confidence interval for the population parameter. 5. To obtain knowledge on design of experiments.													
Course Outcome		Upon completion of this course, the students will be able to 1. Solve problems using probability and one dimension random variable. 2. Obtain discrete and continuous distribution equations for various problems. 3. Analyze two dimensional random variables using correlation and regression. 4. Perform test hypothesis and calculate confidence interval for the population parameter. 5. Design experiments using concepts using one way and two way classification.													
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	-	-	-	-	-	-	-	-	3	3	-	-
CO-2	3	3	-	-	-	-	-	-	-	-	-	3	3	-	-
CO-3	3	3	-	2	-	-	-	-	-	-	-	3	3	-	-
CO-4	3	3	-	2	-	-	-	-	-	-	-	3	3	-	-
CO-5	3	3	3	-	-	-	-	-	-	-	-	3	3	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: PROBABILITY AND RANDOM VARIABLES													(12)		
Axioms of Probability- Bayes’ Theorem -Random variables – Moments – Moment generating functions. Suggested Reading: Basic Probability Practical Component: Probability density functions													CO-1 BTL-3		

<b>MODULE 2: STANDARD DISTRIBUTIONS</b>		<b>(12)</b>
Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions <b>Suggested Reading:</b> Discrete and Continuous Functions. <b>Practical Component:</b> Problems in distributions.		<b>CO-2 BTL-3</b>
<b>MODULE 3: TWO-DIMENSIONAL RANDOM VARIABLES</b>		<b>(12)</b>
Joint distribution – Marginal and conditional distribution – Co-variance – Correlation and Regression <b>Suggested Reading:</b> Random Variables <b>Practical Component:</b> Two Dimensional Random Variable Problems		<b>CO-3 BTL-3</b>
<b>MODULE 4: TESTING OF HYPOTHESIS</b>		<b>(12)</b>
Sampling distributions – Testing of Hypothesis – Small samples – t Test, F Test and Chi-square Test – Large samples – Single mean – Difference in means – single proportion and difference in proportions. <b>Suggested Reading:</b> Sampling Problems <b>Practical Component:</b> Testing of Hypothesis		<b>CO-4 BTL-3</b>
<b>MODULE 5: DESIGN OF EXPERIMENTS</b>		<b>(12)</b>
Analysis of variance – One Way Classification – Completely Randomized block design – Two Way Classification – Randomized block design – Latin Square design. <b>Suggested Reading:</b> Analysis of variance <b>Practical Component:</b> Design of Experiments		<b>CO-5 BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.	
2.	Johnson. R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.	
3.	A. Chandrasekaran, G. Kavitha, "Probability, Statistics, Random Processes and Queuing Theory", Dhanam Publications, 2014.	
4.	Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma, "MATLAB and its Applications in Engineering", Pearson Publication, Second Edition, 2016.	
<b>REFERENCE BOOKS</b>		
1.	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.	
2.	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.	
3.	Dean G. Duffy., "Advanced Engineering Mathematics with MATLAB", CRC Press, Third Edition 2013.	
<b>E BOOKS</b>		

1.	<a href="http://nptel.ac.in/courses/IIT-MADRAS/Principles_of_Communication1/Pdfs/1_5.pdf">http:// nptel.ac.in/courses/ IIT-MADRAS/ Principles_of_Communication1/ Pdfs/ 1_5.pdf</a>
2.	<a href="https://www.khanacademy.org">https://www.khanacademy.org</a>
<b>MOOC</b>	
1.	<a href="https://www.edx.org/course/introduction-probability-science-mitx-6-041x-2">https://www.edx.org/course/introduction-probability-science-mitx-6-041x-2</a>

COURSE TITLE		WEB TECHNOLOGY										CREDITS		3	
COURSE CODE		CSB4301				COURSE CATEGORY			PC			L-T-P-S		2-0-2-1	
Version		1.0				Approval Details						LEARNING LEVEL		BTL-3	
ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment				Practical Component						ESE			
15%		15%				20%						50%			
Course Description		The course aim to impart a full stack knowledge of web development to the students. The course covers concepts, technologies and tools that are needed for developing a complete web based solution.													
Course Objective		1. To understand basics of Internet based communications. 2. To learn concepts of HTML pages with CSS. 3. To understand Client-Side validation using Java Script. 4. To know Bootstrapping pages using HTML5 and AJAX. 5. To learn Web Server side programming using Java Servlets. 6. To understand various web standards and its Applications.													
Course Outcome		Upon completion of this course, the students will be able to 1. Design Dynamic HTML pages with CSS. 2. Incorporate Client-Side validation in HTML pages using Java Script. 3. Construct Bootstrap pages using HTML5 and AJAX. 4. Develop Web Server Programs using Java Servlets. 5. Explain various web standards and its Applications													
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	1	2	3	-	-	-	-	-	-	-	-	3	1	1	1
CO-2	1	2	3	-	3	-	-	-	-	-	-	3	1	1	1
CO-3	1	2	3	-	3	-	-	-	-	-	-	3	2	2	2

CO-4	1	2	3	-	3	-	-	-	-	-	-	3	2	2	2
CO-5	1	2	3	-	3	-	-	-	-	-	-	3	2	2	2
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: INTRODUCTION</b>													<b>(9L+3P=12)</b>		
Introduction – Network concepts – Web concepts – Internet addresses - Common Gateway Interface: Programming CGI Scripts – HTML - basic HTML tags – Cascading Style Sheets HTML Forms– Server Side Includes – Custom Database- Query Scripts - Server security issues.  <b>Practical Component:</b> 1. Create a web page with the following CSS. a) Inline style sheets. b) Internal style sheets. c) External style sheets. Create a HTML form for reading Name, Age, Gender, Address, Payment Options, Phone number, Email address, preferred user name, various Area of Interest etc. from the user.  <b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106105084/13">http://nptel.ac.in/courses/106105084/13</a>													<b>CO-1 BTL-3</b>		
<b>MODULE 2: SCRIPTING &amp; CLIENT SIDE</b>													<b>(9L+3P=12)</b>		
Introduction to XML Introduction to XHTML– DHTML -Cascading Style Sheets - Scripting language- Java Script: variables - Control statements, Functions, Arrays, Objects – Events. Writing Client-side validation scripts, Node JS & Angular JS.  <b>Practical Component:</b> 1. Write a Java Script program to validate the data including the email id entered by the user in the above form are in correct format. Display error message if input is not in correct format. Call the script when the page is submitted. 2. Write a simple XML program for Book store. <b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106105084/26">http://nptel.ac.in/courses/106105084/26</a>													<b>CO-2 BTL-3</b>		
<b>MODULE 3: RICH INTERNET APPLICATION &amp; HTML5</b>													<b>(9L+3P=12)</b>		
AJAX enabled rich internet applications-HTML review, Feature detection, The HTML5 new Elements, Canvas, Video and audio, Web storage, Geolocation, Offline Webpages, Microdata, HTML5 APLS, Migrating from HTML4 to HTML5, CSS3 and Bootstrap.  <b>Practical Component:</b> 1. Create a HTML form with the following HTML5 controls – (Color–Date–Email–Month – Range- Number (with inputs from 1 to 100) –URL). 2. Using Canvas & SVG in HTML5 write a program to draw line, arc, rectangle and circle. Fill colors using gradient style. <b>Suggested reading:</b> 1. <a href="https://www.tutorialspoint.com/bootstrap/bootstrap_tutorial.pdf">https://www.tutorialspoint.com/bootstrap/bootstrap_tutorial.pdf</a>													<b>CO-3 BTL-3</b>		
<b>MODULE 4: SERVER SIDE PROGRAMMING</b>													<b>(9L+3P=12)</b>		

<p>Server side Programming – Java Servlets: Servlet lifecycle- Generic servlet- Http servlet, JSP: Introduction- Lifecycle – JSP scripting elements – Implicit Objects – JSP Directive elements – Action Elements – MVC.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Write a simple Java Servlet Program to read the values entered using HTML form controls and display the same.</li> <li>2. Create a Java Servlet program for finding the biggest of three numbers.</li> </ol> <p><b>Suggested reading:</b></p> <ol style="list-style-type: none"> <li>1. <a href="https://www.btechguru.com/training--programming--j2ee--servelets--1what-is-a-servlet-video-lecture--12106--24--154.html">https://www.btechguru.com/training--programming--j2ee--servelets--1what-is-a-servlet-video-lecture--12106--24--154.html</a></li> <li>2. <a href="https://www.w3schools.com/xml/ajax_intro.asp">https://www.w3schools.com/xml/ajax_intro.asp</a></li> </ol>	<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<b>MODULE 5: DATABASE CONNECTIVITY AND WEB STANDARDS (9L+3P=12)</b>	
<p><b>DATABASE CONNECTIVITY:</b> Java Data Base Connectivity- Introduction - Drivers-Establishing connection – Types of Statements-Result Sets.</p> <p><b>WEB STANDARDS - WEB 2.0</b> – History, characteristics, technologies, concepts, usage, web2.0 in education, philanthropy, social work. Web 3.0 – Theory and history understanding basic web artifacts and applications, implementation.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Create a three-tier application using servlets for displaying student mark list. Fetch the results from the database using the entered register number.</li> <li>2. Create a three-tier application using servlets for conducting on-line examination. Create a login page and verify the user name and password before allowing for examination. Use Session key management for the same.</li> </ol> <p><b>Suggested reading:</b></p> <p><a href="https://beginnersbook.com/2013/05/servlet-tutorial/">https://beginnersbook.com/2013/05/servlet-tutorial/</a></p>	<p><b>CO-5</b></p> <p><b>BTL-3</b></p>
<b>TEXT BOOKS</b>	
1.	Deitel, Deitel and Neito, “Internet and World Wide Web – How to program”, Pearson Education Asia, 5 <sup>th</sup> Edition, 2011.
2.	Jason Hunter, William Crawford “Java Servlet Programming” O’Reilly Publications, 2nd Edition, 2001.
<b>REFERENCE BOOKS</b>	
1.	Elliotte Rusty Herold, “Java Network Programming”, O’Reilly Publications, 3rd Edition, 2004.
2.	Eric Ladd and Jim O’Donnell, et al, “USING HTML 4, XML, and JAVA1.2”, Prentice Hall, 2003
<b>E BOOKS</b>	
1.	<a href="https://www.tutorialspoint.com/web_developers_guide/web_pdf_version.htm">https://www.tutorialspoint.com/web_developers_guide/web_pdf_version.htm</a>
2.	<a href="http://www.intuc.net/office_meeting_report/Ajax_SampleChapter.pdf">http://www.intuc.net/office_meeting_report/Ajax_SampleChapter.pdf</a>
3.	<a href="http://repository.mdp.ac.id/ebook/oreilly-books/OReilly.Java.Servlet%20Programming.pdf">http://repository.mdp.ac.id/ebook/oreilly-books/OReilly.Java.Servlet%20Programming.pdf</a>
<b>MOOC</b>	
1.	<a href="https://www.coursera.org/specializations/web-design">https://www.coursera.org/specializations/web-design</a>

COURSE TITLE		THEORY OF COMPUTATION							CREDITS			4			
COURSE CODE		CSB4302		COURSE CATEGORY			PC		L-T-P-S			3-1-0-1			
Version		1.0		Approval Details					LEARNING LEVEL			BTL-3			
ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment			Seminar/ Assignments/ Project			Surprise Test / Quiz		Attendance			ESE		
15%		15%			10%			5%		5%			50%		
Course Description		This course introduces the theory of computation through a set of abstract machines that serve as models for computation - finite automata, pushdown automata, and Turing machines and examines the relationship between these automata and formal languages.													
Course Objective		1. To introduce different types of automata. 2. To design a Regular expression. 3. To write context free grammars. 4. To design a turing machine. 5. To determine the undecidability of a problem.													
Course Outcome		Upon completion of this course, the students will be able to 1. Apply formal proof techniques and design finite automata. 2. Build Regular Languages and Construct Minimized Automata for Regular Languages. 3. Write Context Free Grammar and Design PDA for the Grammar 4. Design Turing machine and identify recursively enumerable language. 5. Determine the undecidability of a problem and identify class P and NP problems.													
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO -1	PO -2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO - 10	PO- 11	PO- 12	PSO- 1	PSO- 2	PS O-3
CO-1	3	3	3	2	-	-	-	-	-	-	-	1	3	2	1
CO-2	3	3	3	2	-	-	-	-	-	-	-	-	3	2	1
CO-3	3	3	3	2	-	-	-	-	-	-	-	-	3	2	1
CO-4	3	3	3	2	-	-	-	-	-	-	-	1	3	2	1
CO-5	3	3	3	3	-	-	-	-	-	-	-	1	3	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related															



MODULE 1: AUTOMATA INTRODUCTION		(12)
Introduction to Formal Proof, Additional Forms of Proof, Inductive Proofs, Finite Automata (FA), Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA), Finite Automata with Epsilon Transitions. <b>Suggested Reading:</b> <a href="https://onlinecourses.nptel.ac.in/noc17_cs34/unit?unit=7&amp;lesson=10">https://onlinecourses.nptel.ac.in/noc17_cs34/unit?unit=7&amp;lesson=10</a>		<b>CO-1</b> <b>BTL-3</b>
MODULE 2: REGULAR EXPRESSIONS AND LANGUAGES		(12)
Regular Expression - FA and Regular Expressions- RE To NFA, NFA To RE-, RE To DFA, DFA To RE, Proving Languages Not to Be Regular, Closure Properties Of RL, Equivalence and Minimization of Automata. <b>Suggested Reading:</b> <a href="https://onlinecourses.nptel.ac.in/noc17_cs34/unit?unit=15&amp;lesson=21">https://onlinecourses.nptel.ac.in/noc17_cs34/unit?unit=15&amp;lesson=21</a>		<b>CO-2</b> <b>BTL-3</b>
MODULE 3: CONTEXT FREE GRAMMAR AND LANGUAGES		(12)
Introduction to Context Free Grammar- Parse Trees- Ambiguity in Grammars and Languages- Definition of the Pushdown Automata- Languages of A Pushdown Automata- Equivalence Of Pushdown Automata and CFG- Deterministic Pushdown Automata <b>Suggested Reading:</b> <a href="https://onlinecourses.nptel.ac.in/noc17_cs34/unit?unit=32&amp;lesson=38">https://onlinecourses.nptel.ac.in/noc17_cs34/unit?unit=32&amp;lesson=38</a>		<b>CO-3</b> <b>BTL-3</b>
MODULE 4: NORMAL FORMS AND TURING MACHINE		(12)
Normal Forms for CFG - Pumping Lemma for CFL- Closure Properties of CFL- Introduction of Turing Machine- Programming Techniques for Turing Machine. <b>Suggested Reading:</b> <a href="https://onlinecourses.nptel.ac.in/noc17_cs34/unit?unit=50&amp;lesson=53">https://onlinecourses.nptel.ac.in/noc17_cs34/unit?unit=50&amp;lesson=53</a>		<b>CO-4</b> <b>BTL-3</b>
MODULE 5: COMPUTATIONAL COMPLEXITY		(12)
Recursively Enumerable and Non-Recursively Enumerable Languages - Diagonalization Language- Undecidable Problem that is RE- Undecidable Problem About Turing Machine- Rice Theorem- Post’s Correspondence Problem- Church Turing Thesis- The Classes Of P And NP, NP Complete and NP Hard Problems. <b>Suggested Reading:</b> <a href="https://onlinecourses.nptel.ac.in/noc17_cs34/unit?unit=58&amp;lesson=61">https://onlinecourses.nptel.ac.in/noc17_cs34/unit?unit=58&amp;lesson=61</a>		<b>CO-5</b> <b>BTL-3</b>
MINI PROJECT/FIELD WORK		
Model A Turing Machine with Memory.		
TEXT BOOKS		
1.	J.E. Hopcroft, R.Motwani and J.D.Ullman, “Introduction to Automata Theory, Languages and Computations”, Second Edition, Pearson Education, 2003.	
REFERENCE BOOKS		
1.	H.R. Lewis and C.H. Papadimitriou, “Elements of the theory of Computation”, Second Edition, Pearson Education, 2003.	
2.	J.Martin, “Introduction to Languages and the Theory of Computation”, Third Edition, TMH,2003.	
3.	Micheal Sipser, “Introduction of the Theory and Computation”, Thomson Brokecole, 2013.	
4.	K.Krithivasan and R.Rama, Introduction to Formal Languages, Automata and Computation, Pearson Education, 2009.	
E BOOKS		

1.	cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf
<b>MOOC</b>	
1.	<a href="https://onlinecourses.nptel.ac.in/noc16_cs14">https://onlinecourses.nptel.ac.in/noc16_cs14</a>

COURSE TITLE	ARTIFICIAL INTELLIGENCE			CREDITS	3
COURSE CODE	CSB4303	COURSE CATEGORY	PC	L-T-P-S	3-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3

**ASSESSMENT SCHEME**

First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

<b>Course Description</b>	This course introduces the different search strategies, types of knowledge representation, different type of learning techniques and various expert systems.
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<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To solve problems using informed and uninformed search strategies.</li> <li>2. To Compare various Knowledge Representation Logic using scripts and frames.</li> <li>3. To Comprehend and analyze the different types of learning.</li> <li>4. To identify the need of Production system and Planning states.</li> <li>5. To Use expert system tools to realize the concepts and components of expert system.</li> </ol>
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<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Solve problems using informed and uninformed search strategies.</li> <li>2. Compare various Knowledge Representation Logic using scripts and frames.</li> <li>3. Comprehend and analyze the different types of learning.</li> <li>4. Identify the need of Production system and planning states.</li> <li>5. Use expert system tools to realize the concepts and components of expert system.</li> </ol>
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**Prerequisites: Nil****CO, PO AND PSO MAPPING**

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	2	-	-	-	-	-	2	3	3	3	3
CO-2	3	3	3	3	3	2	-	-	2	2	2	3	3	-	3
CO-3	3	3	3	3	2	-	-	-	2	2	1	3	3	-	3
CO-4	3	3	3	3	1	-	-	-	-	-	1	3	3	-	3

CO-5	3	3	3	3	3	3	-	-	-	-	3	3	3	-	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: PROBLEM SOLVING															(9)
Introduction to AI- Agents and Environments – Uninformed Search Strategies- Informed Search Strategies- Local Search Algorithm- Problem Formulation-Constraint Satisfaction Problem.														CO-1 BTL-3	
MODULE 2: KNOWLEDGE REPRESENTATION															(9)
Introduction to Game Playing-Alpha Beta Pruning-Knowledge Representation using First order logic-Knowledge Engineering in First Order Logic-Proportional vs First Order Logic-Resolution-Structured representation of Knowledge Using Scripts and Frames.														CO-2 BTL-2	
MODULE 3: INFERENCE AND LEARNING															(9)
Inference- Forward and Backward Chaining-Unification-Uncertainty-Inference in Bayesian Network –Learning from Observations-Forms of Learning-Inductive Learning-Neural Network-Learning Decision trees-Reinforcement Learning-Case Study-Learning examples with python.														CO-3 BTL-3	
MODULE 4: PRODUCTION SYSTEM AND PLANNING															(9)
Introduction to Production system-control strategies-Rete Algorithm-Planning-STRIPS-Planning with state space search-Partial Order Planning-Planning Graphs-Planning & acting in the real world.														CO-4 BTL-2	
MODULE 5: EXPERT SYSTEM															(9)
Expert System- Architecture and Roles of Expert System-Typical Expert System-MYCIN-XOON-DART-Case Study-Construction of simple reflex agent with sensor and actuator using Arduino.														CO-5 BTL-3	
TEXT BOOKS															
1.	Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, 3rd Edition, Pearson Education / Prentice Hall of India, 2010.														
2.	Joseph C. Giarratano,Gary D. Riley ,”Expert Systems: Principles and Programming”, 4th Edition, 2015.														
REFERENCE BOOKS															
1.	Nils J. Nilsson, “Artificial Intelligence: A new Synthesis”, Harcourt Asia Pvt. Ltd., 2000.														
2.	Janakiraman, K. Sarukesi, ‘Foundations of Artificial Intelligence and Expert Systems’, Macmillan Series in Computer Science, 2000.														
3.	W. Patterson, ‘Introduction to Artificial Intelligence and Expert Systems’, Prentice Hall of India, 2003.														
4.	Artificial Intelligence with python, Prateek Joshi,2017.														
E BOOKS															

1.	<a href="https://www.pdfdrive.net/artificial-intelligence-a-modern-approach-3rd-edition-e32618455.html">https://www.pdfdrive.net/artificial-intelligence-a-modern-approach-3rd-edition-e32618455.html</a>
<b>MOOC</b>	
1.	<a href="https://www.coursera.org/courses?query=artificial%20intelligence">https://www.coursera.org/courses?query=artificial%20intelligence</a>
2.	<a href="https://www.coursera.org/specializations/cyber-security">https://www.coursera.org/specializations/cyber-security</a>

COURSE TITLE	PROFESSIONAL ETHICS AND LIFE SKILLS			CREDITS	2
COURSE CODE	GEA4216	COURSE CATEGORY	HS	L-T-P-S	2-0-0-1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course is designed with the aim of developing the ethics and human values with the students and teach them how to apply ethics in engineering problem for betterment of the society.				
Course Objective	1. To understand about ethics and human values 2. To apply the ethics in real world problems 3. To differentiate between safety and risk 4. To transform into responsible human being 5. To analyze the society and work for betterment of society				
Course Outcome	Upon completion of this course, the students will be able to 1. Comprehend the essentials of ethics and human values 2. Enumerate the theories of Engineering ethics and apply to real world scenarios 3. Distinguish between safety and risk and possess the ability to claim appropriate rights 4. Inculcate the life skills and value system for transforming into a responsible human being 5. Analyze and appraise the status of society and formulate schemes for the betterment of the society				
Prerequisites: Nil					
CO, PO AND PSO MAPPING					

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	1	1	1	-	-	2	1	3	-	1	-	1	-	-	-
CO-2	1	2	1	-	-	3	1	3	-	1	-	1	-	-	-
CO-3	1	2	2	2	-	3	2	3	2	3	-	2	-	-	1
CO-4	1	2	3	2	1	3	3	3	2	3	1	3	-	-	1
CO-5	1	2	3	2	2	3	3	3	3	3	2	3	1	1	3
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: HUMAN VALUES</b>														<b>(6)</b>	
Definition of ethics-Morals values and ethics – integrity-Work ethics- Service Learning-Civic Virtue-Respect for others- Caring-Sharing-Honesty-Courage - Valuing time-Cooperation-Commitment-Empathy-Self-confidence-Character-Spirituality-Introduction to Yoga and meditation for professional excellence and stress management.  <b>Self-Study:</b> Case study of Discovery failure														<b>CO-1</b> <b>BTL-3</b>	
<b>MODULE 2: ENGINEERING ETHICS</b>														<b>(6)</b>	
Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.  <b>Self-study:</b> Study the Bhopal gas tragedy														<b>CO-2</b> <b>BTL-3</b>	
<b>MODULE 3: SAFETY, RESPOSIBILITIES AND RIGHTS</b>														<b>(6)</b>	
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.  <b>Self-study:</b> Chernobyl explosion, Nuclear and thermal power plant issues														<b>CO-3</b> <b>BTL-3</b>	
<b>MODULE 4: LIFE SKILLS</b>														<b>(6)</b>	
Definition, Relevance, Types of values, changing concepts of values-aims and values of value education- basic etiquette-morals and values in life-dealing with people. Personal values – Self – Strengths (self-confidence, self-assessment, self-reliance, self-discipline, determination, self-restraint, contentment, humility, sympathy and compassion, gratitude, forgiveness) Weaknesses.  <b>Self-study:</b> Influences - Peer pressure, familial and societal expectations, media														<b>CO-4</b> <b>BTL-3</b>	

MODULE 5: SOCIETIES IN PROGRESS		(6)
Definition of society; Units of society; Communities – ancient and modern – Agents of change – Sense of survival, security, desire for comfort and ease sense of belonging, social consciousness and responsibility.  <b>Self-study:</b> Personal value and professional value of Engineers on societies perception		<b>CO-5</b> <b>BTL-3</b>
TEXT BOOKS		
1.	Subramanian R., Professional ethics, Oxford University press, 2010.	
2.	Manoharan P.K., Education and Personality Development, APH Publishing Corporation, New Delhi, 2008	
REFERENCE BOOKS		
1.	Megan J. Murphy (Editor), Lorna Hecker (Editor), Ethics and Professional Issues in Couple and Family Therapy.	
2.	Andrew Belsey (Editor), Ruth Chadwick (Editor), Ethical Issues in Journalism and the Media (Professional Ethics).	
3.	Warwick Fox (Editor), Ethics and the Built Environment (Professional Ethics).	
4.	Ruchika Nath, Value Education, APH Publishing Corporation, New Delhi, 2008.	

COURSE TITLE	SKILL DEVELOPMENT IN PROGRAMMING			CREDITS	1
COURSE CODE	CSB4331	COURSE CATEGORY	PC	L-T-P-S	0-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
Continuous Internal Assessment					ESE
80%					20%
Course Description	This course is designed with the aim of preparing the students to write innovative and efficient solutions for the real world problems and make them to participate in international coding competitions.				
Course Objective	1. To make the students to solve real world problems 2. To implement the solution in appropriate language 3. To design an efficient program for the problem 4. To apply the programming and data structures concepts during coding 5. To analyze for time and space time complexity of the program				

Course Outcome	Upon completion of this course, the students will be able to														
	1. Create solutions for real time programming tasks														
	2. Implement code in appropriate programming language for language agnostic problems														
	3. Design and develop efficient program for any given computational problem														
	4. Apply the learned engineering knowledge (Data Structures/functional programming) while writing the solution.														
5. Critically evaluate a given program for space and time complexity															
Prerequisites: Basic Programming															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	2	2	-	-	-	-	2	3	3	2	3
CO-2	3	3	3	3	3	2	-	-	-	-	2	3	3	2	3
CO-3	3	3	3	3	2	2	-	-	-	-	1	3	3	2	3
CO-4	3	3	3	3	1	2	-	-	-	-	1	3	3	2	3
CO-5	3	3	3	3	3	3	-	-	-	-	3	3	3	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
LIST OF EXPERIMENTS – Guidelines															
1. Program on recursion.													CO-4 BTL-3		
2. Program using function calls.													CO-5 BTL-3		
3. Program using exception handlers.													CO-1 BTL-3		
4. Program integrating built in packages/Libraries.													CO-2 BTL-3		
5. Program to define and incorporate user defined packages/libraries.													CO-3 BTL-3		
6. Program to integrate external tools.													CO-4 BTL-3		
7. Solve programming related puzzles.													CO-3 BTL-2		
ONLINE REFERENCE															
1.	<a href="https://www.codechef.com/">https://www.codechef.com/</a>														
2.	<a href="https://www.hackerearth.com/">https://www.hackerearth.com/</a>														
3.	<a href="https://www.hackerrank.com/">https://www.hackerrank.com/</a>														

COURSE TITLE		DESIGN PROJECT WITH IoT								CREDITS			1		
COURSE CODE		CSB4332			COURSE CATEGORY			LAB		L-T-P-S			0-0-3-0		
Version		1.0			Approval Details					LEARNING LEVEL			BTL-3		
ASSESSMENT SCHEME															
First Review (Concept)		Second Review (Design)			Third Review (Experiment/ Analysis)			Project Report and Vivo- voce (Results and Conclusion)				ESE			
20%		30%			20%			30%				---			
Course Description		This course is mainly focused on team building and product development as it will make them industry ready. To apply the concepts, principles and algorithms learnt in the field of Internet of Things (IoT) and build products/tools/applications addressing the needs of real-world societal issues.													
Course Objective		<div>1. To know the basic components requirement to build the IoT based applications.</div> <div>2. To learn the technology related to develop an IoT application.</div> <div>3. To get the skill for selecting appropriate platform for product development.</div> <div>4. To apply the concepts, principles and algorithms learnt in the field of computer science, specifically IoT.</div> <div>5. To inculcate the qualities of team building and develop the skills of technical document writing</div>													
Course Outcome		<div>Upon completion of this course, the students will be able to</div> <div>1. Identify the sensors and actuators required for their application and control through simple programs</div> <div>2. Create network connectivity over different components by applying network protocol for interoperability</div> <div>3. Differentiate the two basic IoT gateways Raspberry pi / Arduino and select the one which is suitable for their requirement.</div> <div>4. Develop a system which satisfy the real-time requirements for automation</div> <div>5. Appraise the hardware/software product developed in the form of technical presentations, demonstrations and report generation through team work.</div>													
Prerequisites: Basic programming knowledge															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO -4	PO -5	PO -6	PO- 7	PO- 8	PO- 9	PO -10	PO -11	PO -12	PSO- 1	PSO-2	PSO-3
CO-1	3	3	3	3	-	2	-	-	3	3	3	2	3	3	2
CO-2	3	3	3	3	-	2	-	3	3	3	3	2	3	3	2



CO-3	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3
CO-4	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3
CO-5	3	3	3	3	3	2	-	3	3	-	3	2	3	3	3
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>Note</b>															
<ul style="list-style-type: none"> <li>The students in convenient groups of not more than 3 members have to identify a product for design and fabrication.</li> <li>Every project work shall have a guide who is the member of the faculty of the Department.</li> <li>Design, develop, test and implement a hardware/software system that is demonstratable with required data set.</li> <li>Assessment is based on creativity, applicability to the society, project development skills, team work.</li> <li>Technical communication, presentation and report writing skills form an essential component in assessment.</li> </ul>														<b>CO1, CO2, CO3, CO4, CO5 /BTL3</b>	

**SEMESTER VI**

COURSE TITLE	PRINCIPLES OF COMPILER DESIGN			CREDITS	4
COURSE CODE	CSB4316	COURSE CATEGORY	PC	L-T-P-S	3-1-0-1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
<b>ASSESSMENT SCHEME</b>					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course studies the concepts of different phases of compiler and introduces the design concepts of lexical analyzer, syntax analyzer, semantic analyzer and code generation and optimization				
Course Objective	<ol style="list-style-type: none"> <li>To design a lexical analyzer.</li> <li>To perform syntax analysis.</li> <li>To check for semantic errors.</li> <li>To perform code optimization.</li> <li>To generate the code from intermediate code.</li> </ol>				

<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. Describe the basics of Compiler and Design Simple Lexical Analyzers. 2. Solve Parsing Problems Using Various Syntax Analysis Techniques. 3. Illustrate Various Semantic Models. 4. Employ Various Intermediate Code Generation Techniques and Identify Principle Source of Code Optimization. 5. Describe Code Generation in Compilers.														
<b>Prerequisites: Nil</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO-1	3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO-2	3	2	1	2	1	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	2	1	2	1	-	-	-	-	-	2	3	3	3
CO-4	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO-5	3	2	2	1	1	-	-	-	-	-	-	2	2	2	2
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: INTRODUCTION &amp; LEXICAL ANALYSIS (12)</b>															
Introduction to Compilers- Compiler Vs Interpreter –Cross Compiler – Boot strapping – – Cousins of the Compiler- Compiler construction tools- Phases of a compiler — Grouping of Phases — Symbol table management - Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens: Regular Expressions, Recognition of Tokens: Construction of NFA-DFA-Minimization of DFA.													<b>CO-1 BTL-3</b>		
<b>Suggested Reading:</b> <a href="http://nptel.ac.in/courses/106108052/1">http://nptel.ac.in/courses/106108052/1</a>															
<b>MODULE 2: SYNTAX ANALYSIS (12)</b>															
Role of the parser –Writing Grammars –Context-Free Grammars – Error Recovery Strategies-Top Down parsing: Recursive Descent Parsing – Left recursion- Left Factoring- Predictive Parsing – Bottom-Up Parsing: Shift Reduce Parsing – Operator Precedent Parsing – LR Parsers – SLR Parser – Canonical LR Parser – LALR Parser.													<b>CO-2 BTL-3</b>		
<b>Suggested Reading:</b> <a href="http://nptel.ac.in/courses/106108113/11">http://nptel.ac.in/courses/106108113/11</a>															
<b>MODULE 3: SEMANTIC ANALYSIS (12)</b>															
Syntax Directed Translations: Syntax-directed definitions, Translation Schemes- construction of syntax trees - DAG’S- bottom-up evaluation of s-attributed definitions - l-attributed definitions- Data type as set of values with set of operations- data types; type checking models; semantic models of user -defined types; parametric polymorphism; subtype polymorphism; type-checking algorithms.													<b>CO-3 BTL-3</b>		
<b>Suggested Reading:</b> <a href="http://nptel.ac.in/courses/106108113/12">http://nptel.ac.in/courses/106108113/12</a>															

MODULE 4: INTERMEDIATE CODE GENERATION (12)	
Intermediate languages – Declarations – Assignment Statements – Array Elements - Boolean Expressions – Case Statements – Back patching – Procedure calls- Principal Sources of Optimization – Optimization of basic Blocks- loop optimization.	CO-4 BTL-4
<b>Suggested Reading:</b> <a href="http://nptel.ac.in/courses/106108113/17">http://nptel.ac.in/courses/106108113/17</a>	
MODULE 5: CODE GENERATION (12)	
Issues in the design of code generator – The target machine – Runtime Storage management – Basic Blocks and Flow Graphs – Next-use Information – A simple Code generator – DAG representation of Basic Blocks – Peephole Optimization.	CO-5 BTL-3
<b>Suggested Reading:</b> <a href="http://nptel.ac.in/courses/106108113/27">http://nptel.ac.in/courses/106108113/27</a>	
TEXT BOOKS	
1.	Alfred Aho, Lam, Ravi Sethi, Jeffrey D Ullman, —Compilers Principles, Techniques and Tools, Pearson Education , New International edition, 2014.
REFERENCE BOOKS	
1.	Steven S.Muchnick “Advanced Compiler design implementation” Morgan Kaufmann/ Elsevier Science India, 2003
2.	Allen I. Holub —Compiler Design in C, Prentice Hall of India, 2006.
E BOOKS	
1.	<a href="http://ce.sharif.edu/courses/94-95/1/ce414-2/resources/root/Text%20Books/Compiler%20Design/Alfred%20V.%20Aho,%20Monica%20S.%20Lam,%20Ravi%20Sethi,%20Jeffrey%20D.%20Ullman-Compilers%20-%20Principles,%20Techniques,%20and%20Tools-Pearson_Addison%20Wesley%20(2006).pdf">http://ce.sharif.edu/courses/94-95/1/ce414-2/resources/root/Text%20Books/Compiler%20Design/Alfred%20V.%20Aho,%20Monica%20S.%20Lam,%20Ravi%20Sethi,%20Jeffrey%20D.%20Ullman-Compilers%20-%20Principles,%20Techniques,%20and%20Tools-Pearson_Addison%20Wesley%20(2006).pdf</a>
MOOC	
1.	<a href="https://www.mooc-list.com/course/cs1-compilers-stanford-online">https://www.mooc-list.com/course/cs1-compilers-stanford-online</a>

COURSE TITLE	MACHINE LEARNING			CREDITS	4
COURSE CODE	CSB4317	COURSE CATEGORY	PC	L-T-P-S	3-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	

<b>Course Description</b>	This course provides an introduction to the fundamental methods at the core of modern machine learning. It covers theoretical foundations as well as essential algorithms for supervised and unsupervised learning.
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To provide fundamentals of machine learning algorithms</li> <li>2. To implement supervised learning algorithms</li> <li>3. To implement unsupervised learning algorithms</li> <li>4. To design Artificial Neural Networks.</li> <li>5. To implement probabilistic models.</li> </ol>
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Identify various machine learning algorithms and terminologies and perform data pre-processing using standard ML library.</li> <li>2. Design a predictive model using appropriate supervised learning algorithms to solve any given problem.</li> <li>3. Develop an application using appropriate unsupervised learning algorithms for performing clustering and dimensionality reduction.</li> <li>4. Solve complex problems using artificial neural networks and kernel machines.</li> <li>5. Implement probabilistic graphical models for suitable applications.</li> </ol>

**Prerequisites: Probability and Statistics**

#### CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	-	-	1	-	-	-	-	3	3	2	3
CO-2	3	3	3	3	3	2	1	1	1	1	3	3	3	2	3
CO-3	3	3	3	3	3	2	1	1	1	1	3	3	3	2	3
CO-4	3	3	3	3	3	2	1	1	1	1	3	3	3	2	3
CO-5	3	3	3	3	-	-	1	-	-	-	-	3	3	2	3

**1: Weakly related, 2: Moderately related and 3: Strongly related**

#### MODULE 1: INTRODUCTION TO MACHINE LEARNING (ML)

**(9L+3P)**

Machine Learning Fundamentals –Types of Machine Learning - Examples of Machine Learning - The Machine Learning process.  
 Terminologies in ML- Testing ML algorithms: Overfitting, Training, Testing and Validation Sets- Confusion matrix -Accuracy metrics- ROC Curve- The Bias-Variance tradeoff.  
**Practical Component:**  
 (i) Installation of Python Libraries/ MATLAB tools for Machine Learning  
 (ii) Data pre-processing using Python Machine Learning libraries/ MATLAB.  
**Suggested reading:**  
 ➤ Introduction to Machine Learning - <http://nptel.ac.in/courses/106106139/1>

**CO-1  
BTL-2**

➤ Probability basics- <a href="http://nptel.ac.in/courses/106106139/5">http://nptel.ac.in/courses/106106139/5</a>	
<b>MODULE 2: SUPERVISED LEARNING</b>	<b>(9L+3P)</b>
<p>Regression: Linear Regression – Multivariate Regression- Classification: Linear Discriminant Analysis, Logistic Regression- K-Nearest Neighbor classifier. Decision Tree based methods for classification and Regression- Ensemble methods.</p> <p><b>Practical Component: (Using Python Libraries /MATLAB Tool)</b></p> <ul style="list-style-type: none"> <li>(i) Design a model to predict the housing price from Boston Dataset using Multivariate Linear Regression.</li> <li>(ii) Build a classifier using Logistic Regression, k- Nearest Neighbor / Decision Tree to classify whether the given user will purchase a product or not from a social networking dataset.</li> </ul> <p><b>Suggested reading:</b></p> <ul style="list-style-type: none"> <li>➤ Linear Regression - <a href="http://nptel.ac.in/courses/106106139/12">http://nptel.ac.in/courses/106106139/12</a></li> <li>➤ Decision Trees -<a href="http://nptel.ac.in/courses/106106139/39">http://nptel.ac.in/courses/106106139/39</a></li> </ul>	<b>CO-2 BTL-3</b>
<b>MODULE 3: UNSUPERVISED LEARNING</b>	<b>(9L+3P)</b>
<p>Clustering- K-Means clustering, Hierarchical clustering - The Curse of Dimensionality - Dimensionality Reduction - Principal Component Analysis - Probabilistic PCA- Independent Components analysis</p> <p><b>Practical Component: (Using Python Libraries / MATLAB Tool)</b></p> <ul style="list-style-type: none"> <li>(i) Segment a customer dataset based on the buying behaviour of customers using K-means/Hierarchical clustering.</li> <li>(ii) Dimensionality reduction of any image dataset using Principal Component Analysis.</li> </ul> <p><b>Suggested reading:</b></p> <p>Dimensionality Reduction - <a href="http://nptel.ac.in/courses/106106139/14">http://nptel.ac.in/courses/106106139/14</a></p>	<b>CO-3 BTL-4</b>
<b>MODULE 4: ARTIFICIAL NEURAL NETWORKS AND KERNEL MACHINES</b>	<b>(9L+3P)</b>
<p>Perceptron- Multilayer perceptron- Back Propagation – Initialization, Training and Validation Support Vector Machines(SVM) as a linear and non-linear classifier - Limitations of SVM</p> <p><b>Practical Component: (Using Python Libraries / MATLABTool)</b></p> <ul style="list-style-type: none"> <li>(i) Recognition of MNIST handwritten digits using Artificial Neural Network.</li> <li>(ii) Classification of images/any relevant dataset using SVM.</li> </ul> <p><b>Suggested reading:</b></p> <ul style="list-style-type: none"> <li>➤ ANN - <a href="http://nptel.ac.in/courses/106106139/32">http://nptel.ac.in/courses/106106139/32</a></li> <li>➤ SVM - <a href="http://nptel.ac.in/courses/106106139/26">http://nptel.ac.in/courses/106106139/26</a></li> </ul>	<b>CO-4 BTL-3</b>
<b>MODULE 5: PROBABILISTIC GRAPHICAL MODELS</b>	<b>(9L+3P)</b>

Bayesian Networks - Learning Naive Bayes classifiers-Markov Models – Hidden Markov Models Sampling – Basic sampling methods – Monte Carlo -Reinforcement Learning <b>Practical Component: (Using Python Libraries / MATLAB Tool)</b> <div><div>(i)</div><div>Text classification using Naïve Bayes Classifier.</div></div> <div><div>(ii)</div><div>Predict future stock price of a company using Monte Carlo Simulation.</div></div> <b>Suggested reading:</b> <div><div>➤</div><div>Hidden Markov Model - <a href="http://nptel.ac.in/courses/106106139/67">http://nptel.ac.in/courses/106106139/67</a></div></div> <div><div>➤</div><div>Reinforcement Learning- <a href="http://nptel.ac.in/courses/106106139/83">http://nptel.ac.in/courses/106106139/83</a></div></div>		<b>CO-5</b> <b>BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.	
2.	Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009.	
3.	Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2011.	
<b>REFERENCE BOOKS</b>		
1.	Andreas C. Muller, “Introduction to Machine Learning with Python: A Guide for Data Scientists”, O'Reilly,2016.	
2.	Sebastian Raschka, “Python Machine Learning”, Packt Publishing, 2015.	
3.	Hastie, Tibshirani, Friedman, “The Elements of Statistical Learning: Data Mining, Inference, and Prediction”,2 <sup>nd</sup> Edition, Springer, 2017.	
4.	Ethem Alpaydin, “Introduction to Machine Learning”, 2nd Revised edition, MIT Press,2010.	
<b>E BOOKS</b>		
1.	<a href="http://pdf.th7.cn/download/files/1603/Mastering%20Machine%20Learning%20with%20scikit-learn.pdf">http://pdf.th7.cn/download/files/1603/Mastering%20Machine%20Learning%20with%20scikit-learn.pdf</a>	
<b>MOOC</b>		
1.	<a href="https://www.coursera.org/learn/machine-learning#syllabus">https://www.coursera.org/learn/machine-learning#syllabus</a>	
2.	<a href="https://in.udacity.com/course/intro-to-machine-learning--ud120">https://in.udacity.com/course/intro-to-machine-learning--ud120</a>	
3.	<a href="https://www.udemy.com/machinelearning/">https://www.udemy.com/machinelearning/</a>	

COURSE TITLE	DATA WAREHOUSING AND DATA MINING			CREDITS	3
COURSE CODE	CSB4318	COURSE CATEGORY	PC	L-T-P-S	3-0-0-1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

<b>Course Description</b>	This course gives an introduction to methods and theory for development of data warehouses and data analysis using data mining. Data quality and methods and techniques for preprocessing of data. Modeling and design of data warehouses. Algorithms for classification, clustering and association rule analysis. Practical use of software for data analysis.														
<b>Course Objective</b>	1. To describe the data warehouse and analytical processing 2. To perform data preprocessing 3. To implement classification algorithms 4. To implement clustering methods 5. To give an exposure to data mining tools.														
<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. Describe the functionality of data warehousing component and working of online analytical processing 2. Perform data preprocessing and generate frequent patterns from a given data set. 3. Implement standard classification algorithms and assess the quality of classification models. 4. Demonstrate basic clustering models and perform outlier analysis. 5. Apply data mining on real time applications and infer the outcomes.														
<b>Prerequisites: Nil</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
<b>CO-1</b>	3	3	3	3	3	2	-	-	-	-	3	3	3	3	3
<b>CO-2</b>	3	3	3	3	2	2	-	-	-	-	3	3	3	3	3
<b>CO-3</b>	3	3	3	2	2	2	-	-	-	-	3	2	3	3	3
<b>CO-4</b>	3	3	3	2	1	2	-	-	-	-	3	2	3	3	3
<b>CO-5</b>	3	3	3	2	2	1	-	-	-	-	2	2	3	3	3
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: DATA WAREHOUSING AND ONLINE ANALYTICAL PROCESSING (9)</b>															
Basic of Data Warehouse - Data Warehouse Modeling: Data Cube and OLAP - Data Warehouse Implementation - Data Generalization by Attribute-Oriented Induction - Data Cube Computation - Data Cube Computation Methods - Processing Advanced Kinds of Queries by Exploring Cube Technology - Multidimensional Data Analysis in Cube Space.													<b>CO-1</b> <b>BTL-2</b>		
<b>MODULE 2: INTRODUCTION, DATA PREPROESSING AND MINING FREQUENT PATTERNS AND ASSOCIATON (9)</b>															
Introduction to data mining – kinds of data – Kinds of patterns to be mined – Technologies – applications – issues in mining – Data objects and attribute types – statistical distribution of data – data visualization – Measuring Data similarity and dissimilarity – Need for preprocessing – Data cleaning – Data Integration – Data reduction - Data Transformation and Data Discretization - Frequent Itemsets, Closed Itemsets, and Association Rules - Frequent Itemset Mining Methods.													<b>CO-2</b> <b>BTL-3</b>		

<b>MODULE 3: CLASSIFICATION (9)</b>	
Basics – Decision tree Induction – Baye’s Classification - Rule-Based Classification - Model Evaluation and Selection - Techniques to Improve Classification Accuracy - Bayesian Belief Networks - Classification by Backpropagation - Support Vector Machines - Classification Using Frequent Patterns - Lazy Learners (or Learning from Your Neighbors) - Other Classification Methods.	<b>CO-3</b> <b>BTL-3</b>
<b>MODULE 4: CLUSTERING (9)</b>	
Basics - Partitioning Methods - Hierarchical Method - Density-Based Methods - Grid-Based Methods - Evaluation of Clustering - Clustering with Constraints - Outliers and Outlier Analysis - Outlier Detection Methods - Statistical Approaches - Proximity-Based Approaches - Clustering-Based Approaches.	<b>CO-4</b> <b>BTL-3</b>
<b>MODULE 5: DATA MINING TRENDS AND RESEARCH FRONTIERS (9)</b>	
Mining Complex Data Types - Other Methodologies - Data Mining Applications - Data Mining and Society – Data Mining Trends – Real world applications – Data Mining Tool study.	<b>CO-5</b> <b>BTL-4</b>
<b>TEXT BOOKS</b>	
1.	Han, M.Kamber, “Data Mining: Concept and Techniques”, Academic Press, Morgan Kaufmann Publishers, 3rd Edition, 2012.
<b>REFERENCE BOOKS</b>	
1.	Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw Hill, 2016.
2.	Pieter Adrians, DolfZantinge, “Data Mining”, Addison Wesley, 2000.
<b>E BOOKS</b>	
1.	<a href="https://cs.wmich.edu/~yang/teach/cs595/han/ch01.pdf">https://cs.wmich.edu/~yang/teach/cs595/han/ch01.pdf</a>
<b>MOOC</b>	
1.	<a href="https://www.mooc-list.com/course/data-warehouse-concepts-design-and-data-integration-coursera">https://www.mooc-list.com/course/data-warehouse-concepts-design-and-data-integration-coursera</a>
2.	<a href="https://www.coursera.org/specializations/data-mining">https://www.coursera.org/specializations/data-mining</a>
3.	<a href="https://swayam.gov.in/courses/4412-data-mining">https://swayam.gov.in/courses/4412-data-mining</a>

<b>COURSE TITLE</b>	<b>MODERN SOFTWARE ENGINEERING</b>			<b>CREDITS</b>	<b>4</b>
<b>COURSE CODE</b>	<b>CSB4319</b>	<b>COURSE CATEGORY</b>	<b>PC</b>	<b>L-T-P-S</b>	<b>3-0-2-0</b>
<b>Version</b>	<b>1.0</b>	<b>Approval Details</b>		<b>LEARNING LEVEL</b>	<b>BTL-4</b>
<b>ASSESSMENT SCHEME</b>					



First Periodical Assessment	Second Periodical Assessment	Practical Component	ESE												
15%	15%	20%	50%												
Course Description	This course covers the fundamentals of software engineering, including understanding system requirements, finding appropriate engineering compromises, effective methods of design, coding, and testing, team software development, and the application of engineering tools.														
Course Objective	<div>1. To provide an understanding of different software processes and how to choose between them</div> <div>2. To discuss How to elicit requirements from a client and specify them</div> <div>3. To Design in the large, including principled choice of a software architecture, the use of modules and interfaces to enable separate development, and design patterns.</div> <div>4. To illustrate good coding practices, including documentation, contracts, regression tests and daily builds.</div> <div>5. To demonstrate various quality assurance techniques, including unit testing, functional testing, and automated analysis tools.</div>														
Course Outcome	<div>Upon completion of this course, the students will be able to</div> <div>1. Analyze and choose appropriate process model and represent the given software project scenario.</div> <div>2. Elicit the requirements and develop suitable requirement model.</div> <div>3. Design the software architecture model based on requirements gathered</div> <div>4. Distinguish between the different quality assurance strategies and testing methods</div> <div>5. Summarize the activities of Software Configuration Management</div>														
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	2	2	2	1	2	2	2	1	2	1	1	3	2	1
CO-2	3	2	-	1	1	-	3	2	-	-	-	1	2	2	1
CO-3	3	2	1	2	1	3	3	-	1	-	1	1	2	2	1
CO-4	2	3	1	1	1	2	3	1	-	2	-	1	1	2	1
CO-5	3	3	3	3	2	3	2	1	2	2	2	2	3	3	1
1: Weakly related, 2: Moderately related and 3: Strongly related															

MODULE 1: INTRODUCTION SOFTWARE ENGINEERING AND PROCESS MODELS (12)	
<p>Introduction to Software Engineering – Generic Process model – Perspective process model – Specialized process model – Unified process model – Personal and Team process model – Agile process – Extreme programming – Agile process model – Adaptive Software Development (ASD) – Scrum – Dynamic Systems Development Method (DSDM) – Crystal – Feature Driven Development (FDD) – Lean Software Development (LSD) – Agile Modelling (AM), Agile Unified Process (AUP) – Tool set for the Agile process.</p> <p><b>Practical Component:</b> Design and develop an Agile process models using Scrum, highlighting the outcome of each stage.</p>	<p><b>CO-1</b></p> <p><b>BTL-3</b></p>
MODULE 2: SOFTWARE REQUIREMENTS ANALYSIS AND MODELING (12)	
<p>Requirements Engineering – Eliciting requirements – Developing use cases – Building the requirement model – Negotiating requirements – validating requirements – Scenario based modelling – UML models – Data modelling – Class based, Flow oriented and Behavioural modelling – Patterns for requirement modelling – Requirement modelling for WebApps.</p> <p><b>Practical Component:</b> Consider a real time scenario and using standard tools, develop the Software Requirement Specification Document following the IEEE standards.</p>	<p><b>CO-2</b></p> <p><b>BTL-3</b></p>
MODULE 3: DESIGN CONCEPTS AND PRINCIPLES (12)	
<p>Design process – Design concepts - Design model – Software architecture – Architectural genres – Architectural styles – Architectural design– Component – Designing class based components – Component level design for WebApps – Designing traditional components – Component based development - User Interface Design – Golden rules – Interface analysis and design steps – WebApp Interface design - WebApp design – Design pyramid – Aesthetic design – Content design – Architectural design – Navigation design – Component level design.</p> <p><b>Practical Component:</b> Construct the various design diagrams to represent the process flow and data flow for a given problem specification using Rational Rose / Open source tools.</p>	<p><b>CO-3</b></p> <p><b>BTL-4</b></p>
MODULE 4: SOFTWARE QUALITY ASSURANCE AND TESTING (12)	
<p>Elements of Software Quality Assurance – SQA tools, goals and metrics – Six sigma for Software Engineering – Measures of software reliability and availability – Software safety – ISO 9000 quality standards – SQA plan – Strategic approach to software testing – Verification and validation – Test strategies for conventional software – Test strategies for Object oriented software – Test strategies for WebApps – Validation testing – System Testing – Art of Debugging.</p> <p><b>Practical Component:</b> Demonstrate the working of any two standard testing tools.</p>	<p><b>CO-4</b></p> <p><b>BTL-4</b></p>
MODULE 5: SOFTWARE CONFIGURATION MANAGEMENT (12)	

Software Configuration Management – Elements of SCM - SCM Repository – SCM Process – Version control - Change control – Configuration control – Status reporting - Configuration management for WebApps – Content management – Change management – Version control – Auditing and reporting.		<b>CO-5</b> <b>BTL-3</b>
<b>Practical Component:</b> Prepare a study report on SCM tools such as Ansible, CFEngine, Chef, Puppet, Salt.		
<b>TEXT BOOKS</b>		
1.	Roger S. Pressman, Software Engineering- A practitioner’s Approach, 7 <sup>th</sup> Editon., McGraw-Hill, 2014.	
<b>REFERENCE BOOKS</b>		
1.	Ian Sommerville, Software Engineering, Pearson Education Asia, 7th edition, 2011	
2.	Pankaj Jalote- An Integrated Approach to Software Engineering, Springer Verlag, 2008	
3.	James F Peters and Witold Pedryez, “Software Engineering – An Engineering Approach”, John Wiley and Sons, New Delhi, 2007	
4.	K.K. Agarwal and Yogesh Singh, “Software Engineering”, New Age International Publishers, Third edition, 2008.	
<b>E BOOKS</b>		
1.	<a href="http://www4.ncsu.edu/~tjmenzie/cs510/pdf/SWEBOKv3.pdf">http://www4.ncsu.edu/~tjmenzie/cs510/pdf/SWEBOKv3.pdf</a>	
2.	<a href="https://edisciplinas.usp.br/mod/resource/view.php?id=1094198">https://edisciplinas.usp.br/mod/resource/view.php?id=1094198</a>	
<b>MOOC</b>		
1.	<a href="https://www.coursera.org/courses?languages=en&amp;query=software%20engineering">https://www.coursera.org/courses?languages=en&amp;query=software%20engineering</a>	
2.	<a href="https://www.edx.org/course/software-engineering-introduction-ubcx-softeng1x">https://www.edx.org/course/software-engineering-introduction-ubcx-softeng1x</a>	
3.	<a href="https://nptel.ac.in/courses/106101061/">https://nptel.ac.in/courses/106101061/</a>	

COURSE TITLE	BUSINESS ECONOMICS			CREDITS	2
COURSE CODE	GEA4304	COURSE CATEGORY	BS	L-T-P-S	2- 0- 0- 1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
<b>ASSESSMENT SCHEME</b>					

First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE										
15%	15%	10%	5%	5%	50%										
Course Description	This course encompasses the knowledge to apply economic theory as well as analysis in the process of decision making of a specific business. It is a field of applied economics that studies the financial, organizational, market-related, and environmental issues faced by corporations. Students get to know the concepts such as scarcity, product factors, distribution, and consumption.														
Course Objective	1. To have a knowledge on the introduction factors of Business economics. 2. To Demonstrate cost analysis of the business fields. 3. Enable knowledge about consumer’s and producer’s behavior. 4. Explain about budget. 5. Educate about financial services.														
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the concepts of economics. 2. Demonstrate the cost analysis with respect to elements of cost. 3. Building insights about consumer’s and producer’s behavior. 4. Develop extensive study and application of budgets. 5. Utilize the operations on financial services.														
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	1	-	-	-	-	-	-	-	-	3	-	-	-	-
CO-2	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-
CO-3	-	1	-	-	-	-	-	2	-	-	3	-	-	-	-
CO-4	-	3	-	-	-	-	-	-	-	-	3	-	-	-	-
CO-5	-	3	-	-	-	-	-	-	-	-	2	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO JAVA and OOP (6L)															
Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics.													CO-1 BTL-2		
MODULE 2: INHERITANCE, PACKAGES AND INTERFACE(6L)															

Types of Cost, Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break- even analysis, Economies of Scale Cost Classification		<b>CO-2</b> <b>BTL-2</b>
<b>MODULE 3: EXCEPTION HANDLING AND MULTITHREADING(6L)</b>		
Consumer Behavior: Law of Diminishing Marginal utility – Equimarginal Utility – Consumer’s Equilibrium - Indifference Curve – Production: Law of Variable Proportion – Laws of Returns to Scale – Producer’s equilibrium – Economies of Scale Cost Classification.		<b>CO-3</b> <b>BTL-3</b>
<b>MODULE 4: INPUT/OUTPUT STREAMS (6L)</b>		
Process of budgeting in India –classification of budgets trends – evaluation systems – types of deficits – fiscal policy – indicators — taxation – Centre, state and local – public debt and management.		<b>CO-4</b> <b>BTL-2</b>
<b>MODULE5: Working With AWT Classes Swing, Applet And Graphics (6L)</b>		
Basics of finance and financial environment – instruments of financial markets – financial intermediation – investment banking and brokerage services – securities – types of securities –market for securities – how and where traded – initial public offering (IPO) – secondary markets – trading on exchanges and trading with margins.		<b>CO-5</b> <b>BTL-2</b>
<b>TEXT BOOKS</b>		
1.	S.Shankaran, Business Economics - Margham Publications.	
2.	H.L. Ahuja, Business Economics – Micro & Macro - Sultan Chand & Sons - New Delhi – 55.	
<b>REFERENCE BOOKS</b>		
1.	S.A.Ross, R.W.Westerfield, J.Jaffe and Roberts: Corporate Finance, McGraw-Hill.	
2.	Joseph E Stiglitz: Economics of the Public Sector.	
<b>MOOC</b>		
1.	<a href="https://sites.google.com/site/readbookpdf7734/pdf-download-business-economics-by---mark-taylor-read-online">https://sites.google.com/site/readbookpdf7734/pdf-download-business-economics-by--- mark-taylor-read-online</a>	
2.	<a href="https://bookboon.com/en/economics-ebooks">https://bookboon.com/en/economics-ebooks</a>	

COURSE TITLE	COMPILER DESIGN LAB			CREDITS	2
COURSE CODE	CSB4341	COURSE CATEGORY	PC	L-T-P-S	0- 0- 3- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME															
Continuous Internal Assessment														ESE	
80%														20%	
Course Description		This laboratory course introduces the students to experiment on the basic techniques of compiler design techniques like lexical analysis, parser and the related semantic rules. Students will design and implement the different phases of a compiler by using YACC tools to automate parts of the implementation process. This will provide deeper insights into the subject.													
Course Objective		1. To know the steps in the implementation of a lexical analyzer. 2. To understand the expression grammar and thus implement a parser. 3. Understand the semantic rules for the implementation of YACC Programs. 4. To develop a HTML generator. 5. To design the different phases of a compiler.													
Course Outcome		Upon completion of this course, the students will be able to 1. Design and implement a lexical analyzer 2. Evaluate and implement a parser for Expression grammar 3. Enumerate the semantic rules for YACC Program 4. Design a LEX and YACC to implement a HTML generator 5. Use new tools and technologies for designing different phases of a compiler													
Prerequisites: System Software, C Programming															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	1	3	3	-	2	-	-	-	-	-	-	-	-	-	-
CO-2	1	3	3	-	2	-	-	-	-	-	-	-	-	-	-
CO-3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4	3	1	3	-	-	-	-	-	-	-	-	-	-	-	-
CO-5	1	3	2	-	3	-	-	-	-	-	-	1	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
LIST OF EXPERIMENTS															
1. Implement a lexical analyzer in “C”.														CO-1 BTL-5	
2. Use LEX tool to implement a lexical analyzer.														CO-1 BTL-5	

3. Implement a recursive descent parser for an expression grammar that generates arithmetic expressions with digits, + and *.	<b>CO-2</b> <b>BTL-5</b>
4. Use YACC and LEX to implement a parser for the same grammar as given in problem 3.	<b>CO-2</b> <b>BTL-5</b>
5. Write semantic rules to the YACC program in problem 4 and implement a calculator that takes an expression with digits, + and * and computes and prints its value.	<b>CO-3</b> <b>BTL-5</b>
6. Use Lex and YACC to implement a HTML generator so that the program generates a HTML file which can be viewed in browser. Sample Input: Red Hello, 12 welcome should render the HTML code for displaying 'Hello' in red and 'Welcome' with the size 12	<b>CO-3</b> <b>BTL-5</b>
7. Implement the front end of a compiler that generates the three-address code for a simple language with: one data type integer, arithmetic operators, relational operators, variable declaration statement, one conditional construct, one iterative construct and assignment statement.	<b>CO-4</b> <b>BTL-2</b>
8. Implement the back end of the compiler which takes the three-address code generated in problem 6, and produces the 8086 assembly language instructions that can be assembled and run using an 8086 assembler. The target assembly instructions can be simple move, add, sub, jump. Also, simple addressing modes are used.	<b>CO-5</b> <b>BTL-2</b>

**TEXT BOOKS**

1.	Alfred Aho, Lam, Ravi Sethi, Jeffrey D Ullman, "Compilers Principles, Techniques and Tools", Pearson Education , New International edition , 2016.
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**E BOOKS**

1.	Steven S.Muchnick, "Advanced Compiler design implementation" Morgan Kaufmann/ Elsevier Science India, 2003.
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**REFERENCE BOOKS**

1.	Allen I. Holub, "Compiler Design in C", Prentice Hall of India, 2006.
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COURSE TITLE	Design Project-II			CREDITS	1
COURSE CODE	CSB4342	COURSE CATEGORY	LAB	L-T-P-S	0-0-2-0

Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Review (Concept)	Second Review (Design)	Third Review (Experiment/ Analysis)	Project Report and Vivo- voce (Results and Conclusion)	ESE	
20%	30%	20%	30%	---	
Course Description	This course is mainly focused on team building and product development as it will make them industry ready. To apply the concepts, principles and algorithms learnt in the field of computer science and build products/tools/applications addressing the needs of real-world societal issues.				
Course Objective	<div><div>1.</div><div>To analyse, design and develop products/tools/applications to solve the issues related to real world problems.</div><div>2.</div><div>To apply the concepts, principles and algorithms learnt in the field of computer science.</div><div>3.</div><div>To exercise the lifecycle of project development by following the principles of software engineering.</div><div>4.</div><div>To inculcate the qualities of team building and develop the skills of technical document writing.</div><div>5.</div><div>To examine the various algorithms of study and thus to evaluate and compare the output generated.</div></div>				
Course Outcome	<div><div>Upon completion of this course, the students will be able to</div><div>1.</div><div>Analyse, design and develop products/tools/applications to address the societal needs.</div><div>2.</div><div>Design, develop and test program segments that constitute a software/hardware product</div><div>3.</div><div>Demonstrate the software engineering principles and improve the project management skills</div><div>4.</div><div>Appraise the hardware/software product developed in the form of technical presentations, demonstrations and report generation through team work.</div><div>5.</div><div>Examine and make a comparative analysis of the algorithms involved in the course of the project work.</div></div>				
Prerequisites: Basic programming knowledge					



CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	-	2	-	-	3	3	3	2	3	3	2
CO-2	3	3	3	3	-	2	-	3	3	3	3	2	3	3	2
CO-3	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3
CO-4	3	3	3	3	3	2	-	3	3	-	3	2	3	3	3
CO-5	3	3	3	3	3	2	-	3	3	-	3	2	3	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
Note															
<ul style="list-style-type: none"> <li>The students in convenient groups of not more than 3 members have to identify a product for design and fabrication.</li> <li>Every project work shall have a guide who is the member of the faculty of the Department.</li> <li>Design, develop, test and implement a hardware/software system that is demonstratable with required data set.</li> <li>Assessment is based on creativity, applicability to the society, project development skills, team work.</li> <li>Technical communication, presentation and report writing skills form an essential component in assessment.</li> </ul>														CO1, CO2, CO3, CO4/BTL3	

COURSE TITLE	INTERNSHIP			CREDITS	1
COURSE CODE	CSB4343	COURSE CATEGORY	LAB	L-T-P-S	0-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
Technical report/ Certificate		Presentation and Vivo- voce			ESE
30%		70%			---
Course Description	This course is mainly focused on providing links to classroom learning with industry. To apply the concepts, principles and algorithms learnt in the field of computer science and build products/tools/applications addressing the needs of real-world societal issues.				

Course Objective	<div>1. To analyse, design and develop products/tools/applications to solve the issues related to real world problems.</div> <div>2. To learn critical thinking and problem-solving knowledge in an applied work setting</div> <div>3. To get professional behaviour and knowledge.</div> <div>4. To develop the skills of technical document writing and presentation.</div> <div>5. To develop communication skills and technical knowledge.</div>														
Course Outcome	<div>Upon completion of this course, the students will be able to</div> <div>1. Analyse, design and develop products/tools/applications to address the societal needs.</div> <div>2. Design, develop and test program segments that constitute a software/hardware product</div> <div>3. Demonstrate the software engineering principles and improve the project management skills</div> <div>4. Appraise the hardware/software product developed in the form of technical presentations, demonstrations and report generation through team work.</div> <div>5. Display his communication skills and elaborate on his skillset achieved.</div>														
Prerequisites: Basic programming knowledge															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	-	2	-	-	3	3	3	2	3	3	2
CO-2	3	3	3	3	-	2	-	3	3	3	3	2	3	3	2
CO-3	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3
CO-4	3	3	3	3	3	2	-	3	3	-	3	2	3	3	3
CO-5	3	3	3	3	3	2	-	3	3	-	3	2	3	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
Note															
<div><div>• A student has to compulsorily attend Summer / Winter internship during 3rd year for a minimum period of one month.</div><div>• In lieu of Summer / Winter internship, the student is permitted to register for undertaking case study / project work under an engineering faculty of the Institute and carry out the project for minimum period of one month.</div><div>• In both the cases, the internship report in the prescribed format duly certified by the faculty in-charge shall be submitted to the HoD.</div><div>• Assessment is based on creativity, applicability to the society, project development skills, team work.</div><div>• Technical communication, presentation and report writing skills form an essential component in assessment.</div></div>														CO1, CO2, CO3, CO4, CO5 /BTL3	

COURSE TITLE		SOFTWARE PROJECT MANAGEMENT						CREDITS			3				
COURSE CODE		CSB4401		COURSE CATEGORY		PC		L-T-P-S			3- 0- 0- 1				
Version		1.0		Approval Details				LEARNING LEVEL			BTL-3				
ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment		Seminar/ Assignments/ Project		Surprise Test / Quiz		Attendance			ESE				
15%		15%		10%		5%		5%			50%				
Course Description		A Software Project Management is the complete procedure of software development from requirement gathering to testing and maintenance, carried out according to the execution methodologies, in a specified period of time to achieve intended software product.													
Course Objective		<div>1. To understand the project management principles.</div> <div>2. To demonstrate the basic project management concepts and process models.</div> <div>3. Acquiring knowledge on the software estimation techniques.</div> <div>4. To estimate the risks involved in the project activities.</div> <div>5. To enable the students to understand the concepts of checkpoints, project reporting structure, project progress and tracking mechanisms.</div>													
Course Outcome		<div>Upon completion of this course, the students will be able to</div> <div>1. Frame Project Management principles while developing software.</div> <div>2. Demonstrate basic project management concepts, framework and the process models.</div> <div>3. Acquire adequate knowledge about software process models and software effort estimation techniques.</div> <div>4. Estimate the risks involved in various project activities.</div> <div>5. Design staff selection process and address issues related to peoplemanagement.</div>													
Prerequisites: Software Engineering															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	1	2	3	-	-	2	-	-	-	-	3	3	-	-	-
CO-2	1	3	-	-	-	-	-	-	-	-	3	-	-	-	-
CO-3	1	3	-	-	-	-	-	-	-	-	3	-	-	-	-
CO-4	-	3	3	-	-	2	-	-	-	-	3	-	3	3	-

CO-5	-	2	3	-	-	-	-	-	-	3	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: PROJECT EVALUATION AND PROJECT PLANNING (9L)														
Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.													CO-1 BTL-2	
MODULE 2: PROJECT LIFECYCLE AND EFFORT ESTIMATION(9L)														
Software productivity – Factors affecting software pricing – size related metrics & function related metrics – Factors affecting software engineering productivity – Estimation techniques – Algorithmic cost modelling – COCOMO Model – early design model – Reuse model – Project cost drivers - Algorithmic cost models in project planning – Project duration and staffing – Software measurement and metrics – Measurement process – Product metrics – Analysis of measurements – Case studies.													CO-2 BTL-2	
MODULE 3: ACTIVITY PLANNING AND RISK MANAGEMENT(9L)														
Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules.													CO-3 BTL-3	
MODULE 4: PROJECT MANAGEMENT AND CONTROL (9L)														
Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract Management.													CO-4 BTL-2	
MODULE5: STAFFING IN SOFTWARE PROJECTS(9L)														
Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership.													CO-5 BTL-2	
TEXT BOOKS														
1.	Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.													
REFERENCE BOOKS														
1.	Robert K. Wysocki —Effective Software Project Management, Wiley Publication, 2011.													

2.	Kelkar Sa, “Software Project Management”, Third Edition, PHI Learning, New Delhi, 2012
3.	Gopalaswamy Ramesh, —Managing Global Software Projects – McGraw Hill Education (India), Fourteenth Reprint 2013.
4.	Walker Royce: Software Project Management- Addison-Wesley, 1998.
<b>E BOOKS</b>	
1.	<a href="https://www.scribd.com/doc/194093672/Software-Project-Management-Bob-Hughes-and-Mike-Cotterell-Tata-Mcgraw-Hill-Edition">https://www.scribd.com/doc/194093672/Software-Project-Management-Bob-Hughes-and-Mike-Cotterell-Tata-Mcgraw-Hill-Edition</a>
2.	<a href="http://www.mim.ac.mw/books/Effective%20Project%20Management%20Traditional%20Adaptive%20Extreme%203rd%20Edition.pdf">http://www.mim.ac.mw/books/Effective%20Project%20Management%20Traditional%20Adaptive%20Extreme%203rd%20Edition.pdf</a>
<b>MOOC</b>	
1.	<a href="https://onlinecourses.nptel.ac.in/noc18_mg08/preview">https://onlinecourses.nptel.ac.in/noc18_mg08/preview</a>
2.	<a href="https://www.udemy.com/software-project-management-for-start-ups/">https://www.udemy.com/software-project-management-for-start-ups/</a>

COURSE TITLE	BIG DATA AND ANALYTICS			CREDITS	4
COURSE CODE	CSB4402	COURSE CATEGORY	PC	L-T-P-S	3- 0- 2- 1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	Big data analytics is the use of advanced analytic techniques against very large, diverse data sets that include structured, semi-structured and unstructured data, from different sources, and in different sizes from terabytes to zettabytes. Big Data analytics provides various advantages—it can be used for better decision making, preventing fraudulent activities, among other things.				
Course Objective	<div>1. To understand the importance of Big Data Analytics.</div> <div>2. To have knowledge on the statistical techniques for Big data Analytics.</div> <div>3. To acquire understanding in mining data streams.</div> <div>4. Enable the students to know about clustering techniques.</div> <div>5. Usage of graph analytics and thus to provide solutions.</div> <div>6. To learn about Hadoop map, Reduce programming.</div>				

<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. Outline the importance of Big Data Analytics 2. Apply statistical techniques for Big data Analytics. 3. Analyze problems appropriate to mining data streams. 4. Apply the knowledge of clustering techniques in data mining. 5. Use Graph Analytics for Big Data and provide solutions and apply Hadoop map Reduce programming for handing Big Data														
<b>Prerequisites:</b> Database basics															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO-1	3	3	3	-	-	-	-	-	-	-	-	-	1	1	-
CO-2	3	3	3	3	3	-	-	-	-	-	-	3	1	1	-
CO-3	3	3	3	3	3	-	-	-	-	-	-	-	1	1	-
CO-4	3	3	3	3	3	-	-	-	-	-	-	-	1	1	-
CO-5	3	3	3	3	3	-	-	-	-	-	-	3	1	1	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: INTRODUCTION TO BIG DATA (9L+6P)</b>															
Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - Evolution Of Analytic Scalability - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error. <b>Practical Component:</b> 1. Study of R Programming. 2. Hypothesis Test using R. <b>Suggested reading :</b> <a href="https://www.coursera.org/learn/big-data-introduction">https://www.coursera.org/learn/big-data-introduction</a>													<b>CO-1 BTL-2,3</b>		
<b>MODULE 2: DATA ANALYSIS, CLUSTERING AND CLASSIFICATION(9L+6P)</b>															
Regression Modeling - Multivariate Analysis - Bayesian Modeling - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction. Overview of Clustering - K-means - Use Cases - Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions .- Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Bayes’ Theorem - Naïve Bayes Classifier. <b>Practical Component:</b> 1. K-means Clustering using R													<b>CO-2 BTL-2,3</b>		

2. Naïve Bayesian Classifier		
3. Implementation of Linear Regression		
4. Implement Logistic Regression		
MODULE 3: STREAM MEMORY		(9L+6P)
Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions. <b>Practical Component:</b> 1. Time-series Analysis		CO-3  BTL-3
MODULE 4: ASSOCIATION AND GRAPH MEMORY (9L+6P)		
Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm - Evaluation of Candidate Rules - Applications of Association Rules - Finding Association& finding similarity - Graph Analytics for Big Data: Graph Analytics - The Graph Model - Representation as Triples - Graphs and Network Organization - Choosing Graph Analytics - Graph Analytics Use Cases - Graph Analytics Algorithms and Solution Approaches - Technical Complexity of Analyzing Graphs- Features of a Graph Analytics Platform. <b>Practical Component:</b> 1.Association Rules using R.		CO-4  BTL-2,3
MODULE5: FRAMEWORKS AND VISUALIZATION		(9L+6P)
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Visualizations - Visual Data Analysis Techniques - Interaction Techniques; Systems and Analytics Applications - Analytics using Statistical packages-Approaches to modeling in Analytics – correlation, regression, decision trees, classification, association-Intelligence from unstructured information-Text analytics-Understanding of emerging trends and Technologies-Industry challenges and application of Analytics- Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R. <b>Practical Component:</b> 1.Data Analysis-Visualization using R. 2.Map Reduce using Hadoop 3. In-database Analytics 4. Implementation of Queries using Mongo DB		CO-5  BTL-2,3
TEXT BOOKS		
1.	David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.	
2.	Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012	
3.	Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.	
REFERENCE BOOKS		
1.	EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.	

2.	Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
3.	Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers " CRC Press, 2015
4.	Jimmy Lin and Chris Dyer, "Data-Intensive Text Processing with MapReduce", Synthesis Lectures on Human Language Technologies, Vol. 3, No. 1, Pages 1-177, Morgan Claypool publishers, 2010.
5.	Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012.

**MOOC**

1.	<a href="https://www.edx.org/course/big-data-analytics-2">https://www.edx.org/course/big-data-analytics-2</a>
2.	<a href="http://nptel.ac.in/courses/110106072/">http://nptel.ac.in/courses/110106072/</a>

COURSE TITLE	APPLIED CRYPTOGRAPHY AND NETWORK SECURITY			CREDITS	4
COURSE CODE	CSB4403	COURSE CATEGORY	PC	L-T-P-S	3- 1- 0- 1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3

**ASSESSMENT SCHEME**

First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

<b>Course Description</b>	Applied Cryptography gives a focus on symmetric and public-key, cryptographic protocols, key distribution, authentication, digital signature structures. Network security elaborates on the topics such as access control, services and mechanisms for authentication, network security protocols, application layer security and secure network management.
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To understand Classical and Modern Cryptography.</li> <li>2. To solve cryptographic techniques, like block cipher operations.</li> <li>3. Understand authentication algorithms to prevent unauthorized access.</li> <li>4. To develop authentication applications by applying secure keys.</li> <li>5. To learn the concepts of Wireless Network security using WAP and IP sec.</li> </ol>
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Justify the need of Data Security in communication system and differentiate Classical and Modern Cryptography.</li> <li>2. Create cypher text using modern cryptography and describe the block cypher operation.</li> <li>3. Develop and Apply the authentication algorithms to prevent unauthorized access to the documents for specific application.</li> <li>4. Differentiate Computer security and network security and develop a system for Remote user authentication by applying secure Key Distribution concept.</li> <li>5. Design a solution for Wireless Network security using WAP and IP sec.</li> </ol>

**Prerequisites:** Basics of Networks



CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	-	1	-	-	-	-	-	-	1	1	1	-
CO-2	3	3	-	-	-	-	-	-	-	2	-	1	1	1	-
CO-3	3	3	2	-	-	1	-	-	-	-	-	1	1	1	-
CO-4	2	3	3	2	-	-	-	-	-	-	-	1	1	1	-
CO-5	2	3	-	-	-	1	-	-	-	-	-	1	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: COMPUTER SECURITY BASICS (9L+3T)															
Computer Security Concepts, OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Model for Network Security, Classical Encryption techniques-Substitution and Transposition methods, Block Cipher Principles.														CO-1 BTL-2	
MODULE 2: ENCRYPTION STANDARDS AND BLOCK CIPHER OPERATION(9L+3T)															
Data Encryption Standard- DES Encryption- Initial Permutation- Details of Single Round- Key Generation- DES Decryption, Advanced Encryption Standard (AES)- General Structure-Detailed Structure, AES Transformation Functions, Multiple Encryption and Triple DES-Double DES-Triple DES with Two Keys- Triple DES with Three Keys, Block Cipher Operation-Electronic Code Book- Cipher, Block Chaining Mode- Cipher Feedback Mode-Output Feedback Mode- Counter Mode.														CO-2 BTL-3	
MODULE 3: AUTHENTICATION AND HASH FUNCTION (9L+3T)															
RSA Algorithm, Diffie-Hellman Key Exchange Algorithm, Applications of Cryptographic Hash Functions, Message Authentication Code- Requirements-Functions- Security, MACs Based on Hash Functions (HMAC), MACs Based on Block Ciphers- Data Authentication Algorithm (DAA) – Cipher-based Message Authentication Code (CMAC) , Digital Signatures –Properties - Attacks and Forgeries - Requirements - Direct Digital Signature, Digital Signature Standard.														CO-3 BTL-3	
MODULE 4: NETWORK SECURITY (9L+3T)															
Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys- Public Announcement of Public Keys - Publicly Available Directory - Public-Key Authority - Public-Key Certificates, Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos, Remote User Authentication Using Asymmetric Encryption.														CO-4 BTL-3	
MODULE5: SYSTEM LEVEL SECURITY (9L+3T)															
Wireless Network Security- Wireless LAN Overview - Wireless LAN Security- Wireless Transport Layer Security- WAP End-to-End Security, E-mail Security – Pretty Good Privacy –														CO-5 BTL-3	

Secure/Multipurpose Internet Mail Extension (S/MIME), IP Security- Overview – Policy – Combining Security Associations, Intruders- Malicious Software – Firewalls.	
<b>TEXT BOOKS</b>	
1.	Behrouz A. Forouzan, "Cryptography and Network Security" 3rd Edition, McGraw Hill Publications, 2016.
2.	Bruce Schneier, "Applied Cryptography, Second Edition", John Wiley & Sons Inc, 2007.
<b>REFERENCE BOOKS</b>	
1.	William Stallings, "Cryptography and Network Security - Principles and Practice Paperback" – PEARSON, Jun 2017.
2.	Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill, 2003.
3.	Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Third Edition, Pearson Education, 2003.
<b>MOOC</b>	
1.	<a href="http://nptel.ac.in/courses/106105031/1">http://nptel.ac.in/courses/106105031/1</a>
2.	<a href="http://nptel.ac.in/courses/106102064/23">http://nptel.ac.in/courses/106102064/23</a>

COURSE TITLE	PROGRAMMING PARADIGMS			CREDITS	3
COURSE CODE	CSB4404	COURSE CATEGORY	PC	L-T-P-S	3- 0- 0- 1
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
<b>ASSESSMENT SCHEME</b>					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	Programming paradigms are the ways to classify programming languages based on their features and characteristics. Some paradigms are concerned mainly with implications for the execution model of the language, such as allowing side effects, or whether the sequence of operations is defined by the execution model.				

<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To have the knowledge of various programming languages and its paradigms.</li> <li>2. To understand the concepts of scripting Languages.</li> <li>3. Awareness various data types and statements in programming languages.</li> <li>4. To develop subprograms by identifying the design issues.</li> <li>5. To enable the knowledge concurrency and exception handling in various programming languages.</li> <li>6. To learn about the functional programming and logic programming.</li> </ol>
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Compare various programming languages.</li> <li>2. Explain the concepts of scripting languages.</li> <li>3. Describe various data types and statements in programming languages.</li> <li>4. Identify design issues and Implement subprograms.</li> <li>5. Explain concurrency and exception handling in various programming languages.</li> </ol>

**Prerequisites: Nil**

#### CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	-	1	-	-	-	-	-	-	3	-	-	-
CO-2	3	3	-	-	-	-	-	-	-	2	-	-	-	-	-
CO-3	3	3	-	-	-	1	-	-	-	-	-	-	-	-	-
CO-4	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-
CO-5	3	3	1	-	-	-	-	-	-	-	-	3	-	-	-

**1: Weakly related, 2: Moderately related and 3: Strongly related**

#### MODULE 1: EVOLUTION OF PROGRAMMING LANGUAGES (9L)

Categories of Languages – Procedural languages: FORTRAN, BASIC, C, COBOL, ALGOL 68, PL/1-Object oriented Languages: ADA, SIMULA, Small Talk, C++, Java, C# - Logic Programming: Prolog – Functional Programming: LISP – Scripting languages.

**CO-1  
BTL-3**

#### MODULE 2: DATA TYPES AND STATEMENTS(9L)

Primitive types, Character, string, arrays, associative arrays, record type, tuple, list, union, pointers – Type checking - Arithmetic and Boolean expressions- overloading of operators. Assignment statements -Selection- Iteration-Unconditional branching.

**Suggested reading:** <http://nptel.ac.in/courses/106102067/21>

**CO-2  
BTL-3**

#### MODULE 3: SUB PROGRAMS AND IMPLEMENTATION (9L)

Fundamentals of sub programs – design issues – local referencing environments– parameter passing methods – overloaded sub programs – generic sub programs. Implementation of sub programs – simple sub program – stack implementation – Nested sub programs - blocks – dynamic scope. <b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106102067/37">http://nptel.ac.in/courses/106102067/37</a>		<b>CO-3</b> <b>BTL-4</b>
<b>MODULE 4: CONCURRENCY AND EXCEPTION HANDLING (9L)</b>		
Concurrency: Semaphores – Monitors – Message passing – Concurrency in Ada, Java and C#. Exception handling: Introduction – Exception handling in C++, Java, Python and Ruby.		<b>CO-4</b> <b>BTL-2</b>
<b>MODULE5: FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES(9L)</b>		
Functional Programming languages: Fundamentals of functional programming languages – LISP, Common LISP, Scheme, Haskell, ML, F# - Comparison of Functional and Imperative languages. Logic Programming Languages: Introduction to predicate calculus – Theorem proving – Basic elements of Prolog- Applications of Logic programming.		<b>CO-5</b> <b>BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Robert W. Sebesta, “Concepts of Programming Languages”, Eleventh Edition, Pearson Education, 2016.	
<b>REFERENCE BOOKS</b>		
1.	Kenneth A. Lambert and Kenneth C. Loudon, “Programming Languages Principles and Practices”, Cengage publications, 3/e, 2012	
2.	Ellis Horowitz, “Fundamentals of Programming Languages”, Springer, 2011	
<b>E BOOKS</b>		
1.	<a href="https://cs444pnu1.files.wordpress.com/2014/02/concepts-of-programming-languages-10th-sebesta.pdf">https://cs444pnu1.files.wordpress.com/2014/02/concepts-of-programming-languages-10th-sebesta.pdf</a>	
<b>MOOC</b>		
1.	<a href="https://swayam.gov.in/courses/1357-functional-programming-in-haskell">https://swayam.gov.in/courses/1357-functional-programming-in-haskell</a>	
2.	<a href="https://www.mooc-list.com/course/programming-languages-part-c-coursera">https://www.mooc-list.com/course/programming-languages-part-c-coursera</a>	

COURSE TITLE	CLOUD DEPLOYMENT			CREDITS	3
COURSE CODE	CSB4405	COURSE CATEGORY	PC	L-T-P-S	2- 0- 2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4

ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment				Practical Component						ESE			
15%		15%				20%						50%			
Course Description		The objective of this course is to define and clarify the cloud technologies that can be used to deploy cloud-based applications and services. It also explains how they differ in their implementation and usage. Any enterprise may implement any of the cloud deployment models and use the cloud services as per their needs.													
Course Objective		1. To understand and create virtual machines using virtualization technologies. 2. To enable knowledge in different cloud delivery and deployment models. 3. Acquiring the basics of cloud file systems with the working knowledge on Hadoop. 4. To demonstrate the key features of cloud security. 5. To design an application using a cloud tool such as AWS /Microsoft Azure.													
Course Outcome		Upon completion of this course, the students will be able to  1. Create virtual machines and summarize different cloud virtualization techniques. 2. Demonstrate different cloud delivery and deployment models 3. Use and explain cloud file systems with Hadoop technology 4. Demonstrate the key features pertaining to cloud security 5. Design an application using appropriate cloud tool.													
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	-	-	3	-	-	-	2	-	-	1	1	1	-
CO-2	3	3	-	-	-3	-	-	-	-	2	-	-	1	1	-
CO-3	3	3	-	-	3	1	-	-	-	-	-	-	1	1	-
CO-4	3	3	-	-	3	-	-	-	-	-	-	2	1	1	-
CO-5	3	2	3	-	2	-	-	-	-	-	-	3	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: CLOUD COMPUTING TECHNIQUES										(12L)					

<p>Introduction to Cloud Computing, Definition, Characteristics, Components, Cloud provider, SLA, Virtualization, Types of virtualization, Server virtualization, storage virtualization, Network Virtualization and application virtualization, Importance of virtualization in cloud, Study of hypervisors.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>Create and run virtual machines using VMWare Workstation/Virtual Box.</li> <li>Creation of VM image of base operating system.</li> </ol> <p><b>Suggested reading :</b> <a href="http://nptel.ac.in/courses/106105167/2">http://nptel.ac.in/courses/106105167/2</a></p>	<p><b>CO-1</b></p> <p><b>BTL-3</b></p>
<b>MODULE 2: CLOUD IMPLEMENTATIONS(12L)</b>	
<p>Cloud deployment models: Public cloud, Private cloud and Hybrid cloud, Cloud delivery models: IaaS, PaaS, SaaS and others, Organizational scenarios of clouds, Administering &amp; Monitoring cloud services, benefits and limitations, Deploy application over cloud, Cloud computing platforms: Infrastructure as a service: Amazon EC2, Platform as a Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>Implement Infrastructure as a Service by using OpenStack.</li> <li>Implement Software as a Service by using OwnCloud.</li> </ol> <p><b>Suggested reading :</b> <a href="http://nptel.ac.in/courses/106105167/6">http://nptel.ac.in/courses/106105167/6</a></p>	<p><b>CO-2</b></p> <p><b>BTL-3</b></p>
<b>MODULE 3: CLOUD FILE SYSTEMS AND TECHNOLOGIES(12L)</b>	
<p><b>Cloud file systems:</b> GFS and HDFS, BigTable, HBase and Dynamo, Map-Reduce: The map-Reduce model, <b>Cloud Architectures:</b> Workload distribution, Resource pooling, dynamic scalability, elasticity, Service load balancing, Cloud bursting, Service Technology: SOAP and REST Web services, AJAX and mashups Web services, Service Middleware, Case Study examples.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>Installation of Hadoop.</li> <li>Usage of Hadoop for file systems.</li> </ol> <p><b>Suggested reading :</b> <a href="http://nptel.ac.in/courses/106105167/14">http://nptel.ac.in/courses/106105167/14</a></p>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: CLOUD SECURITY(12L)</b>	
<p>Introduction to Cloud Security, General problems in cloud computing, Threats and vulnerabilities, Architectural Design Considerations: Data Centre or Physical Security, Server Security, Network Security, Application and Platform Security, Encryption and Key Management, Infrastructure Security, Security Management, SSL in Cloud Computing, Identity and Access management.</p> <p><b>Practical Component:</b></p>	<p><b>CO-4</b></p> <p><b>BTL-4</b></p>

<ul style="list-style-type: none"><li>i. Install and learn administrative features of OwnCloud.</li><li>ii. Create, manage user and group of user accounts by OwnCloud.</li></ul> <p><b>Suggested reading :</b> <a href="http://nptel.ac.in/courses/106105167/29">http://nptel.ac.in/courses/106105167/29</a></p>		
<b>MODULE5: CLOUD TOOLS AND FUTURE CLOUD(12L)</b>		
<p>Tools and Technologies for Cloud, Cloud Computing Platform: Eucalyptus, Nimbus, OpenNebula, Cloud Mashups, Cloud Tools: VMWare, Eucalyptus, CloudSim, Implementing real time application over cloud platform, QOS Issues in Cloud, data migration, streaming in Cloud, Concepts in Mobile Cloud Computing, Fog Computing, Dockers, Green Cloud, Cloud Computing, IoT Cloud.</p> <p><b>Practical Component:</b></p> <ul style="list-style-type: none"><li>i. Case study on Amazon EC2.</li><li>ii. Case study on Microsoft Azure.</li></ul> <p><b>Suggested reading :</b> <a href="http://nptel.ac.in/courses/106105167/33">http://nptel.ac.in/courses/106105167/33</a></p>		<p><b>CO-5</b></p> <p><b>BTL-4</b></p>
<b>TEXT BOOKS</b>		
1.	Thomas Erl, Zaigham Mahmood, and Ricardo Puttini,"Cloud Computing Concepts, Technology & Architecture", Prentice Hall, 2013.	
2.	A.Srinivasan,J.Suresh,"Cloud Computing, A practical approach for learning and implementation",Pearson,2014.	
<b>REFERENCE BOOKS</b>		
1.	Barrie Sosinsky, "Cloud Computing Bible", Wiley, 2011.	
2.	Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011	
3.	Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010	
<b>E BOOKS</b>		
1.	<a href="https://www.manning.com/books/exploring-cloud-computing">https://www.manning.com/books/exploring-cloud-computing</a>	
<b>MOOC</b>		
1.	<a href="https://www.mooc-list.com/course/cloud-computing-applications-part-1-cloud-systems-and-infrastructure-coursera">https://www.mooc-list.com/course/cloud-computing-applications-part-1-cloud-systems-and-infrastructure-coursera</a>	
2.	<a href="https://www.mooc-list.com/course/cloud-computing-concepts-part-2-coursera">https://www.mooc-list.com/course/cloud-computing-concepts-part-2-coursera</a>	

COURSE TITLE	Design Project-III			CREDITS	1
COURSE CODE	CSB4431	COURSE CATEGORY	LAB	L-T-P-S	0-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4

ASSESSMENT SCHEME															
First Review (Concept)		Second Review (Design)				Third Review (Experiment/ Analysis)			Project Report and Vivo- voce (Results and Conclusion)				ESE		
20%		30%				20%			30%				---		
Course Description		This course is mainly focused on team building and product development as it will make them industry ready. To apply the concepts, principles and algorithms learnt in the field of computer science and build products/tools/applications addressing the needs of real-world societal issues.													
Course Objective		<div>1. To analyse, design and develop products/tools/applications to solve the issues related to real world problems.</div> <div>2. To apply the concepts, principles and algorithms learnt in the field of computer science.</div> <div>3. To exercise the lifecycle of project development by following the principles of software engineering.</div> <div>4. To inculcate the qualities of team building and develop the skills of technical document writing.</div> <div>5. To examine the various algorithms of study and thus to evaluate and compare the output generated.</div>													
Course Outcome		<div>Upon completion of this course, the students will be able to</div> <div>1. Analyse, design and develop products/tools/applications to address the societal needs.</div> <div>2. Design, develop and test program segments that constitute a software/hardware product</div> <div>3. Demonstrate the software engineering principles and improve the project management skills</div> <div>4. Appraise the hardware/software product developed in the form of technical presentations, demonstrations and report generation through team work.</div> <div>5. Examine and make a comparative analysis of the algorithms involved in the course of the project work.</div>													
Prerequisites: Basic programming knowledge															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	-	2	-	-	3	3	3	2	3	3	2
CO-2	3	3	3	3	-	2	-	3	3	3	3	2	3	3	2
CO-3	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3
CO-4	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3
CO-5	3	3	3	3	3	2	-	3	3	-	3	2	3	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related															



Note					
<ul style="list-style-type: none"><li>• The students in convenient groups of not more than 3 members have to identify a product for design and fabrication.</li><li>• Every project work shall have a guide who is the member of the faculty of the Department.</li><li>• Design, develop, test and implement a hardware/software system that is demonstratable with required data set.</li><li>• Assessment is based on creativity, applicability to the society, project development skills, team work.</li><li>• Technical communication, presentation and report writing skills form an essential component in assessment.</li></ul>					CO1, CO2, CO3, CO4, CO5 /BTL4
COURSE TITLE	PROJECT AND VIVA-VOCE			CREDITS	8
COURSE CODE	CSB4441	COURSE CATEGORY	PC	L-T-P-S	0-0-16-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Review	Second Review	Third Review			End Sem Viva-Voce
10%	20%	20%			50%
Course Description	This course is mainly focused on team building and product development as it will make them industry ready. To apply the concepts, principles and algorithms learnt in the field of computer science and Design and Development of Solution for the identified Engineering complex problem by applying Engineering knowledge.				
Course Objective	<ol style="list-style-type: none"><li>1. To analyse, design and develop products/tools/applications to solve the issues related to real world problems.</li><li>2. To apply the concepts, principles and algorithms learnt in the field of computer science.</li><li>3. To exercise the lifecycle of project development by following the principles of software engineering.</li><li>4. To inculcate the qualities of team building and develop the skills of technical document writing</li></ol>				
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"><li>1. Develop an Engineering solution through Analyzing the problem and Applying the Engineering Knowledge.</li><li>2. Use research-based knowledge and research methods through modern tools</li><li>3. Work as an individual and as a team in solving complex problem.</li><li>4. Communicate effectively and write effective reports on the design of Engineering solution.</li><li>5. Demonstrate the knowledge of project management</li></ol>				
Prerequisites: VII Semesters Course of Study					

CO, PO AND PSO MAPPING																	
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3		
CO-1	3	3	3	3	-	2	-	-	3	3	3	2	3	3	2		
CO-2	3	3	3	3	-	2	-	3	3	3	3	2	3	3	2		
CO-3	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3		
CO-4	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3		
CO-5	3	3	3	3	3	2	-	3	3	-	3	2	3	3	3		
1: Weakly related, 2: Moderately related and 3: Strongly related																	
Note																	
<ul style="list-style-type: none"><li>• The students in convenient groups of not more than 3 members have to identify a product for design and fabrication.</li><li>• Every project work shall have a guide who is the member of the faculty of the Department.</li><li>• Design, develop, test and implement a hardware/software system that is demonstratable with required data set.</li><li>• Assessment is based on creativity, applicability to the society, project development skills, team work.</li><li>• Technical communication, presentation and report writing skills form an essential component in assessment.</li></ul>														CO1, CO2, CO3, CO4, CO5 /BTL4			
REFERENCE BOOKS																	
1.	Neil G. Siegel, Engineering Project Management, Wiley, 2019																
2.	Steve Tockey, How to Engineer Software: A Model-Based Approach, Wiley, 2019																
3.	Darla-Jean Weatherford, Technical Writing for Engineering Professionals, PennWell, 2016																
E BOOKS																	
1.	<a href="https://www.coursera.org/specializations/english-for-research-publication-purposes">https://www.coursera.org/specializations/english-for-research-publication-purposes</a>																

## General Electives

COURSE TITLE	SYSTEM SOFTWARE			CREDITS	3
COURSE CODE	CSC4251	COURSE CATEGORY	PC	L-T-P-S	3- 0- 0- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	System software is designed to provide a platform for other software. Examples of system software include operating systems like macOS, Linux, Android and Microsoft Windows, computational science software, game engines, industrial automation, and software as a service application.				
Course Objective	<ol style="list-style-type: none"> <li>1. To understand the basic architecture of a hypothetical machine.</li> <li>2. To apply one pass and two assembler algorithms and generate object code.</li> <li>3. Acquiring the basics of loader and linker functionalities.</li> <li>4. To understand the usage of macros in assembly languages and the document editing tools.</li> <li>5. To distinguish different system software tools and Illustrate Python Internals.</li> </ol>				
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Explain the basic architecture of a hypothetical machine.</li> <li>2. Apply one pass and two assembler algorithms and generate object code.</li> <li>3. Describe loader and linker functionalities</li> <li>4. Apply Macros in assembly languages</li> <li>5. Demonstrate document editing tools and Distinguish different system software tools and Illustrate Python Internals.</li> </ol>				

Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	1	-	1	1	2	2	3	1	1	3	1	1
CO-2	3	3	1	1	1	1	2	1	1	1	1	-	3	1	1
CO-3	3	3	-	1	-	-	1	-	1	3	1	2	3	1	1
CO-4	3	3	1	1	1	1	2	1	1	1	1	1	3	1	1
CO-5	3	2	1	1	3	1	1	1	-	3	1	2	3	1	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: SYSTEM SOFTWARE INTRODUCTION (9L)															
Types of system software-System software and application software-machine architecture – The Simplified Instructional Computer (SIC) & SIC/XE - Machine architecture - Data and instruction formats - addressing modes - instruction sets - I/O and programming.														CO-1 BTL-3	
MODULE 2: ASSEMBLERS(9L)															
Basic assembler functions - A simple SIC assembler – Assembler algorithm and data structures – Two Pass Assembler Algorithm-Machine dependent assembler features - Instruction formats and addressing modes – Program relocation-Assembly of SIC/XE program-Machine independent assembler features – Literals – Symbol-defining statements – Expressions - One pass assemblers and Multi pass assemblers - Implementation example - MASM assembler.														CO-2 BTL-3	
MODULE 3: LINKERS AND LOADERS(9L)															
Basic loader functions - Design of an Absolute Loader – A Simple Bootstrap Loader - Machine dependent loader features - Relocation – Program Linking – Algorithm and Data Structures for Linking Loader - Machine-independent loader features - Automatic Library Search – Loader Options - Loader design options - Linkage Editors – Dynamic Linking – Bootstrap Loaders - Implementation example - MSDOS linker.														CO-3 BTL-3	
MODULE 4: MACRO PROCESSORS (9L)															
Basic macro processor functions - Macro Definition and Expansion – Macro Processor Algorithm and data structures - Machine-independent macro processor features - Concatenation of Macro Parameters – Generation of Unique Labels – Conditional Macro Expansion – Keyword Macro Parameters-Macro within Macro-Implementation example - MASM Macro Processor – ANSI C Macro language														CO-4 BTL-3	
MODULE5: SYSTEM SOFTWARE TYPES AND PYTHON INTERNALS(9L)															

Device Drivers-Compilers-Interpreters-Text editors - Editor Structure-User Interface - Debugging systems - Debugging functions and capabilities-Debugging Methods-Induction-Deduction-Backtracking-python interpreter-program execution-executing code from a file-Interpreter and compiler-Python compiler internals.		CO-5,6 BTL-3
TEXT BOOKS		
1.	Leland L. Beck, “System Software – An Introduction to Systems Programming”, 3rd Edition, Pearson Education Asia, 2008.	
REFERENCE BOOKS		
1.	D. M. Dhamdhere, “Systems Programming and Operating Systems”, Second Revised Edition, Tata McGraw-Hill, 1999.	
2.	<a href="http://www.pasteur.fr/formation/infobio/python/ch14.html#sect_module">http://www.pasteur.fr/formation/infobio/python/ch14.html#sect_module</a>	
3.	<a href="http://tomlee.co/wp-content/uploads/2012/11/108_python-language-internals.pdf">http://tomlee.co/wp-content/uploads/2012/11/108_python-language-internals.pdf</a>	
E BOOKS		
1.	<a href="https://www.kopykitab.com/index.php?route=product/search&amp;q=System+Software+Notes+eBook">https://www.kopykitab.com/index.php?route=product/search&amp;q=System+Software+Notes+eBook</a>	
2.	<a href="http://www.faadooengineers.com/#">http://www.faadooengineers.com/#</a>	
MOOC		
1.	<a href="https://nptel.ac.in/courses/108107029/module6/lecture36.pdf">https://nptel.ac.in/courses/108107029/module6/lecture36.pdf</a>	
2.	<a href="https://nptel.ac.in/courses/106106092/2">https://nptel.ac.in/courses/106106092/2</a>	

COURSE TITLE	COMPUTER GRAPHICS			CREDITS	3
COURSE CODE	CSC4252	COURSE CATEGORY	DE	L-T-P-S	3-0-0- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
<b>ASSESSMENT SCHEME</b>					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	To provide the fundamental knowledge to develop interactive graphics and animation sequence.				

<b>Course Objective</b>	1. To Learn the rules and algorithms in generating graphical outputs 2. To Learn 2-dimensional objects using suitable transformations 3. To Learn 3-dimensional objects using suitable transformations 4. Learn to Develop illumination and color models 5. Learn to Design animation and motion sequences.														
<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. Design an algorithm to draw fundamental drawings. 2. Apply two dimensional transformations. 3. Design three-dimensional graphics and transformations 4. Apply Illumination and color models. 5. Design animation sequences														
<b>Prerequisites:</b> - Basic knowledge of Animation															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO-1	3	3	3	2	3	1	1	-	1	1	1	2	3	2	1
CO-2	3	3	2	-	1	1	-	1	-	1	-	-	3	2	-
CO-3	3	3	3	2	3	1	1	1	1	-	1	2	3	1	2
CO-4	3	3	3	-	3	1	-	-	-	1	1	2	3	2	2
CO-5	3	3	3	1	3	1	1	1	1	1	-	2	3	2	3
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: OUTPUT PRIMITIVES (9)</b>															
Introduction – points and lines, line drawing algorithms, loading the frame buffer, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives.  <b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106106090/">http://nptel.ac.in/courses/106106090/</a>													<b>CO-1</b>  <b>BTL-3</b>		
<b>MODULE 2: TWO-DIMENSIONAL GRAPHICS (9)</b>															
Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two-dimensional viewing – viewing pipeline, viewing coordinate reference frame; window-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms.  <b>Suggested reading :</b> <a href="http://nptel.ac.in/courses/106106090/">http://nptel.ac.in/courses/106106090/</a>													<b>CO-2</b>  <b>BTL-3</b>		

MODULE 3: THREE-DIMENSIONAL GRAPHICS (9)	
Three dimensional concepts; Three-dimensional object representations – Polygon surfaces- Polygon tables- Plane equations – Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces -B-Spline curves and surfaces. Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling, composite transformations; Three-dimensional viewing – viewing pipeline, viewing coordinates, Projections.  <b>Suggested reading:</b> <a href="http://nptel.ac.in/courses/106106090/">http://nptel.ac.in/courses/106106090/</a>	<b>CO-3</b> <b>BTL-3</b>
MODULE 4: ILLUMINATION AND COLOR MODELS (9)	
Light sources – basic illumination models – halftone patterns and dithering techniques; Properties of light – Standard primaries and chromaticity diagram; Intuitive colour concepts – RGB colour model – YIQ colour model – CMY colour model – HSV colour model – HLS colour model; Colour selection and applications.  <b>Suggested reading :</b> <a href="http://nptel.ac.in/courses/106106090/">http://nptel.ac.in/courses/106106090/</a>	<b>CO-4</b> <b>BTL-3</b>
MODULE 5: ANIMATIONS AND REALISM (9)	
Design of Animation sequences – animation function – raster animation – key frame systems – motion specification –morphing. Tiling the plane – Recursively defined curves – Koch curves – C curves – Dragons – space filling curves – fractals – Grammar based models– turtle graphics – ray tracing.  <b>Suggested reading :</b> <a href="http://nptel.ac.in/courses/106106090/">http://nptel.ac.in/courses/106106090/</a>	<b>CO-5</b> <b>BTL-3</b>
TEXT BOOKS	
1.	Donald Hearn and M.Pauline Baker, “Computer Graphics C Version”, Pearson Education, Second Edition 2011.
2	John F. Hughes, Andries Van Dam, Morgan Mc Guire ,David F. Sklar , James D. Foley, Steven K. Feiner and Kurt Akeley ,”Computer Graphics: Principles and Practice”, , 3rd Edition, Addison-Wesley Professional,2013
REFERENCE BOOKS	
1.	Jeffrey McConnell, “Computer Graphics: Theory into Practice”, Jones and Bartlett Publishers, 2006.
2.	Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard, KelvinSung, and AK Peters, Fundamental of Computer Graphics, CRC Press, 2010.
3	Donald Hearn and M. Pauline Baker, Warren Carithers,“Computer Graphics With Open GL”, 4th Edition, Pearson Education, 2010.
E BOOKS	
1.	<a href="http://edu.uokufa.edu.iq/staff/dr.nidhal/compressed%20comp.book/Hearn,Baker%20-%20Computer%20Graphics%20-%20C%20Version%202nd%20Ed.pdf">http://edu.uokufa.edu.iq/staff/dr.nidhal/compressed%20comp.book/Hearn,Baker%20-%20Computer%20Graphics%20-%20C%20Version%202nd%20Ed.pdf</a>
MOOC	
1.	<a href="https://www.coursera.org/learn/interactive-computer-graphics">https://www.coursera.org/learn/interactive-computer-graphics</a>

2.	<a href="https://in.udacity.com/course/interactive-3d-graphics--cs291">https://in.udacity.com/course/interactive-3d-graphics--cs291</a>
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COURSE TITLE		FREE AND OPEN SOURCE SOFTWARE						CREDITS			3				
COURSE CODE		CSC4253		COURSE CATEGORY		DE		L-T-P-S			3-0-0- 0				
Version		1.0		Approval Details				LEARNING LEVEL			BTL-4				
ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment			Seminar/ Assignments/ Project		Surprise Test / Quiz		Attendance			ESE			
15%		15%			10%		5%		5%			50%			
Course Description		To Comprehend the fundamental principles of Enterprise Application using free open source software (OSS).													
Course Objective		1. To Learn about Open Standards and Open Source software 2. To Learn Open Source Licensing and Development Process 3. To Learn Linux Operating System Installation and Configuration 4. Creation and Maintenance of GiT Repository 5. To Comprehend Open Source Case Studies.													
Course Outcome		Upon completion of this course, the students will be able to 1. Explain Open Standards and Open Source software. 2. Describe Open Source Licensing and Development Process. 3. Demonstrate Linux Operating System Installation and Configuration 4. Create and Maintain GiT Repository 5. Illustrate Open Source Case Studies													
Prerequisites: - Nil															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	1	1	2	2	1	1	1	1	3	1	1	3	1	2
CO-2	2	3	1	1	-	-	1	-	-	3	-	1	3	-	2
CO-3	3	3	3	3	-	1	1	1	-	3	1	1	3	2	1
CO-4	3	3	3	3	2	1	1	-	2	3	-	1	3	2	2
CO-5	1	1	2	2	3	-	-	1	1	3	1	2	3	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: Introduction to Open Standards and Open Source														(9)	



Introduction to Standards - Open and Closed Standards – De-Facto Vs De Jure Standards Introduction to Open Source - Open Source Vs Open Standard – Freeware Vs Open Source Software - Open Source Licensing- Contract and Copyright Law- Issues with Copyrights and Patents- The Open Source Definition- Warranties.	<b>CO-1</b> <b>BTL-2</b>
<b>MODULE 2: Open Source Licensing and Development Process (9)</b>	
GNU General Public License - GNU Lesser General Public License - The Mozilla Public License 1.1 (MPL 1.1) - Application and Philosophy Non-Open Source Licenses - Classic Proprietary License -Sun Community Source License - Microsoft Shared Source Initiative- Models of Open Source and Free Software Development – Forking- Choosing an Open Source or Free Software License -  Drafting Open Source Licenses.	<b>CO-2</b> <b>BTL-2</b>
<b>MODULE 3: Linux Operating System (9)</b>	
Linux - Installation and Hardware Configuration – Boot Process-The Linux Loader (LILO) – The Grand Unified Bootloader (GRUB) – Dual-Booting Linux and other Operating System – Boot-Time Kernel Options- X Windows System Configuration-System Administration – Backup and Restore Procedures- Strategies for keeping a Secure Server.	<b>CO-3</b> <b>BTL-4</b>
<b>MODULE 4: Version Control and Collaborative Development (9)</b>	
Introduction to GiT- Introduction – Installation and Setup – GiT Repository – Creation and Maintenance - GiT Branching – Case Study - Installing GiT and Creating and Maintaining Repository using GiT.	<b>CO-4</b> <b>BTL-4</b>
<b>MODULE 5: Open Source – Case Studies (9)</b>	
GitHub - Introduction – Creating Repository – Creating Branch – Commit – Opening Pull Request – Merge Pull Request – Creating Repository using GitHub cloud Service.  Download and use any open source tool- Create one new Report not generated by the software.  (Ex: Ticket Reservation System at <a href="https://alf.io/">https://alf.io/</a> )	<b>CO-5</b> <b>BTL-3</b>
<b>TEXT BOOKS</b>	

1.	Andrew M. St. Laurent, “Understanding Open Source and Free Software Licensing”, O’Reilly Media, 2004.
2	Scott and Ben Straub, “Pro Git”, Apress, Second Edition, 2014.
3	Nihad A. Hassan, Rami Hijazi, “Open Source Intelligence Methods and Tools: A Practical Guide to Online Intelligence”, Apress, 2018.
4	Karl Fogel, “Producing Open Source Software: How to Run a Successful Free Software Project”, O’Reilly Media, 2004.

**REFERENCE BOOKS**

1.	Kirk St. Amant and Brian Still, “Handbook of Research on Open Source Software: Technological, Economic, and Social Perspectives”, IGI Global, 2007.
2.	Fadi P. Deek and James A. M. McHugh, “Open Source: Technology and Policy”, Cambridge University Press, 2008.
3	Joseph Feller, Brian Fitzgerald, Scott A. Hissam and Karim R. Lakhani , “Perspectives on Free and Open Source Software”, The MIT Press, 2007.
4	<a href="https://guides.github.com/">https://guides.github.com/</a> - For GitHub.
5	<a href="https://git-scm.com/book/en/v2/">https://git-scm.com/book/en/v2/</a> - For Git.

**E BOOKS**

1.	<a href="http://www.univasf.edu.br/~brauliro.leal/download/HandbookofOpenSourceTools.pdf">http://www.univasf.edu.br/~brauliro.leal/download/HandbookofOpenSourceTools.pdf</a>
2	Open Source Intelligence Tools and Resources Handbook: <a href="https://www.i-intelligence.eu/wp-content/uploads/2018/06/OSINT_Handbook_June-2018_Final.pdf">https://www.i-intelligence.eu/wp-content/uploads/2018/06/OSINT_Handbook_June-2018_Final.pdf</a>
3	<a href="https://opensourceforu.com/2018/07/how-to-program-with-shell-scripts-a-tutorial/">https://opensourceforu.com/2018/07/how-to-program-with-shell-scripts-a-tutorial/</a>
4	<a href="https://producingoss.com/en/producingoss.pdf">https://producingoss.com/en/producingoss.pdf</a>

**MOOC**

1.	<a href="https://www.coursera.org/learn/open-source-tools-for-data-science">https://www.coursera.org/learn/open-source-tools-for-data-science</a>
2.	<a href="https://www.udemy.com/open-source-video-editing-b/">https://www.udemy.com/open-source-video-editing-b/</a>

COURSE TITLE	ERP AND ENTERPRISE DOMAINS			CREDITS	3
COURSE CODE	CSC4255	COURSE CATEGORY	DE	L-T-P-S	3-0-0- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment				Seminar/ Assignments/ Project			Surprise Test / Quiz		Attendance		ESE		
15%		15%				10%			5%		5%		50%		
Course Description		This course serves as an introduction to the world of Enterprise Resource Planning. It describes how ERP system is implemented and how it is integrated with existing business processes and the impact of ERP on the organization.													
Course Objective		1. To Learn principles of business engineering 2. To Learn Supply Chain Management and Customer Relationship Management 3. To Learn ERP implementation strategies 4. To Learn ERP business models 5. Practice with ERP software's.													
Course Outcome		Upon completion of this course, the students will be able to 1. Identify the basic concepts and need of ERP 2. Apply technologies to build business models in ERP 3. Implement ERP framework in real time environment 4. Describe the strategic value and organizational impact of utilizing ERP for various business modules 5. Demonstrate various ERP software and develop small applications using suitable software													
Prerequisites: - Nil															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	1	3	1	-	1	1	3	2	1	1	3	2	1
CO-2	3	2	3	2	3	1	-	-	3	-	3	1	3	2	1
CO-3	3	2	1	2	1	-	3	-	-	2	-	2	3	1	1
CO-4	3	2	1	2	1	-	-	1	3	3	3	2	3	2	1
CO-5	3	2	-	2	-	1	1	-	3	3	-	2	3	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO ERP														(9)	
Enterprise- An Overview- Business Functions and Business Processes, Integrated Management Information- Business Modelling, Integrated Data Model- ERP Introduction, Basic ERP Concepts and Investments, Risks and Benefits of ERP.														CO-1 BTL-2	

Suggested reading : <a href="http://nptel.ac.in/courses/110105083/10">http://nptel.ac.in/courses/110105083/10</a>	
<b>MODULE 2: ERP AND RELATED TECHNOLOGIES</b> (9)	
Business Intelligence, E-commerce, Business Process Reengineering, Data warehousing, Data Mining, On-line Analytical Processing (OLAP), Supply Chain Management (SCM), Customer Relationship Management (CRM), ERP Security, On-demand (SaaS) ERP, Cloud or hosted ERP.  Suggested reading: <a href="http://nptel.ac.in/courses/110105083/18">http://nptel.ac.in/courses/110105083/18</a>	<b>CO-2</b> <b>BTL-3</b>
<b>MODULE 3: ERP IMPLEMENTATION</b> (9)	
ERP Implementation strategies and Lifecycle- Pre-implementation- Requirements Definition- Implementation Methodologies- Package selection- Project Teams and Process Definition- Vendors, Consultants and Employees- Training and Education- Data Migration- Project Management and Monitoring- Post Implementation Activities.  Suggested reading: <a href="https://nptel.ac.in/courses/112107238/60">https://nptel.ac.in/courses/112107238/60</a>	<b>CO-3</b> <b>BTL-3</b>
<b>MODULE 4: ERP BUSINESS MODULES</b> (9)	
Business modules in an ERP Package, Finance, Manufacturing, Human Resources, Plant Maintenance, Materials Management, Quality Management, Marketing, Sales, Distribution and Service.  Suggested reading: <a href="https://nptel.ac.in/courses/110105083/15">https://nptel.ac.in/courses/110105083/15</a>	<b>CO-4</b> <b>BTL-3</b>
<b>MODULE 5: THE ERP MARKET AND FUTURE DIRECTIONS</b> (9)	
ERP Marketplace and Marketplace Dynamics, SAP, Oracle, Sage Group, Infor, QAD, Epicor, Odoo- Future directions and trends in ERP- ERP Case studies.  Suggested reading: <a href="http://nptelvideos.com/sap/">http://nptelvideos.com/sap/</a>	<b>CO-5</b> <b>BTL-3</b>
<b>TEXT BOOKS</b>	
1.	Alexis Leon, “ERP demystified”, Second Edition Tata McGraw-Hill, 2014..
<b>REFERENCE BOOKS</b>	
1.	Jose Antonio Fernandz, Franklin Martinez and Jim Keogh, “The SAP R/3 Handbook”, Third Edition, McGraw-Hill Education, 2006.
2	Vinod Kumar Garg and N.K.Venkita Krishnan, “Enterprise Resource Planning – Concepts and Practice”, PHI, 2011.
3	Mahadeo Jaiswal, Ganesh Vanapalli, “Textbook of Enterprise Resource Planning”, Macmillan Publishers India, 2005.
<b>E BOOKS</b>	

1.	<a href="https://bookboon.com/en/a-guide-to-erp-ebook">https://bookboon.com/en/a-guide-to-erp-ebook</a>
<b>MOOC</b>	
1.	<a href="http://www.sap.com/solutions/business-suite/erp/index.epx">www.sap.com/solutions/business-suite/erp/index.epx</a>
2	<a href="https://www.udemy.com/introduction-to-erp-systems/">https://www.udemy.com/introduction-to-erp-systems/</a>

COURSE TITLE	MOBILE APPLICATION DEVELOPMENT			CREDITS	3
COURSE CODE	CSC4266	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4

ASSESSMENT SCHEME			
First Periodical Assessment	Second Periodical Assessment	Practical Component	ESE
15%	15%	20%	50%
Course Description	This course is an introduction to the primary concepts of Mobile application development frameworks; Architecture, design and engineering issues, techniques, methodologies for mobile application development.		
Course Objective	<ol style="list-style-type: none"> <li>1. To Learn Mobile platforms, apps development with emulator</li> <li>2. To Illustrate user interfaces for interacting with apps and triggering actions</li> <li>3. To Learn graphics, animation and Multimedia interfacing</li> <li>4. To Test mobile apps with different testing methods</li> <li>5. To develop an apps and distributing apps on mobile markets</li> <li>6. To build an mobile application using android studio</li> </ol>		
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Appreciate the Mobility landscape</li> <li>2. Familiarize with Mobile apps development aspects.</li> <li>3. Design and develop mobile apps, using Android as development platform</li> <li>4. Appreciation of nuances such as native hardware play, location awareness, graphics, and multimedia.</li> <li>5. Build a mobile application using Android studio and Phone Gap.</li> </ol>		

**Prerequisites: - Nil**

CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	-	2	2	-	-	-	-	-	-	2	2	1
CO-2	3	3	3	3	1	-	-	-	-		-	1	1	1	2

CO-3	3	2	-	3	1	2	-	-	-	-	-	-	1	2	1
CO-4	2	3	3	3	-	2	-	-	-	-	-	-	1	2	1
CO-5	3	2	3	3	1	2	-	-	-	-	-	-	1	1	2
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: GETTING STARTED WITH MOBILITY</b>														<b>(6+6)</b>	
Mobility landscape, Mobile platforms, Mobile apps development, Overview of Android platform, setting up the mobile app development environment along with an emulator, a case study on Mobile app development. <b>Practical Component:</b> (i) Setting up Development Environment (ii) Saying hello to Android <b>Suggested reading:</b> <a href="https://onlinecourses.nptel.ac.in/noc16_cs23">https://onlinecourses.nptel.ac.in/noc16_cs23</a>														<b>CO-1 BTL-2</b>	
<b>MODULE 2: BUILDING BLOCKS OF MOBILE APPS</b>														<b>(6+6)</b>	
App user interface designing – mobile UI resources (Layout, UI elements, Draw-able, Menu), Activity- states and life cycle, interaction amongst activities. App functionality beyond user interface - Threads, Async task, Services – states and life cycle, Notifications, Broadcast receivers, Telephony and SMS APIs Native data handling – on-device file I/O, shared preferences, mobile databases such as SQLite, and enterprise data access (via Internet/Intranet). <b>Practical Component:</b> (i) Notifications, Broadcast Receivers (ii) Connect SQLite Database <b>Suggested reading:</b> <a href="http://www.appmachine.com/tour/building-blocks/">www.appmachine.com/tour/building-blocks/</a>														<b>CO-2 BTL-2</b>	
<b>MODULE 3: SPRUCING UP MOBILE APPS</b>														<b>(6+6)</b>	
Graphics and animation – custom views, canvas, animation APIs, multimedia – audio/video playback and record, location awareness, and native hardware access (sensors such as accelerometer and gyroscope). <b>Practical Component:</b> (i) Location Awareness (ii) Sensor data app (Motion, Position, Environment) <b>Suggested reading:</b> <a href="https://www.theserverside.com/tutorial/Mobile-application-development-tutorial">https://www.theserverside.com/tutorial/Mobile-application-development-tutorial</a> .														<b>CO-3 BTL-3</b>	
<b>MODULE 4: TESTING MOBILE APPS</b>														<b>(6+6)</b>	
Debugging mobile apps, White box testing, Black box testing, and test automation of mobile apps, JUnit for Android, Robotium, MonkeyTalk. <b>Practical Component:</b> (i) Testing using Robotium <b>Suggested reading:</b> <a href="http://www.softwaretestinghelp.com/beginners-guide-to-mobile-application-testing/">www.softwaretestinghelp.com/beginners-guide-to-mobile-application-testing/</a>														<b>CO-4 BTL-4</b>	
<b>MODULE 5 TAKING APPS TO MARKET</b>														<b>(6+6)</b>	
Versioning, signing and packaging mobile apps, distributing apps on mobile market place <b>Practical Component:</b>														<b>CO-5 BTL-4</b>	

(i) Configuring (ii) Packaging and Debugging (iii) Reminder app using Android Studio (iv) College students Database App using Phonegap <b>Suggested reading: <a href="https://www.tutorialspoint.com/mobile_marketing/">https://www.tutorialspoint.com/mobile_marketing/</a></b>		
<b>REFERENCE BOOKS</b>		
1.	Leigh Williamson, John Ponzio, Patrick Bohrer, "Swift in the Cloud", Wiley Publications, 1 <sup>st</sup> edition, 2017.	
2	Hazem Saleh, "JavaScript Mobile Application Development", Packt Publishing, 2014.	
<b>E BOOKS</b>		
1.	<a href="http://martinfowler.com/agile.html">http://martinfowler.com/agile.html</a>	
2	<a href="http://www.it-ebooks.info/tag/agile">www.it-ebooks.info/tag/agile</a>	
<b>MOOC</b>		
1.	<a href="https://www.coursera.org/browse/computer-science/mobile-and-web-development">https://www.coursera.org/browse/computer-science/mobile-and-web-development</a>	
2.	<a href="https://www.edx.org/course/introduction-mobile-application-hkustx-comp107x-2">https://www.edx.org/course/introduction-mobile-application-hkustx-comp107x-2</a>	

COURSE TITLE	GAME DESIGN AND PROGRAMMING			CREDITS	3
COURSE CODE	CSC4267	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	This course is an introduction to the primary concepts of gaming, and an exploration of how these basic concepts affect the way gamers interact with Different games. In this course you will understand Game architecture, Interface and Development.				
Course Objective	1. To Learn game architecture such as Application layer and game logics. 2. To Learn Game building. 3. To Learn game controller and interfacing program 4. To Develop game scripting and AI techniques 5. To Inculcate to develop puzzle games, single player and multi-player games.				

Course Outcome	Upon completion of this course, the students will be able to 1. Explore the Game Architecture 2. Build the Games with Looping / Caching 3. Develop the Games with User Interface. 4. Develop the Games Using Lua. 5. Develop the Games Using OpenGL, DirectX.														
Prerequisites: - Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	-	-	-	-	-	-	-	-	1	2	1
CO-2	3	3	1	-	1	-	-	-	-		-	1	1	2	1
CO-3	3	3	1	-	2		-	-	1	-	-	1	1	2	2
CO-4	3	3	1	-	1	-	-	-	-	-	-	1	1	2	1
CO-5	3	3	1	-	1	-	-	-	-	-	-	-	1	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: GAME ARCHITECTURE														(12)	
Game Programming Style, Game Architecture, Application Layer, Game Logic, Game Views for AI Agents, Networked Game Architecture.  Practical Component:  (i)Graphics Display  (ii)User Interface  Suggested reading: Game View for the Human Player													CO-1  BTL-2		
MODULE 2: : GAME BUILDING														(12)	
Creating a Game Project, Building a Game, Creating Build Scripts, Game Initialization, Game Shutdown, Game Actors and Component Architecture, Gamming with Loop, Loading and Caching Game Data, Resource Files, Resource Cache.  Practical Component:  (i)Building Games with Actor  (ii)Building Games with Components  Suggested reading: CodingTidbits and Style													CO-2  BTL-2		
MODULE 3: GAMING INTERFACE (12)															



Using XInput or DirectInput, Working with a Game Controller, Working with the Keyboard, User Interface Programming.		CO-3  BTL-3
<b>Practical Component:</b>  (iii) Control Properties – Hot Keys, Tooltips, Dragging, Sounds and Animation. <b>Suggested reading:</b> Game Events		
<b>MODULE 4: Scripting with Lua, An Introduction to Game AI</b>		<b>(12)</b>
Lua – Comments, Variables, Functions, Tables, Flow Control, Operators, Binding Lua to C++, Lua C API, tolua++, Lua Development and Debugging, Gaming with AI Techniques. <b>Practical Component:</b>  (i) Game with Path Finding.  <b>Suggested reading:</b> Gaming withFinite State Machines		CO-4  BTL-3
<b>MODULE 5: GAME DEVELOPMENT</b>		<b>(12)</b>
Design Example for simple game development - Simple 3D Interactive Game Development- Puzzle games, Single Player games, Multi Player game Development. <b>Practical Component:</b>  (i) Implementation of Simple 3D Interactive Game Development using OpenGL, DirectX.  (ii) Implementation of Puzzle games, Single Player games, Multi Player game Development.		CO-5  BTL-3
<b>REFERENCE BOOKS</b>		
1.	Mike McShaffrfy, “Game Coding Complete”, Charles River Media, 2017.	
2	Ernest Adams and Andrew Rollings, “Fundamentals of Game Design”, 2 nd Edition Prentice Hall / New Riders, 2009.	
3	Jesse Schell, The Art of Game Design: A book of lenses, 1 st Edition, CRC Press, 2008.	
<b>E BOOKS</b>		
1.	<a href="http://canvas.projekti.info/ebooks/Game%20Coding%20Complete%20-%204th%20Edition.pdf">http://canvas.projekti.info/ebooks/Game%20Coding%20Complete%20-%204th%20Edition.pdf</a>	
2	<a href="http://graphics.cs.cmu.edu/nsp/course/15-462/Fall04/slides/GameProg.pdf">http://graphics.cs.cmu.edu/nsp/course/15-462/Fall04/slides/GameProg.pdf</a>	
<b>MOOC</b>		
1.	<a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-89-multicore-programming-primer-january-iap-2007/lecture-notes-and-video/l16-introduction-to-game-development/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-89-multicore-programming-primer-january-iap-2007/lecture-notes-and-video/l16-introduction-to-game-development/</a>	
2.	<a href="https://www.coursera.org/specializations/game-development?">https://www.coursera.org/specializations/game-development?</a>	
3.	<a href="https://nptel.ac.in/courses/106/106/106106182/">https://nptel.ac.in/courses/106/106/106106182/</a>	

COURSE TITLE	.NET FRAMEWORK AND PROGRAMMING								CREDITS			3			
COURSE CODE	CSC4268			COURSE CATEGORY			DE		L-T-P-S			2-0-2- 0			
Version	1.0			Approval Details					LEARNING LEVEL			BTL-4			
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment			Practical Component						ESE					
15%	15%			20%						50%					
Course Description	This course will cover the .NET architecture. The goal of this course is comprehend the basics of object oriented programming using C#. It covers GUI applications Development using .NET framework, database applications using ADO.NET and create Web Applications Using ASP.NET.														
Course Objective	1. To Learn .NET architecture and Microsoft visual studio IDE. 2. To Learn object-oriented programming using C# and file handling. 3. To Learn GUI Applications Development Using .Net Framework 4. To Develop Database Applications Using Ado.Net 5. To Develop Web Applications Using Asp.Net														
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the basis of .Net framework. 2. Develop C# program based on the features of .Net Framework. 3. Develop simple applications under .Net framework 4. Develop Database Applications Using ADO.Net 5. Build Web based Applications using .Net programming languages.														
Prerequisites: - Computer Programming															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO-3
CO-1	3	3	3	1	-	-	-	-	-	-	-	-	1	2	1
CO-2	3	3	3	-	-	-	-	-	-		-	-	1	2	2
CO-3	3	3	3	1	-		-	-	-	-	-	-	2	1	1
CO-4	3	3	3	-	1	-	-	-	-	-	-	-	1	2	3
CO-5	3	3	3	-	1	-	-	-	-	-	-	-	1	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO .NET (12)															

<p>What is .NET, Why .NET, Advantages of .NET, Architecture of .NET, Introduction to CLR, CLR architecture, Just-in-time compiler (JIT), Microsoft Intermediate Language (MSIL), Understanding IL with ILDASM, .NET Framework, common class library, common type system (CTS), common language specifications (CLS), Languages under .NET, Working with Microsoft Visual studio IDE.</p> <p><b>Practical Component:</b> Study of .NET IDE framework</p>	<p><b>CO-1</b> <b>BTL-2</b></p>
<p><b>MODULE 2: OBJECT ORIENTED PROGRAMMING USING C# (12)</b></p>	
<p>Explain features and phases of the object-oriented approach, Write and execute C# programs, Use decision-making constructs and loop constructs, Implement structures, enumerations, arrays, and collections, Implement polymorphism and overload functions and operators, Explain and use delegates and events, Use various stream classes to implement file handling.</p> <p><b>Practical Component:</b> (i) Array, string and structures using C# (ii) Object Oriented programming concepts, (iii) Exception Handling Mechanism</p>	<p><b>CO-2</b> <b>BTL-2</b></p>
<p><b>MODULE 3: GUI APPLICATIONS DEVELOPMENT USING .NET FRAMEWORK (9)</b></p>	
<p>Work with the Windows Forms and controls, Perform validation of controls using classes and controls, Work with Dialog Boxes, Menus and MDI Application, Implement Printing and Reporting Functionality in a Windows Forms Application, Package and deploy applications.</p> <p><b>Practical Component:</b> Simple online registration form using Windows forms and Controls</p>	<p><b>CO-3</b> <b>BTL-3</b></p>
<p><b>MODULE 4: DEVELOPING DATABASE APPLICATIONS USING ADO.NET (12)</b></p>	
<p>Create and manage connections using ADO.NET, Identify the disconnected and connected environment in ADO.NET, Create datasets and data tables, Retrieve and store large binary data, Perform bulk copy operations, Execute SQL notification maintain and update a cache, Read, write, validate, and modify XML data using XML reader and writer classes.</p> <p><b>Practical Component:</b> Payroll Processing Application</p>	<p><b>CO-4</b> <b>BTL-4</b></p>
<p><b>MODULE 5: DEVELOPING WEB APPLICATIONS USING ASP.NET (12)</b></p>	
<p>Create a Web Application, Program a Web Application, Add and Configure Server Controls, Create a Common Layout by Using Master Pages, Manage State for a Web Application, Access and Display Data, Control Access to a Web Application, Deploy a Web Application, Build Dynamic Web Applications, Create Controls for Web Applications, ASP.NET MVC.</p> <p><b>Practical Component:</b> Simple ASP.Net web application using web controls Session tracking using user authentication</p>	<p><b>CO-5</b> <b>BTL-4</b></p>

TEXT BOOKS	
1.	Andrew Troelsen, “Pro C# 10 and the .NET 4 Platform”, 5 <sup>th</sup> Edition, Apress, 2010.
2	Bill Evjen, Scott Hanselman, Devin Rader, “Professional ASP.NET 3.5: In C# and VB (Programmer to Programmer)”, Wrox Publications, 2008.
REFERENCE BOOKS	
1.	Eric Butow and Tommy Ryan, “C# Your Visual Blueprint for building .NET Applications”, Visual Publications, 2001.
2	Danny Ryan and Tommy Ryan, “ASP.NET Your Visual Blueprint for building Web on the .NET Framework”, Visual Publisher, 2001.
3	Peter Wright, Beginning Visual C# 2005 Express Edition: From Novice to Professional, Apress, 2006.
4	Christian Nagelet et al, Professional C# 2005, Wiley Publishing, 2006.
5	Fritz Onion, Keith Brown, Essential ASP.NET 2.0, Addison Wesley, 2006.
E-Books	
1.	C# Essentials: Programming the .NET Framework 2nd Edition, Kindle Edition
MOOC	
1.	<a href="https://www.edx.org/learn/.net">https://www.edx.org/learn/.net</a>

COURSE TITLE	LINUX INTERNALS			CREDITS	3
COURSE CODE	CSC4269	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	This course focuses on the elements of the Linux kernel that allow programmers to build software components that are linked to the hardware level. This course provides general understanding of basic tools and interfaces in order to successfully modify features and develop new aspects of the kernel.				

<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To Describe the difference between Linux and windows and to Learn Linux server installation</li> <li>2. To Learn Boot Loaders and GRUB</li> <li>3. To Learn Setting up web server using Apache and creating a secure tunnel.</li> <li>4. Learn to configure NFS server and client and DHCP network configuration configure network interfaces</li> <li>5. Practice with Linux Process Control &amp; Shell Programming</li> </ol>
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Install LINUX OS.</li> <li>2. Manage the user accounts</li> <li>3. Setup environment for internet and intranet services</li> <li>4. Enabling Intranet services such as configure NFS server and client</li> <li>5. Write Shell Programming for various functionalities required for the applications</li> </ol>
<b>Prerequisites: - Basic OS concepts</b>	

CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	1	-	-	-	-	-	-	-	-	2	2	2
CO-2	3	3	3	2	1	-	-	-	-		-	-	1	2	1
CO-3	3	3	3	1	2		-	-	-	-	-	1	1	2	2
CO-4	3	3	3	2	2	-	-	-	-	-	-	2	2	3	1
CO-5	3	3	3	3	3	-	-	-	-	-	-	1	1	2	2
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
MODULE 1: INSTALLING LINUX AS A SERVER(12)															
<p>History of Linux operating system - Difference between windows 2000 and Linux distribution - Installing Linux in a server configuration - Dual booting issues - methods of installation - GNOME and KDE - Xwindows system - KDE Basics - Installing software.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Installation of RedHat Linux</li> <li>2. Write script to print the message "Hello" on the console</li> <li>3. Write script to perform following basic math operation as               <ol style="list-style-type: none"> <li>(a) Addition</li> <li>(b) Subtraction</li> <li>(c) Multiplication</li> <li>(d) Division</li> </ol> </li> </ol>													<p><b>CO-1</b></p> <p><b>BTL-1</b></p>		
MODULE 2: SINGLE - HOST ADMINISTRATION													(12)		

<p>Managing users – User properties – user database – utilize user management tools setUID &amp; getUID -Command Line – Booting and Shutting down –Boot loaders, GRUB, Bootstrapping - File System – Core System services – Compiling Linux kernel Securing an individual server.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Setting up the UID</li> <li>2. Write the script to display current date, time, username and currency directory</li> <li>3. Write the shell script to show various system configurations like               <ol style="list-style-type: none"> <li>(a) Currently logged user and his long name</li> <li>(b) Current Shell</li> <li>(c) Your home directory</li> <li>(d) Your operating system type</li> <li>(e) Your current path settings</li> <li>(f) Your current Working directory</li> </ol> </li> </ol>	<p><b>CO-2</b></p> <p><b>BTL-2</b></p>
<p><b>MODULE 3:INTERNET SERVICES</b> (12)</p>	
<p>Internet Services - understanding naming services - BIND configuration file and database file - DNS - FTP -Setting up web server using Apache - SMTP - Install, configure and run postfix server -POP - conflicts between pop and other protocols- SSH public key Cryptography - creating a secure tunnel.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Set up SSH keys so you can connect to your neighbour's machine without having to enter a password.</li> <li>2. Make a list of open (listening) ports on your machine.</li> <li>3. Make a backup copy of your home directory in /var/tmp on your neighbour's "backup server," using scp. Archive and compress before starting the data transfer! Connect to the remote host using ssh, unpack the backup, and put one file back on the original machine using sftp.</li> </ol>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<p><b>MODULE 4: NFS and NIS</b> (12)</p>	
<p>Intranet Services - NFS - enable and configure NFS server and client - NIS - configure NIS Client – setup secondary NIS server - NIS tools - SAMBA - Administrating samba Printing - Install cups - add and manage print jobs - DHCP network configuration configure network interfaces - use routers.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. From your local workstation, display a graphical application, such as <b>xclock</b> on your neighbour's screen. The necessary accounts will have to be set up. Use a secure connection!</li> <li>2. Send an E-mail to your local account. Try two different ways to send and read it. How can you check that it really arrived?</li> <li>3. Display network information for your workstation: IP address, routes, name servers.</li> </ol>	<p><b>CO-4</b></p> <p><b>BTL-4</b></p>

MODULE 5: LINUX PROCESS CONTROL & SHELL PROGRAMMING		(12)
<p>Linux process environment - login process - parent child relationship - process variable process monitoring -invoking foreground and background process - terminating process Daemons -Introduction to Shell programming - Shell scripts - executing shell scripts creating scripts - simple examples.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"><li>1. Write a shell script to convert the contents of a given file from uppercase to lowercase and also count the number of lines, words and character of the resultant file.</li><li>2. Write a shell script to list the files arranged in descending order of their size</li><li>3. Write a shell script to find the reverse of a given number</li><li>4. Write a shell to print the pattern 1 2 2 3 3 3  4 4 4 4</li></ol>		<p><b>CO-5</b></p> <p><b>BTL-3</b></p>
TEXT BOOKS		
1.	Steven Graham, Steve Shah, "Linux Administration A Beginners Guide" ,3rd edition, Dreamtech press ,2003.	
REFERENCE BOOKS		
1.	McKinnon, McKinnon, "Installing and Adminstrating Linux ", 2nd edition,Wiley Dreamtech, 2002.	
2	Sandip Bhattacharya, Panancrazio De Mauro,ShishirGundavaram, Mark Mamone,Kapil Sharma, Deepak Thomas,Simon Whiting "Beginning Red Hat Linux 9 ", 5th edition , Wiley Dreamtech. ,2003	
E BOOKS		
1.	<a href="http://www.worldcat.org/title/linux-internals/oclc/704568240">http://www.worldcat.org/title/linux-internals/oclc/704568240</a>	
MOOC		
1.	nptel.ac.in/courses/106108101/20	

COURSE TITLE	AGILE SOFTWARE DEVELOPMENT			CREDITS	3
COURSE CODE	CSC4270	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	

<b>Course Description</b>	This course helps to develop software following Agile Approaches and provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.														
<b>Course Objective</b>	<ol style="list-style-type: none"><li>1. To explain the background and driving forces for taking an Agile approach to software development</li><li>2. To recognize the business value of adopting Agile approaches</li><li>3. To drive development with unit tests using Test Driven Development</li><li>4. To apply design principles and refactoring to achieve Agility</li><li>5. To deploy automated build tools, version control and continuous integration</li><li>6. To perform testing activities within an Agile project</li></ol>														
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"><li>1. Explain the background and driving forces for taking an Agile approach to software development</li><li>2. Recognize the business value of adopting Agile approaches</li><li>3. Drive development with unit tests using Test Driven Development</li><li>4. Apply design principles and refactoring to achieve Agility</li><li>5. Deploy automated build tools, version control and continuous integration</li></ol>														
<b>Prerequisites: Software Engineering</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO-1	3	3	3	-	1	-	-	-	-	-	-	-	2	2	-
CO-2	3	3	3	-	1	-	-	-	-	2	-	-	2	2	-
CO-3	3	3	3	-	-	1	-	-	-	-	-	-	2	1	2
CO-4	3	3	3	-	1	-	-	-	-	-	-	-	2	2	-
CO-5	3	3	3	-	3	-	-	-	-	-	-	3	1	2	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: FUNDAMENTALS OF AGILE</b>														<b>(12)</b>	
The Genesis of Agile, Introduction and background, Agile Manifesto and Principles, Overview of Scrum, Extreme Programming, Feature Driven development, Lean Software Development, Agile project management, Design and development practices in Agile projects, Test Driven Development, Continuous Integration, Refactoring, Pair Programming, Simple Design, User Stories, Agile Testing, Agile Tools. <b>Practical Component:</b> Design a customer preview following agile manifesto <b>Suggested reading:</b> <a href="https://www.tutorialspoint.com/agile/index.htm">https://www.tutorialspoint.com/agile/index.htm</a>													<b>CO-1 BTL-2</b>		
<b>MODULE2: AGILE SCRUM FRAMEWORK</b>														<b>(12)</b>	



<p>Introduction to Scrum, Project phases, Agile Estimation, Planning game, Product backlog, Sprint backlog, Iteration planning, User story definition, Characteristics and content of user stories, Acceptance tests and Verifying stories, Project velocity, Burn down chart, Sprint planning and retrospective, Daily scrum, Scrum roles – Product Owner, Scrum Master, Scrum Team, Scrum case study, Tools for Agile project management.</p> <p><b>Practical Component:</b> Showcase the sprints planning in banking application</p> <p><b>Suggested reading:</b> <a href="https://www.tutorialspoint.com/scrum/index.htm">https://www.tutorialspoint.com/scrum/index.htm</a></p>	<p><b>CO-2</b> <b>BTL-2</b></p>
<p><b>MODULE 3: AGILE TESTING (12)</b></p>	
<p>The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester</p> <p><b>Practical Component:</b> Demonstrate the quality of an application using agile TDD tools.</p> <p><b>Suggested reading:</b> <a href="https://www.tutorialspoint.com/agile_testing/index.htm">https://www.tutorialspoint.com/agile_testing/index.htm</a></p>	<p><b>CO-3</b> <b>BTL-3</b></p>
<p><b>MODULE 4: CORBA (12)</b></p>	
<p>Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control.</p> <p><b>Practical Component:</b> Demonstrate how refactoring technique works for the changes need to be adopted in banking application.</p> <p><b>Suggested reading:</b> <a href="https://searchsoftwarequality.techtarget.com/tutorial/Agile-software-development-tutorial-Agile-project-management-tools">https://searchsoftwarequality.techtarget.com/tutorial/Agile-software-development-tutorial-Agile-project-management-tools</a></p>	<p><b>CO-4</b> <b>BTL-2</b></p>
<p><b>MODULE 5: INDUSTRY TRENDS (12)</b></p>	
<p>Market scenario and adoption of Agile, Agile ALM, Roles in an Agile project, Agile applicability, Agile in Distributed teams, Business benefits, Challenges in Agile, Risks and Mitigation, Agile projects on Cloud, Balancing Agility with Discipline, Agile rapid development technologies.</p> <p><b>Practical Component:</b> Design and Demonstrate the complete banking software on customer end application using agile.</p> <p><b>Suggested reading:</b> <a href="https://docs.oracle.com/en/cloud/paas/developer-cloud/csdc/using-agile-methodology-oracle-developer-cloud-service.html#GUID-F4B9AAE1-EEB4-49DC-979C-60623BB39024">https://docs.oracle.com/en/cloud/paas/developer-cloud/csdc/using-agile-methodology-oracle-developer-cloud-service.html#GUID-F4B9AAE1-EEB4-49DC-979C-60623BB39024</a></p>	<p><b>CO-5</b> <b>BTL-4</b></p>
<p><b>REFERENCE BOOKS</b></p>	
<p>1.</p>	<p>Ken Schawber, Mike Beedle, “Agile Software Development with Scrum”, Pearson Publications, 2008.</p>

2.	Robert C. Martin, “Agile Software Development, Principles, Patterns and Practices”, Prentice Hall Publications, 2002.
3.	Lisa Crispin, Janet Gregory, “Agile Testing: A Practical Guide for Testers and Agile Teams”, Addison Wesley Publications, 2008.
4.	Alistair Cockburn, “Agile Software Development: The Cooperative Game”, Addison Wesley Publications, 2006.
5.	Mike Cohn, “User Stories Applied: For Agile Software”, Addison Wesley Publications, 2004.
<b>E BOOKS</b>	
1.	<a href="http://martinfowler.com/agile.html">http://martinfowler.com/agile.html</a>
2.	<a href="http://www.it-ebooks.info/tag/agile">www.it-ebooks.info/tag/agile</a>
<b>MOOC</b>	
1.	<a href="https://swayam.gov.in/courses/4722-july-2018-data-base-management-systems">https://swayam.gov.in/courses/4722-july-2018-data-base-management-systems</a>
2.	<a href="https://www.coursera.org/courses?languages=en&amp;query=agile">https://www.coursera.org/courses?languages=en&amp;query=agile</a>
3.	<a href="http://nptel.ac.in/courses/106101061/26">nptel.ac.in/courses/106101061/26</a>

COURSE TITLE	ADVANCED JAVA PROGRAMMING WITH FRAMEWORKS			CREDITS	3
COURSE CODE	CSC4271	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	This course develops programming ability of students to createdynamic web applications using server-side technology with JavaDatabase Connectivity. Students can learn networking and remotemethod invocation using Java API. Different Java frameworkslikeSpring, Java Server Faces and Hibernate will increase abilityofstudentsin web application development.				

<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To outline the importance of core java platform</li> <li>2. To write web applications using Servlet and JSP.</li> <li>3. To create simple business logic for enterprise applications using EJB.</li> <li>4. To create simple enterprise application using struts framework</li> <li>5. To create and deploy web applications using eclipse IDE and create Database connectivity using Hibernate.</li> </ol>
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Outline the importance of core java platform</li> <li>2. Write web applications using Servlet and JSP.</li> <li>3. Create simple business logic for enterprise applications using EJB.</li> <li>4. Create simple enterprise application using struts framework</li> <li>5. Create and deploy web applications using eclipse IDE and create Database connectivity using Hibernate.</li> </ol>

**Prerequisites: Basics of java**

#### CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	1	-	-	-	-	-	-	-	2	2	-
CO-2	3	3	3	-	-	-	-	-	-	2	-	-	2	2	-
CO-3	3	3	3	-	3	1	-	-	-	-	-	3	2	2	-
CO-4	3	3	3	-	3	1	-	-	-	-	-	3	2	2	-
CO-5	3	3	3	-	3	1	-	-	-	-	-	3	2	2	-

**1: Weakly related, 2: Moderately related and 3: Strongly related**

#### MODULE 1: CORE JAVA EE

**(12)**

Java EE 5 Platform Overview - Java EE Platform – Distributed Multi-tiered Applications - Web and Business Components - Java EE Containers – services & types - Application Assembly and Deployment– Packaging Applications -Getting Started with Web Applications – Application Deployment –Web application development and deployment Steps - Configuring Web application – Web application deployment descriptor (web.xml file) - Web Application Archive (\*.WAR file) – \*.WAR directory structure - Building & Deploying Applications, Ant build tool - Advanced Java EE – Web &Business Components Development.

#### **Practical Component:**

Develop web application that demonstrates how to dynamically change the display language based on user preference., Develop and configure a simple website(html site)

**CO-1  
BTL-3**

<b>MODULE 2: SERVLETS &amp; JSP</b>		<b>(12)</b>
<p>Servlet Overview - Life cycle of Servlet - Handling Client HTTP Request and Server HTTP Response Practical (Hands-on Working Examples) - Initializing Parameters and Servlet Context - Initializing a Servlet – Servlet Context initialization Parameters – Servlet Context Attributes (Context binder)- Session Management, Request Dispatcher &amp; Redirecting - Overview of JSP - JSP Architecture &amp; lifecycle - Components of Java Server Pages - Implicit Objects &amp; Standard JSP Tags - Scope of JSP objects.</p> <p><b>Practical Component:</b></p> <p>Create registration and login form using JSP, Write a program to send email using Servlet</p>		<p><b>CO-2</b></p> <p><b>BTL-3</b></p>
<b>MODULE 3: ENTERPRISE JAVA BEANS(12)</b>		
<p>EJB overview &amp; Architecture - About Session Beans - Persistence Programming Model – Session beans: Stateless and Stateful – Entity beans – CMP and BMP – Message Driven Beans Java EE Application Assembly and Deployment – Anatomy of EJB Module &amp; Packaging - Java Persistence API -Designing a Java Enterprise Application.</p> <p><b>Practical Component:</b></p> <p>Write an example program for Simple Business Interface using Statefull and Stateless EJB, write an example of Invoking a 3.0 Entity from a Session Bean</p>		<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: STRUTS</b>		<b>(12)</b>
<p>Struts Framework: Basics &amp; Architecture – Request Handling Life Cycle - Building a simple strut– Configuration, Actions, Interceptors, Results, Value Stack/OGNL Struts2 Tag LibrariesStruts2 XML Based Validations - Database Access.</p> <p><b>Practical Component:</b></p> <p>Create a login application using Action Form, write a program to retrieve the value which is set in the JSP Page in the case of Dynamic Action Form</p>		<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<b>MODULE 5: HIBERNATE AND IDE</b>		<b>(12)</b>
<p>Introduction to Hibernate, ORM Overview, Hibernate Environment - Hibernate Architecture &amp;API, Hibernate Configuration, Hibernate Sessions, Persistent Class &amp; Mapping Files - Building Hibernate application, Hibernate Query Language (HQL) - Hibernate O/R Mappings – Collection &amp;Association Mappings-Hibernate Annotations Eclipse-overview –installation-perspectives-workspacescreatingprojects-packages-classes-interfaces-java build path – run configuration –running program-creating JAR files-debugging programs and configurations-installing plugins developing application using Eclipse.</p> <p><b>Practical Component:</b></p> <p>Demonstrate Hibernate using XML in Eclipse</p>		<p><b>CO-5</b></p> <p><b>BTL-3</b></p>
<b>REFERENCE BOOKS</b>		

1.	Jim Keogh, “The Complete Reference J2EE”, Tata McGraw – Hill Edition 2002.
2.	James Holmes, “The Complete References Struts”, 2 <sup>nd</sup> Edition, Tata McGraw, 2007.
3.	Jusin Couch, Daniel H. Steinberg, “J2EE Bible” Wiley India (P) Ltd, New Delhi 2002.
4.	Paul Tremblett, “Instant Enterprise Java Y-Beans”, Tata McGraw Hill, 2001.
<b>E BOOKS</b>	
1.	<a href="http://www.idt.mdh.se/kurser/cd5480/2003/lectures/j2ee1_3tutorial.pdf">http://www.idt.mdh.se/kurser/cd5480/2003/lectures/j2ee1_3tutorial.pdf</a>
2.	<a href="http://www.tutorialspoint.com/eclipse/index.htm">http://www.tutorialspoint.com/eclipse/index.htm</a>
<b>MOOC</b>	
1.	<a href="https://www.mooc-list.com/course/concurrent-programming-java-coursera">https://www.mooc-list.com/course/concurrent-programming-java-coursera</a>
2.	<a href="https://www.mooc-list.com/course/java-servlets-and-jsp-build-java-eejee-app-25-steps-simpliv">https://www.mooc-list.com/course/java-servlets-and-jsp-build-java-eejee-app-25-steps-simpliv</a>

COURSE TITLE	MIDDLEWARE TECHNOLOGIES			CREDITS	3
COURSE CODE	CSC4272	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	The main objective of the course is to create a practical, wide-ranging discussion on Middleware Technologies to help students understand what is going on so they can pick out the real issues from the imaginary issues and start building complex distributed systems with confidence.				
Course Objective	<div>1. To Discuss the different types of server client concepts.</div> <div>2. To Illustrate the design of EJB architecture.</div> <div>3. To Deploy EJB for specific applications.</div> <div>4. To Build an application using CORBA</div> <div>5. To Build an application using COM.</div> <div>6. To Summarize various Middle ware Technologies.</div>				

Course Outcome	Upon completion of this course, the students will be able to														
	1. Discuss the different types of server client concepts.														
	2. Illustrate the design of EJB architecture.														
	3. Deploy EJB for specific applications.														
	4. Build an application using CORBA														
5. Build an application using COM & summarize various Middle ware Technologies															
Prerequisites: Knowledge about basic Client Server applications.															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	-	1	-	-	-	-	-	-	-	2	2	-
CO-2	3	3	3	3	3	-	-	-	-	2	-	-	2	2	-
CO-3	3	3	3	-	3	1	-	-	-	-	-	-	2	-	2
CO-4	3	3	3	3	3	-	-	-	-	-	-	-	2	2	-
CO-5	3	3	3	3	3	-	-	-	-	-	-	3	-	2	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: CLIENT / SERVER CONCEPTS														(12)	
Client server – File server – Database server – Group server – Object server – Web server – Middleware – General middleware – Service specific middleware – Client / server building blocks – RPC – Messaging – Peer-to-peer. Practical Component: 1. Create a distributed name server (like DNS) RMI. Suggested reading: <a href="https://www.whoishostingthis.com/resources/corba/">https://www.whoishostingthis.com/resources/corba/</a>														CO-1 BTL-2	
MODULE 2: EJB ARCHITECTURE (12)															
EJB architecture – Overview of EJB software architecture – View of EJB – Conversation – Building and deploying EJB – Roles in EJB. Practical Component: 1. Create a Java Bean to draw various graphical shapes and display it using or without using BDK. Suggested reading: <a href="https://www.tutorialspoint.com/ejb/">https://www.tutorialspoint.com/ejb/</a>														CO-2 BTL-2	
MODULE 3: EJB APPLICATIONS														(12)	
EJB session beans – EJB entity beans – EJB clients – EJB deployment – Building an application with EJB. Practical Component:														CO-3 BTL-3	

1. Develop an Enterprise Java Bean for student Information System. 2. Develop an Enterprise Java Bean for Library operations <b>Suggested reading:</b> <a href="https://www.tutorialspoint.com/ejb/">https://www.tutorialspoint.com/ejb/</a>		
<b>MODULE 4: CORBA</b>		<b>(12)</b>
CORBA – Distributed systems – Purpose – Exploring CORBA alternatives – Architecture overview – CORBA and networking model – CORBA object model – IDL – ORB – Building an application with CORBA. <b>Practical Component:</b> 1. Develop a middleware component for retrieving Stock Market Exchange information using CORBA. 2. Develop a middleware component for retrieving Bank Balance using CORBA. <b>Suggested reading:</b> <a href="http://www.ois.com/Products/what-is-corba.html">http://www.ois.com/Products/what-is-corba.html</a>		<b>CO-4</b> <b>BTL-2</b>
<b>MODULE 5: COM</b>		<b>(12)</b>
COM – Data types – Interfaces – Proxy and stub – Marshalling – Implementing server/client – Interface pointers – Object creation – Invocation – Destruction – Comparison COM and CORBA – Introduction to .NET – Overview of .NET architecture – Marshalling – Remoting. <b>Practical Component:</b> 1. Develop a component for browsing CD catalogue using COM / .NET 2. Develop a component for retrieving information from message box using DCOM/.NET <b>Suggested reading:</b> <a href="https://www.codeguru.com/cpp/com-tech/activex/tutorials/article.php/c5567/Step-by-Step-COM-Tutorial.htm">https://www.codeguru.com/cpp/com-tech/activex/tutorials/article.php/c5567/Step-by-Step-COM-Tutorial.htm</a>		<b>CO-5</b> <b>BTL-2</b>
<b>TEXT BOOKS</b>		
1.	Robert Orfali, Dan Harkey and Jeri Edwards, "The Essential Client / Server Survival Guide", Galgotia Publications Pvt. Ltd, Third Edition, 2002.	
2.	Tom Valesky, "Enterprise Java Beans", Pearson Education, 2002.	
3.	Jason Pritchard, "COM and CORBA Side by Side", Addison Wesley, 2000	
4.	Joel Murach, Anne Boehm "C#", Murach, 2012.	
5.	Robert Orfali, Dan Harkey and Jeri Edwards, "The Essential Client / Server Survival Guide", Galgotia Publications Pvt. Ltd, Third Edition, 2002.	

REFERENCE BOOKS	
1.	Mowbray, "Inside CORBA", Pearson Education, 2002
2.	Jeremy Rosenberger, "Teach Yourself CORBA in 14 days", TEC Media, 2000.
MOOC	
1.	<a href="https://swayam.gov.in/courses/4722-july-2018-data-base-management-systems">https://swayam.gov.in/courses/4722-july-2018-data-base-management-systems</a>

COURSE TITLE	DATABASE SECURITY			CREDITS	3
COURSE CODE	CSC4351	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3

**ASSESSMENT SCHEME**

First Periodical Assessment	Second Periodical Assessment	Practical Component	ESE
15%	15%	20%	50%

<b>Course Description</b>	This course is designed to provide a wide knowledge of database security issues and deep understanding of the database security techniques. It is a study of principles and practices of implementing computer database security in modern businesses and industries, including database security principles, database auditing, security implementation and database reliability.
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<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To identify the security issues and solve them using appropriate security models.</li> <li>2. To implement security mechanisms in a database system and provide a secured information flow.</li> <li>3. To deploy EJB for specific applications.</li> <li>4. To write Shell Programming for various functionalities required for the applications</li> <li>5. To identify and discover security attacks through statistical inference and discovery methods.</li> <li>6. To develop new generation DBMS through protection models.</li> </ol>
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<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Identify the security issues and solve them using appropriate security models.</li> <li>2. Implement security mechanisms in a database system and provide a secured information flow.</li> <li>3. Apply User roles and privileges for a secure database design.</li> <li>4. Identify and discover security attacks through statistical inference and discovery methods.</li> <li>5. Develop new generation DBMS through protection models.</li> </ol>
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**Prerequisites: Database basics**



CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	-	1	-	-	-	-	-	-	-	2	2	-
CO-2	3	3	3	-	-	-	-	-	-	2	-	-	2	2	-
CO-3	3	3	3	-	3	1	-	-	-	-	-	-	2	-	2
CO-4	3	3	3	-	-	-	-	-	-	-	-	-	2	2	-
CO-5	3	3	3	3	-	-	-	-	-	-	-	3	-	2	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: TECHNOLOGIES FOR DATABASE SECURITY (6L+6P)															
Data Management Technologies-Security Problems in Databases- Relational and Entity Relationship Data Models-Architectural Issues-Database Design-Database Administration-System Functions-Query Processing-Transaction,Storage and Metadata Management-Database Integrity-Fault Tolerance-Distributed Databases-Client/Server Databases-Data Warehousing and Data Mining-Object Technology-Object Technology Model-Secure Multimedia Data Management Systems. <b>Practical Component:</b> Creation of a Database Schema: Make use of the data definition statements of SQL and write scripts for creating 3 tables, where the table 1 should be related to rows of table 2 which in turn is related to table 3. Ensure that the primary and foreign keys are properly declared.													CO-1  BTL-3		
MODULE 2: SECURITY FOR DATABASE SYSTEMS (6L+6P)															
Security Policies-Access Control Policies-Authorization Policies-Role based Access Control-Administration Policies-Identification and Authentication-Auditing a Database-Policy enforcement and Related Issues-SQL Extensions for Security-Query Modification-Historical Developments in Security for Database Systems-Design Principles. <b>Practical Component:</b>  Populating the Database: Fill the table with meaningful data with proper foreign keys assigned. This should be implemented as a security exercise.													CO-2  BTL-3		
MODULE 3: STATISTICAL DATABASE PROTECTION (6L+6P)															
The Inference Problem-Statistical Database Inference-Complexity of the Inference Problem-Security Constraint Processing for Inference Control-Security, Content based, Association based, Event Based- Release based, Logical, Aggregate-Level based, Fuzzy and Complex Constraints-Approach to Security Constraint Processing-Algorithm: Consistency and Completeness-Query Processor-Conceptual Structure for Inference Control-Semantic Nets and the Inference Problem-Multilevel Semantic Nets- Enforcing Security Constraints. <b>Practical Component:</b>  Implement a matrix of user-roles against the database resources. Here, the database resources are the base tables and their corresponding views. Your created matrix should													CO-3  BTL-3		

have the necessary information regarding to whom the access is permitted and where it is given. You are required to write a SQL script of GRANT statements. Also, check it manually by producing the script on a paper.		
<b>MODULE 4: SECURITY FOR DISTRIBUTED DATABASES</b>		<b>(6L+6P)</b>
<p>Discretionary Security-Distributed Access Control-Auditing a Distributed Databases-SQL for Distributed Database Security-Security Impact-Multi level Security for Distributed Database Systems- Architectures-Distributed Data with Centralized Control and Distributed Control-Secure Heterogeneous and Federated Database Systems- Architectures-Secure Client/Server Database Management-Migrating Legacy Databases and Applications.</p> <p><b>Practical Component:</b></p> <p>1. Develop a security policy for a distributed database management system.</p> <p>2. Indicate any additional SQL security measures that could be taken, and comment on the strengths and weaknesses of the measures you have taken.</p>		<b>CO-4</b> <b>BTL-3</b>
<b>MODULE 5: SECURITY OF OBJECT DATABASE SYSTEMS</b>		<b>(6L+6P)</b>
<p>Policy Issues and Enforcement-Object-Oriented Databases: The ORION model and the SORION model -Jajodia and Kogan's Model- Aspects of Objects and Security- Security for Object Request Brokers- OMG Security Services-Object Modelling for Secure Applications- Multilevel OMT-UML and Security.</p> <p><b>Practical Component:</b></p> <p>1. An Employee named Ben was assigned a sensitive task. But he was not given a hike in his tenure. Keeping this in mind, he tried to make modifications to the existing customer table. Answer these questions and find out whether he succeeds in his attempt. (you can refer to your database design and security script).</p> <p>a. Ben was given an opportunity to delete the CUSTOMER table. Find out if he succeeds in this attempt? Was he given any SYSADM privileges?</p> <p>b. He then again tried to delete some customers from the table. Did he ever succeed? Did the created deletes cascade?</p> <p>c. He then tried to insert a line in all orders over Rs.1000 for the 500 products. Did he succeed? How was the problem detected?</p> <p>d. He tried to change his password? Did he ever succeed? How much privilege can any individual ever be given?</p>		<b>CO-5</b> <b>BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Database and Applications Security: Integrating Information Security Management, Bhavani Thuraisingham, Auerbach Publications, 1 edition, 2005.	
2.	Database Security, Silvana Castano, Mariagrazia Fugini, Giancarlo Martella, Pierangela Samarati, Second edition, ACM Press, Pearson Education,1995.	
<b>REFERENCE BOOKS</b>		

1.	Database Security, Alfred Basta, melissazgola, CENGAGE learning, 2011.
<b>EBOOK</b>	
1.	<a href="https://epdf.pub/database-and-applications-security-integrating-information-security-and-data-man.html">https://epdf.pub/database-and-applications-security-integrating-information-security-and-data-man.html</a>
<b>MOOC</b>	
1.	<a href="https://www.coursera.org/learn/network-security-database-vulnerabilities">https://www.coursera.org/learn/network-security-database-vulnerabilities</a>
2.	<a href="https://www.udemy.com/course/database-security-for-cyber-professionals/">https://www.udemy.com/course/database-security-for-cyber-professionals/</a>

COURSE TITLE	MULTICORE ARCHITECTURE			CREDITS	3
COURSE CODE	CSC4352	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	In this course we will look at the challenges and techniques in programming these systems. The course will expose students to theoretical as well as practical aspects of designing multicore software systems. It assumes that the student has undergraduate level knowledge of programming, data structures, operating systems, computer architecture, and algorithms.				
Course Objective	1. To recognize the need for parallel computing 2. To write and run simple parallel programs 3. To implement distributed memory programs in MPI 4. To implement shared memory programs using threads 5. To implement shared memory programs in OpenMP 6. To evaluate the parallel programs.				
Course Outcome	Upon completion of this course, the students will be able to  1. Recognize the need for parallel computing 2. Write and run simple parallel programs 3. Implement distributed memory programs in MPI 4. Implement shared memory programs using threads & OpenMP 5. Evaluate the parallel programs.				
Prerequisites : Concepts of Microprocessor and Computer Architecture					
CO, PO AND PSO MAPPING					

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	-	1	-	-	-	-	-	-	-	2	2	-
CO-2	3	3	3	-	-	-	-	-	-	2	-	-	2	2	-
CO-3	3	3	3	-	3	1	-	-	-	-	-	-	2	-	2
CO-4	3	3	3	3	3	-	-	-	-	-	-	-	2	2	-
CO-5	3	3	3	-	-	-	-	-	-	2	3	3	2	2	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
<b>MODULE 1: PARALLEL HARDWARE AND PARALLEL SOFTWARE</b>														<b>(6+6)</b>	
<p>Need for Parallel Computing- Background and Modifications of von Neumann Model - Parallel Hardware- Parallel Software- Input and Output- Performance - Parallel Program Design - Writing and Running Parallel Programs.</p> <p><b>Practical Component:</b> (use the command line of a Unix shell, the gcc compiler)</p> <ol style="list-style-type: none"> <li>Implement a simple parallel program to compute n values with p cores where p is much lesser than n.</li> <li>Implement inter process communication using Message Passing API</li> </ol>														<b>CO-1</b> <b>BTL-3</b>	
<b>MODULE 2: DISTRIBUTED-MEMORY PROGRAMMING WITH MPI</b>														<b>(6+6)</b>	
<p>Introduction-The Trapezoidal Rule in MPI - Dealing with I/O - Collective Communication- MPI Derived Data types- Performance Evaluation of MPI Programs</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>Implement MPI program that prints greetings from the processes</li> <li>Write a program to implement Parallelizing the trapezoidal rule using MPI</li> </ol>														<b>CO-2</b> <b>BTL-3</b>	
<b>MODULE 3: SHARED-MEMORY PROGRAMMING WITH PTHREADS</b>														<b>(6+6)</b>	
<p>Processes, Threads, and Pthreads - Hello, World - Matrix-Vector Multiplication - Critical Sections - Busy-Waiting – Mutexes - Producer-Consumer Synchronization and Semaphores - Barriers and Condition Variables - Read-Write Locks- Caches, Cache Coherence, and False Sharing – Thread Safety.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>Implement a Pthread “Hello World” Program</li> <li>Write a program to send messages using Pthread using Producer Consumer synchronization.</li> </ol>														<b>CO-3</b> <b>BTL-3</b>	
<b>MODULE 4: SHARED MEMORY PROGRAMMING WITH OpenMP</b>														<b>(6+6)</b>	

Introduction -The Trapezoidal Rule - Scope of Variables - The Reduction Clause - The parallel for Directive - More About Loops in OpenMP: Sorting - Scheduling Loops - Producers and Consumers- Caches, Cache Coherence, and False Sharing – Thread Safety.					CO-4  BTL-4
Practical Component:					
1. Implement a “hello,world” program that uses OpenMP  2. Implement trapezoidal rule program using OpenMP					
MODULE 5: PARALLEL PROGRAM DEVELOPMENT					(6+6)
Two n-Body Solvers- Parallelizing and Evaluation in OpenMP- Tree search – Recursive and Non- Recursive DFS –Data structures and Performance of the serial implementations- static and dynamic parallelization of tree search using Pthreads and evaluation - Parallelizing the tree-search programs using OpenMP and its performance - Implementation of tree search using MPI with static and dynamic partitioning.					CO-5  BTL-4
Practical Component:					
1. Implement reduced algorithm for computing n-body forces  2. Implement the recursive and non-recursive solution to TSP using DFS.					
TEXT BOOKS					
1.	Peter S. Pacheco, “An Introduction to Parallel Programming”, Morgan Kauffman/Elsevier, 2011.				
REFERENCE BOOKS					
1.	Michael J Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw Hill, 2003.				
2.	Shameem Akhter and Jason Roberts, “Multi-core Programming”, Intel Press, 2006.				
3.	Darryl Gove, “Multicore Application Programming for Windows, Linux, and Oracle Solaris”, Pearson, 2011.				
E BOOKS					
1.	<a href="https://www.goodreads.com/book/show/9230165-an-introduction-to-parallel-programming">https://www.goodreads.com/book/show/9230165-an-introduction-to-parallel-programming</a>				
MOOC					
1.	<a href="https://www.coursera.org/learn/parprog1">https://www.coursera.org/learn/parprog1</a>				
2.	<a href="https://www.udemy.com/introduction-to-parallel-programming-using-gpgpu-and-cuda/">https://www.udemy.com/introduction-to-parallel-programming-using-gpgpu-and-cuda/</a>				
COURSE TITLE		SOFT COMPUTING		CREDITS	3
COURSE CODE	CSC4353	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					

First Periodical Assessment	Second Periodical Assessment	Practical Component					ESE								
15%	15%	20%					50%								
Course Description	This course will cover fundamental concepts used in Soft computing. The concepts of Fuzzy logic (FL) will be covered first, followed by Artificial Neural Networks (ANNs) and optimization techniques using Genetic Algorithm (GA). Applications of Soft Computing techniques to solve a number of real life problems will be covered to have hands on practices. In summary, this course will provide exposure to theory as well as practical systems and software used in soft computing.														
Course Objective	1. To apply concepts of fuzzy sets, fuzzy logic and heuristics-based systems. 2. To derive appropriate rules for fuzzy inference systems 3. To apply the mathematical background to optimize neural network learning 4. To implement optimization algorithms and random search procedures in self-learning. 5. To analyze case studies to illustrate the intelligent behavior of programs based on soft computing.														
Course Outcome	Upon completion of this course, the students will be able to  1. Apply concepts of fuzzy sets, fuzzy logic and heuristics-based systems. 2. Derive appropriate rules for fuzzy inference systems 3. Apply the mathematical background to optimize neural network learning 4. Implement optimization algorithms and random search procedures in self-learning. 5. Analyze case studies to illustrate the intelligent behavior of programs based on soft computing.														
Prerequisites : Set Theory, Fuzzy Set Theory															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO-8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	3	-	1	-	-	-	-	-	-	-	2	2	-
CO-2	3	3	3	-	-	-	-	-	-	2	-	-	2	2	-
CO-3	3	3	3	-	3	1	-	-	-	-	-	-	2	-	2
CO-4	3	3	3	-	-	-	-	-	-	-	-	-	2	2	-
CO-5	3	3	3	3	-	-	-	-	-	-	-	3	3	2	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: FUZZY SET													(6+6)		
Introduction to Neuro – Fuzzy and Soft Computing Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and parameterization. Practical Components:													CO-1  BTL-2		

1. Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform maxmin composition on any two fuzzy relations. <b>Suggested reading :</b> <a href="https://nptel.ac.in/courses/106/105/106105173/">https://nptel.ac.in/courses/106/105/106105173/</a> <a href="https://in.mathworks.com/help/fuzzy/index.html?s_tid=CRUX_lftnav">https://in.mathworks.com/help/fuzzy/index.html?s_tid=CRUX_lftnav</a>		
<b>MODULE 2: FUZZY LOGIC</b>		<b>(6+6)</b>
Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling. <b>Practical Components:</b> Using MATLAB Fuzzy Logic Tool Box 1. Create single input and single output Mamdani Fuzzy model. 2. Create two input and single output Mamdani Fuzzy model. 3. Implement the Tipper problem. 4. Solve Air Conditioner Controller using MATLAB Fuzzy logic toolbox <b>Suggested reading:</b> 1. <a href="https://nptel.ac.in/courses/106/105/106105173/">https://nptel.ac.in/courses/106/105/106105173/</a> 2. <a href="https://in.mathworks.com/help/fuzzy/index.html?s_tid=CRUX_lftnav">https://in.mathworks.com/help/fuzzy/index.html?s_tid=CRUX_lftnav</a>	<b>CO-2</b> <b>BTL-3</b>	
<b>MODULE 3: OPTIMIZATION</b>		<b>(6+6)</b>
Genetic Algorithms: Chromosomes – Fitness function – Population – GA operators – Elitism – GA Parameters – Convergence. Multi-objective Genetic Algorithm. Basics of Simulated Annealing – Random Search – Downhill Simplex Search – Particle Swarm Optimization – Ant Colony Optimization. <b>Practical Components:</b> 1.Implement Travelling Salesman problem using GA/PSO/SA/ACO <b>Suggested reading:</b> <a href="https://nptel.ac.in/courses/106/105/106105173/">https://nptel.ac.in/courses/106/105/106105173/</a>	<b>CO-3</b> <b>BTL-3</b>	
<b>MODULE 4: NEURAL NETWORKS</b>		<b>(6+6)</b>
Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation Multilayer Perceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning. <b>Practical Components:</b> 1. Create a perceptron with appropriate no. of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights. 2. Create a simple ADALINE network with appropriate no. of input and output nodes. Train it using delta learning rule until no change in weights is required. Output the final weights. <b>Suggested reading:</b> <a href="https://nptel.ac.in/courses/106/105/106105173/">https://nptel.ac.in/courses/106/105/106105173/</a>	<b>CO-4</b> <b>BTL-3</b>	
<b>MODULE 5: NEURO-FUZZY MODELLING</b>		<b>(6+6)</b>

Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN		CO-5  BTL-3
<b>Practical Components:</b> 1. Modelling a Two input Sinc Function 2. On-Line Identification in Control System <b>Suggested reading:</b> <a href="https://nptel.ac.in/courses/117105084/">https://nptel.ac.in/courses/117105084/</a>		
<b>TEXT BOOKS</b>		
1.	J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, Pearson, 2004..	
<b>REFERENCE BOOKS</b>		
1.	Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, 1997..	
2.	Davis E.Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, 2009	
3.	S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2003.	
<b>E BOOKS</b>		
1.	<a href="https://lillipdf56-por.firebaseio.com/14-ricky-hoeger-6/9789332549883-neuro-fuzzy-and-soft-computing-a-computational-a-ebook.pdf">https://lillipdf56-por.firebaseio.com/14-ricky-hoeger-6/9789332549883-neuro-fuzzy-and-soft-computing-a-computational-a-ebook.pdf</a>	
<b>MOOC</b>		
1.	<a href="https://www.coursera.org/learn/neural-networks">https://www.coursera.org/learn/neural-networks</a>	
2.	<a href="https://onlinecourses.nptel.ac.in/noc18_cs13/">https://onlinecourses.nptel.ac.in/noc18_cs13/</a>	

COURSE TITLE	DIGITAL IMAGE PROCESSING			CREDITS	3
COURSE CODE	CSC4354	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	This course will cover the fundamentals of image processing. The course provides a mathematical framework to describe and analyze images as two-dimensional signals in the spatial and frequency domains. In this class not only will you learn the theory behind fundamental processing tasks including image enhancement, recovery,				



	segmentation, and learn how to perform these key processing tasks in practice using state-of-the-art techniques and tools.														
Course Objective	<ol style="list-style-type: none"><li>1. To Infer the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.</li><li>2. To apply the techniques of smoothing, sharpening and enhancement on the image and extend to the restoration concepts and filtering techniques.</li><li>3. To illustrate the concepts of segmentation and examine the multi resolution analysis.</li><li>4. To interpret and illustrate the basics of Image Compression.</li><li>5. To analyze the various recognition methods.</li><li>6. To build the real-world problem by designing an appropriate system and implementing the theory and algorithms of this course.</li></ol>														
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"><li>1. Infer the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.</li><li>2. Apply the techniques of smoothing, sharpening and enhancement on the image and extend to the restoration concepts and filtering techniques.</li><li>3. Illustrate the concepts of segmentation and examine the multi resolution analysis.</li><li>4. Interpret and illustrate the basics of Image Compression and various recognition methods</li><li>5. Build the real-world problem by designing an appropriate system and implementing the theory and algorithms of this course.</li></ol>														
Prerequisites : Concepts of Digital Signal Processing															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	-	1	-	-	-	-	-	-	-	2	2	-
CO-2	3	3	3	-	-	-	-	-	-	2	-	-	2	2	-
CO-3	3	3	3	-	3	1	-	-	-	-	-	-	2	-	2
CO-4	3	3	3	-	-	-	-	-	-	-	-	-	2	2	-
CO-5	3	3	3	3	-	-	-	-	-	-	-	3	3	2	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: DIGITAL IMAGE FUNDAMENTALS (6+6)															

<p>Introduction – Steps in Image Processing Systems – Components of an Image Processing System- Image Acquisition – Sampling and Quantization – Pixel Relationships – Introduction to the Basic Mathematical Tools Used in Digital Image Processing .</p> <p><b>Practical Component:</b> (Using Python Libraries /MATLAB)</p> <ol style="list-style-type: none"> <li>Perform scalar arithmetic operations.</li> <li>Perform basic operations on vectors.</li> <li>Perform matrix operations.</li> </ol>	<p><b>CO-1</b> <b>BTL-2</b></p>
<p><b>MODULE 2: IMAGE ENHANCEMENT AND RESTORATION</b> (6+6)</p>	
<p>Spatial Filtering: Basic Intensity Transformation Functions- Histogram Processing - Fundamentals of Spatial Filtering – Smoothing - Sharpening- Highpass, Bandreject, and Bandpass Filters from Lowpass Filters - Combining Spatial Enhancement Methods. Filtering in Frequency Domain : Sampling and the Fourier Transform of Sampled Functions - The Discrete Fourier Transform of One Variable - Extensions to Functions of Two Variables -Some Properties of the 2-D DFT and IDF -Basics of Filtering in the Frequency Domain -Image Smoothing Using Lowpass Frequency Domain Filters -Image Sharpening Using Highpass Filters - Selective Filtering -The Fast Fourier Transform</p> <p><b>Practical Component:</b> (Using Python Libraries /MATLAB)</p> <ol style="list-style-type: none"> <li>Perform histogram equalization on the given image</li> <li>Perform image enhancement using different filters in spatial domain</li> <li>Perform image enhancement using different filters in frequency domain</li> </ol>	<p><b>CO-2</b> <b>BTL-2</b></p>
<p><b>MODULE 3: IMAGE RESTORATION AND IMAGE TRANSFORMS</b> (6+6)</p>	
<p>Image Restoration – degradation model, Noise models – spatial filtering – Periodic Noise Reduction Using Frequency Domain Filtering – Linear, Position-Invariant Degradations - Estimating the Degradation Function - Inverse Filtering - Minimum Mean Square Error (Wiener) Filtering - Constrained Least Squares Filtering - Geometric Mean Filter - Image Reconstruction from Projections.</p> <p>Wavelet and Other Image Transforms: Matrix-based Transforms – Correlation – Basis Functions in the Time-Frequency Plane - Basis Images - Fourier-Related Transforms - Walsh- Hadamard Transforms -Slant Transform - Haar Transform - Wavelet Transforms</p> <p><b>Practical Component:</b> (Using Python Libraries /MATLAB)</p> <ol style="list-style-type: none"> <li>Restore the image using spatial and frequency domain filters</li> <li>Implement Haar transform and wavelet transform</li> <li>Implement Walsh-Hadamard Transforms and Slant Transform.</li> </ol>	<p><b>CO-3</b> <b>BTL-3</b></p>
<p><b>MODULE 4: COLOR IMAGE PROCESSING AND IMAGE COMPRESSION</b> (6+6)</p>	
<p>Color Image Processing: Color Fundamentals - Color Models - Pseudocolor Image Processing - Basics of Full- Color Image Processing -Color Transformations - Color Image Smoothing and Sharpening - Using Color in Image Segmentation - Noise in Color Images. Image Compression: Fundamentals – Coding Redundancy, Spatial and Temporal Redundancy, Irrelevant information, Measuring Image Information, Fidelity Criteria, Image Compression Models – Basic Compression Methods -Digital Image Watermarking.</p> <p><b>Practical Component:</b> (Using Python Libraries /MATLAB)</p> <ol style="list-style-type: none"> <li>Segment the image using colors.</li> <li>Perform image compression using various compression methods and compare its performance.</li> </ol>	<p><b>CO-4</b> <b>BTL-4</b></p>

MODULE 5: MORPHOLOGICAL IMAGE PROCESSING AND IMAGE SEGMENTATION(6+6)	
<p>Morphological Image Processing: Erosion and Dilation - Opening and Closing - The Hit-or-Miss Transform -Some Basic Morphological Algorithms - Morphological Reconstruction - Summary of Morphological Operations on Binary Images- Grayscale Morphology. Image Segmentation: Fundamentals - Point, Line, and Edge Detection - Thresholding - Segmentation by Region Growing and by Region Splitting and Merging - Region Segmentation Using Clustering and Superpixels - Image Segmentation Using Snakes -Segmentation Using Level Sets.</p> <p><b>Practical Component:</b> (Using Python Libraries /MATLAB)</p> <ol style="list-style-type: none"> <li>Perform morphological operations on an image.</li> <li>Segment the image using Region growing, splitting and merging</li> <li>Segment image using snakes.</li> </ol>	<b>CO-5 BTL-4</b>
TEXT BOOKS	
1.	Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", 4thEdition, Pearson, 2018..
REFERENCE BOOKS	
1.	Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB Pearson Education, Inc., 2011.
2.	Kenneth R. Castleman,Digital Image Processing Pearson, 2006.
3.	Anil K.Jain, "Fundamentals of Digital Image Processing", Person Educaiton, 2003.
4.	William K Pratt, "Digital Image Processing", John Willey, New York, 2002.
5.	Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", Second Edition, Thomson Learning, 2001.
E BOOKS	
1.	<a href="http://web.ipac.caltech.edu/staff/fmasci/home/astro refs/Digital Image Processing 3rdEd truncated.pdf">http://web.ipac.caltech.edu/staff/fmasci/home/astro refs/Digital Image Processing 3rdEd truncated.pdf</a>
MOOC	
1.	<a href="https://onlinecourses.nptel.ac.in/noc18_ee40/">https://onlinecourses.nptel.ac.in/noc18_ee40/</a>

<b>CSC4355</b>	<b>COURSE CATEGORY</b>	<b>DE</b>	
<b>1.0</b>	<b>Approval Details</b>		<b>LEA</b>

<b>Second Periodical Assessment</b>	<b>Practical Component</b>	
<b>15%</b>	<b>20%</b>	

The course focuses on the application level with only minor attention to operating-system level security; network-level security. Assignments will involve uncovering security holes in software, implementing secure applications, and presenting on a case study. The course is intended for upper-level Computer Science majors who expect to be writing applications with a security component. Students are required to sign a pledge of responsible conduct at the start of the course.

1. To know of the fundamental concepts of security and develop the threat models.
2. To understand the design of Client and Server Programming Model using Network Security concepts.
3. To know the concepts of Web Application Security such as SQL Injection, XSS.
4. To understand the design concept of coding in security using C++ and JAVA Programming Languages.
5. To know more about building Code using C, C++, Java and Web Programming Languages and apply the concepts of Cryptography and Digital Signatures.

Upon completion of this course, the students will be able to

1. Apply the knowledge of the fundamental concepts of security and develop the threat models.
2. Analyze and Design the Client and Server Programming Model using Network Security concepts.
3. Apply and Illustrate the concepts of Web Application Security such as SQL Injection, XSS.
4. Analyze and Design the coding in security using C++ and JAVA Programming Languages.
5. Build the Secure Code using C, C++, Java and Web Programming Languages and apply the concepts of Cryptography and Digital Signatures.

**Prerequisites: Web Technology, C, C++, Java**

PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO -10	PO-11	PO-12
	3	-	1	-	-	-	-	-	-	-
	3	-	3	-	-	-	-	2	-	-
	3	-	3	1	-	-	-	-	-	-
	3	-	3	-	-	-	-	-	-	-
	3	-	3	-	-	-	-	-	-	-

**1: Weakly related, 2: Moderately related and 3: Strongly related**

**ENTALS****(6+6)**

es - Security Mechanisms - Need for secure systems- Proactive security development process- Security principles - threat

Kali Linux, a security attack scenario and thus implement a securitymechanismusingthe Encryption/Decryptionstrategies.

tal Signature Scheme, and indicate its features as a securitymechanism.

onDetectionSystem(IDS).YoucanmakeuseofSNORToranyotherequivalentsoftware.Itshouldbeabletosniffthepackets,perform

**Y PROGRAMMING****(6+6)**

esandFunctionality-ProgrammingServersandClients-Programming Wired and Wireless Sniffers - Programming arbitrary pack

area network be protected from attackers on the external Internet?Illustratebyimplementingwitha securecode.

lmonitorthetheHoneypotonthenetwork.Makeobservationsoftheworkingofthe honeypotsetup.

orawirelessauditionanaccesspointorarouter.Also,decryptWEP

vacity)andWEA(WirelessProtectedAccess).Indicatethesecurityparametersinvolved.

**SECURITY****(6+6)**

g - Web Application Fuzzers - Scraping Web Applications – HTML andXML file analysis - Web Browser Emulation - Attackin

angling-Automationofattackssuchas SQLInjection,XSS.

ncesthatyoufindoutbetweenNetworkSecurityandWebSecurity.

ation and identify all the security issues and vulnerabilities within theWeb Application. Make sure you use the SDLC Mod  
rocess.

ne different attack vectors such as SQL Injection, Cr

leInclusionandCrossSiteRequestForgery(CSRF).Also,Performacasestudywith

cationSecurityScannerandanalyzeit'sperformance.

**N C****(6+6)**

lationerrors–StringVulnerabilitiesandexploits–Mitigationstrategiesforstrings-Pointers–Mitigationstrategiesinpointerbasedv  
ilities.

ilitiesinC/C++programsandalsoperformthefollowing:

cpy()andstrncat()insteadofstrcpy(),strcat().

streadd()andstrecpy().

wandFormatStringAttacksinC/C++.

onstratememoryleakandfindoutasolutiontoovercomethisissue.

**N C++ AND JAVA****(6+6)**

-Commonerrorsindynamicmemorymanagement-Memorymanagers-Double –freevulnerabilities–Integersecurity-Mitigation

show dynamic memory management concepts of allocating memory,and the vulnerabilities incurred. Compare the concep

C++ismore securethan C.

oleprogramshowJavaismoresecurethanC/C++.

handlesMemoryManagement,AccessSpecificKeywordsandCompileTimeChecking.

ings, “cryptography And Network Security”, 7Th Edition, Pearson, 2016.

an and Vincent Liu, “Web Application Security, A Beginner's Guide”, McGraw-Hill Education; 1 edition , 2011.

ward , David LeBlanc, “Writing Secure Code”, Microsoft Press, 2<sup>nd</sup> Ed., 2003

acord, “Secure Coding in C and C++”, Pearson Education, 2<sup>nd</sup> Ed., 2013

MOOC	
1.	<a href="https://www.coursera.org/specializations/secure-coding-practices?">https://www.coursera.org/specializations/secure-coding-practices?</a>
2.	<a href="https://www.mooc-list.com/course/it-security-defense-against-digital-dark-arts-coursera">https://www.mooc-list.com/course/it-security-defense-against-digital-dark-arts-coursera</a>

COURSE TITLE	DISTRIBUTED DATABASE MANAGEMENT SYSTEMS			CREDITS	3
COURSE CODE	CSC4356	COURSE CATEGORY	DE	L-T-P-S	3-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	This course will deal with the fundamental issues in large distributed database systems which are motivated by the computer networking and distribution of processors.				
Course Objective	<div>1. To know the concept of Distributed DBMS</div> <div>2. To learn the design strategies and fragmentations</div> <div>3. To gain the integration process for distributed DB</div> <div>4. To understand the Query processing &amp; Optimizations</div> <div>5. To understand the concepts of Transaction processing &amp; Database Security</div>				

<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. Explain concepts of Distributed DBMS 2. Design Strategies & Fragmentations concepts 3. Integrate the Distributed DB 4. Execute Query processing & Optimizations 5. Implement Transaction processing & Database Security														
<b>Prerequisites: Distributed Database Management Systems</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
<b>CO-1</b>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<b>CO-2</b>	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
<b>CO-3</b>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<b>CO-4</b>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>CO-5</b>	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: INTRODUCTION TO DISTRIBUTED DBMS (6+6)</b>															
Database concepts: Data Models- Database Operations- Database Management-DB Clients, Servers, and Environments. DBE Architecture: Services- Components and Subsystems- Sites - Expected Services-Expected Subsystems- DBMS Services–Transaction Management in Distributed Systems <b>Practical Component:</b> 1. Consider a three-site system where transactionT1 enters the system at Site 1. Transaction T1 needs to reads the total balance for accounts 100, 200, and 300. Let’s assume that the account table is horizontally fragmented across three sites. Site 1 holds accounts 1 to 150, Site 2 holds accounts 151 to 250, and Site 3 holds accounts 251 and higher. If X, Y, and Z represent the balances for accounts 100, 200, and 300, respectively, execute this distributed transaction as follows: Send "necessary commands" to Site 1 to read "X" from DB1; Send "necessary commands" to Site 2 to read "Y" from DB2; Send "necessary commands" to Site 3 to read "Z" from DB3; Receive "X" from Site 1; Receive "Y" from Site 2; Receive "Z" from Site 3; Calculate Result = X + Y + Z; Display Result to User;													<b>CO-1 BTL-2</b>		
<b>MODULE 2: DATA DISTRIBUTION ALTERNATIVES (6+6)</b>															

<p>Data Distribution Alternatives: Design Alternatives- Localized Data- Distributed Data. Fragmentation: Vertical Fragmentation- Horizontal Fragmentation. Distribution Transparency: Location Transparency- Fragmentation Transparency-Replication Transparency-Location, Fragmentation, and Replication Transparencies</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Consider the table EMP (EmpID, Name, Loc, Sal, DOB, Dept). Let's assume that for security reasons the salary information for employees needs to be maintained in the company server located in 'YY'. Fragment the table vertically to achieve this:</li> <li>2. Suppose we have three branch offices, with each employee working at only one office. For ease of use, we decide that information for a given employee should be stored in the DBMS server at the branch office where that employee works. Fragment the EMP table horizontally into three to achieve this.</li> </ol>	<p><b>CO-2 BTL-2</b></p>
<p><b>MODULE 3: QUERY OPTIMIZATION (6+6)</b></p>	
<p>Query Optimization : Sample Database- Query Processing in Centralized Systems: Query Parsing and Translation - Query Optimization- Query Processing in Distributed Systems- Heterogeneous Database Systems.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Create a Bank database with CUSTOMER (CID, CNAME, STREET, CCITY); B RANCH (BNAME, ASSETS, BCITY); ACCOUNT (A#, CID, BNAME, BAL); LOAN (L#, CID, BNAME, AMT); TRANSACTION (TID, CID, A#, Date, AMOUNT);</li> </ol> <p>Suppose we want to retrieve the name of all customers who have one more accounts in branches in the city of Edina. We can write the SQL statement for this question as Select c.Cname From Customer c, Branch b, Account a Where c.CID = a.CID AND a.Bname = b.Bname AND b.Bcity = 'Edina';</p> <ol style="list-style-type: none"> <li>a. Give the relational algebra (RA) expression for the above query.</li> <li>b. Use Join Operators and rewrite the query</li> <li>c. Perform cost estimation for the query</li> <li>d. Give maximum possible alternatives for the query and choose the most optimal query,</li> </ol>	<p><b>CO-3 BTL-3</b></p>
<p><b>MODULE 4: DEADLOCK HANDLING (6+6)</b></p>	
<p>Deadlock Handling: Deadlock Definition- Deadlocks in Centralized Systems- Deadlocks in Distributed Systems- Distributed Deadlock Detection. Replication Control: Replication Control Scenarios. Failure and Commit Protocols: Commit Protocols.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Implement detection of deadlock in distributed environment.</li> <li>2. Implement distributed wound–wait algorithm for deadlock handling</li> </ol>	<p><b>CO-4 BTL-3</b></p>
<p><b>MODULE 5: DDBE SECURITY (6+6)</b></p>	
<p>DDBE Security: Cryptography- Securing Data. Authentication and Authorization- Data encryption- Unvalidated Input and SQL Injection- Data Inference- Data Auditing</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Implement SQL injection. List the Malicious input entered by an attacker, SQL query built from malicious input, SQL update built from malicious input</li> </ol>	<p><b>CO-5 BTL-3</b></p>



TEXT BOOKS	
1.	M.Tamer Ozsu, Patrick Valduriz “Principles of Distributed Database Systems”, 3 <sup>rd</sup> Ed. Springer, 2011.
REFERENCE BOOKS	
1.	Stefano Ceri, Giuseppe Pelagatti, Distributed Databases: Principles and Systems, McGraw Hill, 2007.
2.	Chhanda Ray, Ray, Distributed Database Systems, Pearson Education India, 2009.
E BOOKS	
1.	<a href="http://www.scs.ryerson.ca/~mcarberr/cps610/DDBMS.pdf">http://www.scs.ryerson.ca/~mcarberr/cps610/DDBMS.pdf</a>
MOOC	
1.	<a href="http://www.inf.unibz.it/dis/teaching/DDB07/index.html">http://www.inf.unibz.it/dis/teaching/DDB07/index.html</a>
2.	<a href="http://freevideolectures.com/Course/2280/Database-Design/15">http://freevideolectures.com/Course/2280/Database-Design/15</a>

COURSE TITLE	AUGMENTED AND VIRTUAL REALITY			CREDITS	3
COURSE CODE	CSC4357	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	This course presents an introduction to virtual and augmented reality technologies, with an emphasis on designing and developing interactive virtual and augmented reality experiences. The course presents a review of current Virtual Reality (VR) and Augmented Reality (AR) technologies and provides a detailed analysis of the engineering, scientific and functional aspects of VR systems and the fundamentals of VR modelling and programming				
Course Objective	<div><div></div><div>1. To understand the object presentation in augmented reality.</div><div>2. To know the application of AR</div><div>3. To learn the how to apply the AR in real-time problems</div><div>4. To understand the AVR system development</div></div>				
Course Outcome	<div>Upon completion of this course, the students will be able to</div> <div><div></div><div>1. Explain the object presentation in augmented reality.</div><div>2. Create content for Augmented reality application.</div><div>3. Apply augmented reality to a problem and evaluate.</div><div>4. Represent the Virtual reality systems</div><div>5. Apply techniques of creation and presentation of virtual environments in virtual reality</div></div>				

<b>Prerequisites:</b> Computer Graphics															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO-1	3	3	3	-	1	-	-	-	-	-	-	-	1	1	-
CO-2	3	3	3	-	-	-	-	-	-	2	-	2	1	1	-
CO-3	3	3	3	-	-	1	-	-	-	2	-	-	1	1	-
CO-4	3	3	3	-	1	-	-	-	-	-	-	-	1	1	-
CO-5	3	3	3	-	-	-	3	-	-	2	-	-	1	1	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: INTRODUCTION TO AUGMENTED REALITY</b>														<b>(6+6)</b>	
What Is Augmented Reality-The Relationship between Augmented Reality and Other Technologies-How Does Augmented Reality Work- Ingredients of an Augmented Reality Experience.  <b>Suggested reading:</b> <a href="https://nptel.ac.in/courses/106105195/13">https://nptel.ac.in/courses/106105195/13</a> <b>Practical Component:</b> 1. Experience existing VR and AR applications														<b>CO-1 BTL-2</b>	
<b>MODULE 2: HARDWARE, SOFTWARE AND CREATING CONTENT</b>														<b>(6+6)</b>	
Major Hardware Components for Augmented Reality Systems-Major Software Components for Augmented Reality Systems-Software Used to Create Content for the Augmented Reality Application-Creating Visual Content-Creating Audio Content-Creating Content for Other Senses. <b>Practical Component:</b> 1. Installation and familiarizing game engine environment 2. Installation and setting up of AR Toolkit 3. Create a simple diorama with game objects 4. Build Hello World in AR Toolkit														<b>CO-2 BTL-2</b>	
<b>MODULE 3: INTERACTION AND MOBILE AUGMENTED REALITY</b>														<b>(6+6)</b>	
Advantages and Disadvantages of Mobile Augmented Reality- Architectures for Mobile Augmented Reality Systems- Augmented Reality Applications- GIS Modeling – Tracking – Target detection <b>Practical Component:</b> 1. Acquiring and modify an image for Augmented Reality development 2. Tracking a 3D object on a Real World Image 3. Tracking a 3D object with Scripting 4. Multiple target detection														<b>CO-3 BTL-3</b>	
<b>MODULE 4: VIRTUAL REALITY AND REPRESENTATION (6+6)</b>															

Introduction to virtual reality-The Beginnings of VR-VR Paradigms-Collaboration-Virtual reality Systems-Representation-Interaction techniques-Virtual reality Medium-Form and Genre		CO-4 BTL-3
<b>Suggested reading :</b> <a href="https://nptel.ac.in/courses/106106138/2">https://nptel.ac.in/courses/106106138/2</a>		
<b>Practical Component:</b> 1. Setting up a project for virtual reality platform for a project 2. Develop a gaze-based control for a VR application 3. Use button interface functions for a VR project		
<b>MODULE 5: VR APPLICATIONS</b> (6+6)		
VR Application-Caterpillar virtual prototyping System-Science applications-Scientific visualization-Scientific Exploration- Physical system simulation and interaction- Medical Applications-Virtual reality exposure Therapy		CO-5 BTL-4
<b>Suggested reading :</b> <a href="https://nptel.ac.in/courses/106106138/8">https://nptel.ac.in/courses/106106138/8</a>		
<b>Practical Component:</b> 1. Develop a VR application for any real-life application		
<b>TEXT BOOKS</b>		
1.	Alan B Craig, “Understanding Augmented Reality-Concepts and Applications”, Morgan Kaufmann, Elsevier, 2013.	
2.	Alan B Craig, William R Sherman and Jeffrey D Will, “Developing Virtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann, Elsevier, 2009.	
<b>REFERENCE BOOKS</b>		
1.	Tomas Akenine-Moller, Eric Haines, Naty Hoffman, Angelo Pesce, Micha Iwanicki, Sebastien Hillaire, Real-Time Rendering, Fourth Edition, CRC Press, Taylor & Francis Group, 2018	
2.	William R Sherman and Alan B Craig, “Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics)”. Morgan Kaufmann Publishers, San Francisco, CA, 2002.	
3.	Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, “3D User Interfaces, Theory and Practice”, Addison Wesley, USA, 2005.	
<b>E BOOKS</b>		
1.	<a href="http://www.realtimerendering.com/Real-Time_Rendering_4th-TOC_Preface_Intro_Bib_Index.pdf">http://www.realtimerendering.com/Real-Time_Rendering_4th-TOC_Preface_Intro_Bib_Index.pdf</a>	
<b>MOOC</b>		
1.	<a href="https://www.coursera.org/learn/ar">https://www.coursera.org/learn/ar</a>	
2.	<a href="https://www.udacity.com/course/introduction-to-virtual-reality--ud1012">https://www.udacity.com/course/introduction-to-virtual-reality--ud1012</a>	

COURSE TITLE	SOFTWARE TESTNG			CREDITS	3
COURSE CODE	CSC4366	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0

Version	1.0	Approval Details		LEARNING LEVEL	BTL-4										
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment	Practical Component			ESE										
15%	15%	20%			50%										
Course Description	The fundamental principles and processes of software testing. You will have actively created test cases and run them using an automated testing tool. You will be being writing and recognizing good test cases, including input data and expected outcomes.														
Course Objective	To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods. To discuss various software testing issues and solutions in software unit test; integration, regression, and system testing.														
Course Outcome	Upon completion of this course, the students will be able to <ul style="list-style-type: none"><li>1. Design test cases suitable for a software development for different domains</li><li>2. Identify suitable tests to be carried out.</li><li>3. Prepare test planning based on the document.</li><li>4. Document test plans and test cases designed</li><li>5. Use the automated testing tools to check the behavior of the real time application</li></ul>														
Prerequisites: Software Engineering, Basic Programming															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	1	-	-	-	-	-	-	-	-	-	-
CO-2	3	3	3	3	-	-	-	-	-	2	-	2	-	-	-
CO-3	3	3	3	3	-	1	-	-	-	2	-	-	-	-	-
CO-4	3	3	3	3	1	-	-	-	-	-	-	-	-	-	-
CO-5	3	3	3	3	-	-	3	-	-	2	-	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO TESTING															
(12)															

<p>Testing as an Engineering Activity – Testing as a Process – Testing axioms – Basic definitions – Software Testing Principles – The Tester’s Role in a Software Development Organization – Origins of Defects – Cost of defects – Defect Classes – The Defect Repository and Test Design – Defect Examples – Developer/Tester Support of Developing a Defect Repository – Defect Prevention strategies</p> <p><b>Practical Component:</b> Consider any Signup, Sign in page any webpage</p> <ul style="list-style-type: none"> <li>i) Find Defects</li> <li>ii) Report the Defects</li> <li>iii) Provide Suggestions</li> </ul>	<b>CO-1 BTL-2</b>
<b>MODULE 2: TEST CASE DESIGN (12)</b>	
<p>Test case Design Strategies – Using Black Box Approach to Test Case Design – Random Testing – Requirements based testing – Boundary Value Analysis – Equivalence Class Partitioning – State based testing – Cause-effect graphing – Compatibility testing – user documentation testing – domain testing – Using White Box Approach to Test design – Test Adequacy Criteria – static testing vs. structural testing – code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – code complexity testing – Evaluating Test Adequacy Criteria.</p> <p><b>Practical Component:</b> Assume that your application supports the following functionalities</p> <ul style="list-style-type: none"> <li>i) Forms with various fields</li> <li>ii) The application interacts with the database</li> <li>iii) Image upload</li> <li>iv) Send email functionality.</li> </ul> <p>Write the test Case Scenarios for all situation.</p>	<b>CO-2 BTL-2</b>
<b>MODULE 3: LEVELS OF TESTING (12)</b>	
<p>The need for Levers of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests – The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – Scenario testing – Defect bash elimination System Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Ad-hoc testing – Alpha, Beta Tests – Testing OO systems – Usability and Accessibility testing – Configuration testing – Compatibility testing – Testing the documentation – Website testing.</p> <p><b>Practical Component:</b></p> <ul style="list-style-type: none"> <li>i) Hold a ballpoint pen. Identify the types of testing you would perform on it to make sure that it is of the highest quality.</li> <li>ii) Identify the types of testing you would perform on a mouse to make sure that it is of the highest quality.</li> </ul>	<b>CO-3 BTL-3</b>
<b>MODULE 4 : TEST DATA MANAGEMENT (12)</b>	
<p>People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – The role of three groups in Test Planning and Policy Development – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group.</p> <p><b>Practical Component:</b> i) Create a Test Plan document for Library Management System and report test items.</p>	<b>CO-4 BTL-4</b>

ii)Report the test results of Library Management System		
<b>MODULE 5: AUTOMATION TESTING</b>		<b>(12)</b>
Software test automation – skill needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation – Test metrics and measurements – project, progress and productivity metrics. <b>Practical Component:</b> i) Case study on Selenium IDE ii) Perform test on any website using selenium and record the results.		<b>CO-5 BTL-4</b>
<b>TEXT BOOKS</b>		
1.	M.G.Limaye , Software Testing, Tata McGraw-Hill, 2014.	
2.	Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education, 2006.	
3.	Ron Patton, “Software Testing”, Second Edition, Sams Publishing, Pearson Education, 2007	
<b>REFERENCE BOOKS</b>		
1.	Edward Kit,” Software Testing in the Real World – Improving the Process”, Pearson Education, 1995	
2.	Boris Beizer,” Software Testing Techniques” – 2nd Edition, Van Nostrand Reinhold, New York, 1990.	
3.	Ilene Burnstein, “Practical Software Testing”, Springer International Edition, 2003	
4.	Aditya P. Mathur, “Foundations of Software Testing _ Fundamental Algorithms and Techniques”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008	
5.	Implementing Automated Software Testing: How to Save Time and Lower Costs While Raising Quality - By: Elfriede Dustin.	
<b>E BOOKS</b>		
1.	<a href="http://www.softwaretestingclass.com/wp-content/uploads/2016/02/Beginner-Guide-To-Software-Testing.pdf">http://www.softwaretestingclass.com/wp-content/uploads/2016/02/Beginner-Guide-To-Software-Testing.pdf</a>	
2.	<a href="http://www.diku.dk/forskning/performance-engineering/Software-construction/Slides/testing.pdf">http://www.diku.dk/forskning/performance-engineering/Software-construction/Slides/testing.pdf</a>	
<b>MOOC</b>		
1.	<a href="https://onlinecourses.nptel.ac.in/noc17_cs32">https://onlinecourses.nptel.ac.in/noc17_cs32</a>	
2.	<a href="https://www.edx.org/micromasters/software-testing-verification">https://www.edx.org/micromasters/software-testing-verification</a>	
3.	<a href="https://www.tutorialspoint.com/software_testing/index.html">https://www.tutorialspoint.com/software_testing/index.html</a>	
4.	<a href="https://www.udemy.com/introduction-to-software-testing-or-software-qa/">https://www.udemy.com/introduction-to-software-testing-or-software-qa/</a>	

COURSE TITLE	CYBER PHYSICAL SYSTEMS			CREDITS	3
COURSE CODE	CSC4367	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
<b>ASSESSMENT SCHEME</b>					

First Periodical Assessment	Second Periodical Assessment	Practical Component	ESE												
15%	15%	20%	50%												
Course Description	This course introduces the principles, tools, models, and processes essential to cyber-physical system development, such as model-based development methods, basics of feedback for task scheduling, modern verification, and validation techniques, and their integration in today's industrial development processes.														
Course Objective	<div>1. To learn cyber-physical systems modelling</div> <div>2. To Understand the core principles behind CPS</div> <div>3. To learn about design of cyber-physical systems</div>														
Course Outcome	<div>Upon completion of this course, the students will be able to</div> <div>1. Interpret Various model of cyber physical system development.</div> <div>2. Design an CPS systems using synchronous model development</div> <div>3. Device Cyber physical systems using asynchronous model development</div> <div>4. Develop time-based solutions for Cyber Physical Systems</div> <div>5. Construct complete CPS systems using appropriate model as per requirement</div>														
Prerequisites: Basics of Cryptography															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	1	-	-	-	-	-	-	-	1	1	-
CO-2	3	3	3	3	-	-	-	-	-	2	-	2	1	1	-
CO-3	3	3	3	3	-	1	-	-	-	2	-	-	1	1	-
CO-4	3	3	3	3	1	-	-	-	-	-	-	-	1	1	-
CO-5	3	3	3	3	-	-	3	-	-	2	-	-	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO CYBER PHYSICAL SYSTEMS														(6L+6P)	
Cyber Physical Systems – Introduction - CPS Key features – Reactive Computation – Concurrency – Feedback control of physical world – Real Time Computation – Safety Critical Application – Formal Models. Practical Component 1. Design a simple traffic light system 2. Design a abstract model for room temperature control														CO-1 BTL-3	

<b>MODULE2:SYNCHRONOUSMODELOFCYBERPHYSICALSYSTEMS(6L+6P)</b>	
<p>Introduction to Synchronous model development - Reactive Components – Properties of Components – Composing Components – Synchronous Design – Introduction to safety requirements.</p> <p><b>Practical Component</b></p> <ol style="list-style-type: none"> <li>Design a Pacemaker with suitable control factors</li> <li>Device a leader election algorithm for a strongly connected network</li> </ol>	<b>CO-2 BTL-3</b>
<b>MODULE 3: ASYNCHRONOUS MODEL OF CYBER PHYSICAL SYSTEMS (6L+6P)</b>	
<p>Introduction to Synchronous model development – Asynchronous Process – Asynchronous Design Primitives – Asynchronous Coordination Protocols.</p> <p><b>Practical Component</b></p> <ol style="list-style-type: none"> <li>Design a railway signalling system where two trains in opposite direction tries to use a track by applying test /set register concept.</li> <li>Design a toilet occupancy status lamp for Shatabdi express using asynchronous model development.</li> </ol>	<b>CO-3 BTL-3</b>
<b>MODULE 4: TIMED MODEL OF CPS (6L+6P)</b>	
<p>Dynamical Systems – Continuous Time Model – Timed Model – Timed Processes – Timing based Protocols – Timed Automata.</p> <p><b>Practical Component</b></p> <ol style="list-style-type: none"> <li>Design a time based chemical processing unit with temperature control.</li> <li>Design a time based pacemaker which actuates at equal interval of time</li> </ol>	<b>CO-4 BTL-2</b>
<b>MODULE 5: REAL TIME SCHEDULING AND HYBRID SYSTEMS (6L+6P)</b>	
<p>Real time scheduling concepts – Introduction to EDF and Fixed Priority Scheduling – Hybrid Systems- Hybrid Dynamical Models- Designing Hybrid Systems</p> <p><b>Practical Component</b></p> <ol style="list-style-type: none"> <li>Design a cruise control device for controlling speed in a car.</li> <li>Using Hybrid Model develop a car that follows lines with specific color.</li> </ol>	<b>CO-5 BTL-3</b>
<b>TEXT BOOKS</b>	
1.	Rajeev Alur, “Principles of Cyber-Physical Systems” ,The MIT Press, Cambridge, Massachusetts London, England, 2015
2.	Edward Ashford Lee, Sanjit Arunkumar Seshia “ Introduction to Embedded Systems: A Cyber-physical Systems Approach”, LeeSeshia.org,2011
3.	Andre Platzer, “Logical Foundations of Cyber-Physical Systems”, Springer 2018
<b>REFERENCE BOOKS</b>	
1.	Edward Kit,” Software Testing in the Real World – Improving the Process”, Pearson Education, 1995
<b>MOOC</b>	
1.	<a href="https://www.mooc-list.com/tags/cyber-physical-systems">https://www.mooc-list.com/tags/cyber-physical-systems</a>

COURSE TITLE	SCRIPTING LANGUAGES			CREDITS	3
COURSE CODE	CSC4368	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0



Version	1.0	Approval Details		LEARNING LEVEL	BTL-3										
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment	Practical Component			ESE										
15%	15%	20%			50%										
Course Description	Scripting languages are primarily designed for "gluing", i.e. connecting components. We will first learn the basics of scripting, learning in particular how scripts are useful.														
Course Objective	1. To understand and apply Javascript on client-side scripting. 2. To understand and apply Ajax on client-side scripting. 3. To Compare and contrast the differences between different scripting languages														
Course Outcome	Upon completion of this course, the students will be able to 1. Apply the Perl coding in web pages. 2. Make use of advanced concepts of Perl in scripting language. 3. Apply the advanced PHP code in web pages. 4. Apply the JavaScript coding in web pages. 5. Develop the web pages using Python														
Prerequisites: Web Technologies															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	3	3	1	-	-	-	-	-	-	-	1	1	-
CO-2	3	3	3	3	-	-	-	-	-	2	-	2	1	1	-
CO-3	3	3	3	3	-	1	-	-	-	2	-	-	1	1	-
CO-4	3	3	3	3	1	-	-	-	-	-	-	-	1	1	-
CO-5	3	3	3	3	-	-	3	-	-	2	-	-	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION JAVASCRIPT & AJAX (6L+6P)															

Java Script: Variables, Control Statements, Functions, Arrays, Objects, Strings & Manipulations – Handling Events – Ajax: The Basics, XMLHttpRequest, JavaScript and XML		CO-1 BTL-3
<b>Practical Component:</b> 1. Create a web page with JS to validate age (onblur event) greater than 18 and count the no of words in the description field (onclick event) 2.Create a web page to display the contents of XML in a tabular format		
<b>MODULE2:JAVASCRIPT FRAMEWORKS-REACT JS (6L+6P)</b>		
Need for different JS – Comparison ANGULAR, REACT, and VUE – React JS: Components-Lifecycle, State, Props, Form and User Input, jQuery, Stateless Components		CO-2 BTL-3
<b>Practical Component:</b> 1. Create a navigation-bar in ReactJS using UI frameworks 2. Create a weather forecast ReactJS single page application.		
<b>MODULE 3: PHP PROGRAMMING (6L+6P)</b>		
Basics, Function, Arrays, Error Handling, Strings, HTML forms, Authenticating Users, File Uploads		CO-3 BTL-3
<b>Practical Component:</b> 1. Send an email from a web page to your student email account 2. Upload the list of students in the local host to the server		
<b>MODULE 4: PYTHON -DJANGO (6L+6P)</b>		
Integrated Web Applications in Python – Building Small, Efficient Python Web Systems, Web Application Framework. Django – Http Response, Http Request, Query Dict, Templates, Configuring Django for Database Access		CO-4 BTL-2
<b>Practical Component:</b> 1. Create a form to update the marks after revaluation in database using Django 2. Upload the list of students in the local host to the server		
<b>MODULE 5: PYTHON –FLASK (6L+6P)</b>		
Installation, Request-Response, Templates, Web Forms, Database Connection		CO-5 BTL-3
<b>Practical Component:</b> 1. Create an events web page to add event details to database using Flask 2. Create a Discussion Forum using Templates		
<b>TEXT BOOKS</b>		
1.	Ajax : Creating Web Pages with Asynchronous JavaScript and XML, Edmond Woychowsky, Prentice Hall, 2006	
2.	React JS Notes for Professionals, GoalKicker.com Publishers	
3.	Beginning PHP and MySQL From Novice to Professional, Fourth Edition, W. Jason Gilmore, A Press publisher 2010	
<b>REFERENCE BOOKS</b>		
1.	Adrian Holovaty, Jacob K. Moss , “The Definitive Guide to Django: Web Development Done Right”, Apress Publishers, 2009	
<b>MOOC</b>		
1.	<a href="http://nptel.ac.in/courses/117106113/34">http://nptel.ac.in/courses/117106113/34</a>	

PARALLEL PROGRAMMING								
CSC4369			COURSE CATEGORY			DE		
1.0			Approval Details					
End Periodical Assessment			Practical Component					
15%			20%					
The course is to study the mathematical models, methods and technologies of parallel programming for multiprocessor systems. It aims to start to practise in the area of parallel programming. The course gives an overview of the architectures and communication models. It provides the foundations for development of efficient parallel algorithms, including examples from relatively simple numerical problems.								
Understand the language design issues related to parallel programming Understand the parallel computer architecture Learn Program with Pthreads								
On completion of this course, the students will be able to Apply the best practices while designing algorithms for parallel programming Demonstrate the working of Tuple Space and Matrix Multiplication Implement the parallel programming using C++, FORTRAN, HPF. Understand the working of high performance workstation and shared memory parallel processing Analyze the performance of the algorithm designed for Parallel processing								
Syllabus								
PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO -10	PO-11
3	3	1	-	-	-	-	-	-
3	3	-	-	-	-	-	2	-
3	3	-	1	-	-	-	2	-
3	3	1	-	-	-	-	-	-
3	3	-	-	3	-	-	2	-
1: Weakly related, 2: Moderately related and 3: Strongly related								
(6L+6P)								

sm in todays Hardware--Memory organization of parallel computers-Thread level parallelism-Interconnected networks- Ro  
 ee with n leaves can be embedded into a butterfly network of dimension  $\log n$ . The leaves of the trees correspond to the b

**(6L+6P)**

ams-LevelsofParallelism-DatadistributionofArrays-Information exchange-Parallel Matrix-vectorProduct-Process adThreads  
 matrixofdimension  $100 \times 100$ . Specify the distribution vector  $((p_1, b_1), (p_2, b_2))$  to describe the following data distributions for proces

thblocksize

**PROGRAM****(6L+6P)**

performance metrics for parallel programs-Asymptotic times for Global communication-Analysis of parallel execution times

ation about benchmark suite to evaluate the performance of parallel system with a shared address space based  
 this obtained by running the benchmark?  
 ear array which send the message from the  
 the asymptotic running time.

**(6L+6P)**

ective communications in MPI-Deadlock with collective communication-Process group in MPI-Process Topologies-Timings a

MPI program:

```
er2[8],recvbuffer2[8];
```

```
k); MPI Comm size(MPI COMM WORLD, & p);left= (rank-1+ p)%p;right= (rank+1)%p;
```

```
Recv(recvbuffer1,size,MPICHAR,right,...);MPISend(sendbuffer2,size,MPICHAR,right,...);MPIRecv(recvbuffer2,size,MPICHAR,
```

the processors are arranged in a logical ring an  
 left and its neighbor to the right. Assign a unique name to each MPI process and fill out the missing pieces of the programs such that each

d() and MPI Recv() operations are arranged such that depending on the implementation a deadlock can occur. Describe how a de  
 possible by arranging the order of the MPI Send() and MPI Recv() operations appropriately.  
 y() is used to avoid deadlocks.  
 and MPI Irecv() are used.

**(6L+6P)**

threads-Thread coordination with PThreads-Condition Variables-Extended Lock Mechanism-One-Time Initialization-Impleme  
 l-Thread attributes and cancellation-Thread scheduling with Pthreads-Priority Inversion-Thread Specific Data

n of two matrices MA and MB. A separate thread must be created for each element of the output matrix MC. A separate da  
 eads created

ger, “ Parallel Programming for Multicore and Cluster Systems”,

n in Practice, Cambridge University Press, 2012

programming in C with MPI and OpenMP”, Tata McGraw-Hill

3.

<https://www.researchgate.net/publication/309090907/figure/fig/1/figure-fig1/1513211111111/09ed/7308fdfb0b640077328aa4fd10ce429f511a.pdf>

[learn/parprog1](#)

COURSE TITLE	CYBER FORENSICS AND LAWS			CREDITS	3
COURSE CODE	CSC4370	COURSE CATEGORY	DE	L-T-P-S	2-0-2-
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3

#### ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Practical Component	ESE
15%	15%	20%	50%

<b>Course description</b>	It enables the students to gain in-depth knowledge in the field of Computer forensics & Cyber Crime. The course the students will be able to learn investigation tools and techniques, analysis of data to identify evidence, Technical Aspects & Legal Aspects related to cyber crime
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To understand the basics of cyber crime</li> <li>2. To know the Cyber laws and Practices</li> <li>3. To learn the tools used in cyber crime investigation</li> </ol>
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Outline the Cyber-crime and its types.</li> <li>2. Apply the Cyber Forensics Techniques</li> <li>3. Use the Cyber Investigation Techniques</li> <li>4. Explore the Cyber Evidence Management Techniques</li> <li>5. Recall the Cyber Laws in India</li> </ol>

**Prerequisites: CYBER SECURITY****PO AND PSO MAPPING**

	PO - 1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO - 10	PO-11	PO-12	PSO-1	PSO-2	
	3	3	3	3	1	-	-	-	-	-	-	-	1	1	
	3	3	3	3	-	-	-	-	-	2	-	2	1	1	
	3	3	3	3	-	1	-	-	-	2	-	-	1	1	
	3	3	3	3	1	-	-	-	-	-	-	-	1	1	
	3	3	3	3	-	-	3	-	-	2	-	-	1	1	

**1: Weakly related, 2: Moderately related and 3: Strongly related****MODULE 1: INTRODUCTION****(6L+6P)**

Crime - White collar crimes – Economic offense – cyber stalking - cyber extortion – cyber terrorism - cyber espionage - cyber warfare –cyber weapons - Data frauds – cybersquatting - Child Pornography - obscene messages Racketing - IP spoofing.

**Practical Component:**

IP Spoofing  
Key logger  
Email Fraud

**Suggested Readings:**

Communication Fraud - Software piracy

**CO-1  
BTL-3****MODULE2:CYBER FORENSICS AND WIRESHARK****(6L+6P)**

device – Hard disk –Disk characteristics - Disk imaging - Data Carving – Techniques - commercial piracy - software – Steganography – Network components - Port scans - Wireshark - pcap analysis - Trojans and Backdoors.

**Practical Component:**

Pcab file Analysis – Case Study  
Network Port Scan – Forensics

**Suggested Readings:**

and Passive Sniffing

**CO-2  
BTL-3****MODULE 3: CYBER INVESTIGATION AND TOOLS****(6L+6P)**

Steps of Investigation - cyber investigation, Network Investigation - Investigating audit logs - Investigating Web attacks - Investigating Computer Intrusions - Profiling – Cyber Criminal profiling – Stylometric - E-Mail Investigation Tracking - IP Tracking - E-Mail Recovery- Recovering Deleted Evidences - Password Cracking.

**Practical Component:**

Investigating Audit Logs  
Investigating Web attacks

**Suggested Readings:**

Identifying and preserving digital crime scene

**CO-3  
BTL-3****MODULE 4: EVIDENCE MANAGEMENT(6L+6P)**

Evidence – Digital Evidence - Types – physical evidence – Real evidence – Circumstantial evidence – network evidence- Digital evidence– – Digital Evidence Collection- Evidence Preservation - Evidence Analysis - Contextual Information – Evidence Management -

**Practical Component:**

Digital Evidence Analysis

**CO-4  
BTL-2**

Network Analysis	
<b>Suggested Readings:</b>	
Investigative Reconstruction with Digital Evidence	
<b>MODULE 5: CYBER LAWS AND AUTHORITIES</b>	<b>(6L+6P)</b>
Information Technology Act 2000 – Digital signature - Electronic Governance - Secure electronic records Regulation of certifying authorities – CERT-In - Electronic signature certificates -Penalties compensation	<b>CO-5 BTL-3</b>
<b>Practical Component:</b> 1. Digital Signature	
<b>Suggested Readings:</b> IPR Laws	

**BOOKS**

Marjie T. Britz, “Computer Forensics and Cyber Crime”, Pearson, 2013.
Garima Tiwari, “Understanding Laws– Cyber Laws And Cyber Crimes”, Lexis Nexis, 2014.

**REFERENCE BOOKS**

Chuck Easttom, Jeff Taylor, “Computer Crime, Investigation, and the Law”, Course Technology, 2018.
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**WEBSITES**

<a href="https://eforensicsmag.com/download/introduction-to-digital-forensics/">https://eforensicsmag.com/download/introduction-to-digital-forensics/</a>
<a href="https://www.udemy.com/digital-forensics-for-cyber-professionals/">https://www.udemy.com/digital-forensics-for-cyber-professionals/</a>

COURSE TITLE	SERVICE ORIENTED ARCHITECTURE			CREDITS	
COURSE CODE	CSC4371	COURSE CATEGORY	DE	L-T-P-S	2
Version	1.0	Approval Details		LEARNING LEVEL	I

**ASSESSMENT SCHEME**

First Periodical Assessment	Second Periodical Assessment	Practical Component	ESE
15%	15%	20%	50%

<b>Course Description</b>	Based on an understanding of architectural styles, you will review architectures for web applications. SOC architecture supports interoperability and integration of enterprise applications with the help of technologies like Web Services. Service-oriented architecture, Grid and Utility computing.
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To understand the principles of service orientation</li> <li>2. To know the software-oriented architectures</li> <li>3. To understand the need for web service security</li> </ol>
<b>Course Outcome</b>	Upon completion of this course, the students will be able to <ol style="list-style-type: none"> <li>1. Outline the Cyber-crime and its types.</li> <li>2. Apply the Cyber Forensics Techniques</li> <li>3. Use the Cyber Investigation Techniques</li> <li>4. Explore the Cyber Evidence Management Techniques</li> <li>5. Recall the Cyber Laws in India</li> </ol>

**Prerequisites: NIL**

## PO AND PSO MAPPING

	PO - 1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO - 10	PO-11	PO-12	PSO-1	PSO-2
	3	3	3	3	1	-	-	-	-	-	-	-	1	1
	3	3	3	3	-	-	-	-	-	2	-	2	1	1
	3	3	3	3	-	1	-	-	-	2	-	-	1	1
	3	3	3	3	1	-	-	-	-	-	-	-	1	1
	3	3	3	3	-	-	3	-	-	2	-	-	1	1

1: Weakly related, 2: Moderately related and 3: Strongly related

## MODULE 1: SOA AND WEB SERVICES FUNDAMENTALS

(6L+6P)

Fundamentals of SOA - Characteristics - Common misperception - Benefits - Pitfalls of adopting SOA - Transition from XML to web service to SOA - Standards for SOA - The roots of SOA - Web services framework - Service descriptions with WSDL - Messaging with SOAP.

**Practical Component:**

Implement a simple web service that converts the temperature from Fahrenheit to Celsius and vice versa. Also, put this web service on your website.

## MODULE 2: SECOND GENERATION WEB SERVICES

(6L+6P)

Activity management and comparison - Message exchange patterns - Service activity - Coordination - Atomic transactions - Business activities - Business protocols - Process definitions - Process services - Orchestration and coordination - Collaboration - Addressing - Reliable messaging - WS policy framework - Policy assertions and alleviates policies - Relationship to activity management - Metadata exchange security - WS notification and events.

**Practical Component:**

1. Illustrate a RESTful Web Service as an example of these second generation web service. Make use of the RESTful methods.

## MODULE 3: SERVICE ORIENTATION

(6L+6P)

Service oriented architecture - Components - Common principles of service - Orientation - Interrelationship among principles - Service orientation versus object orientation - Service layers - Different services layers - Configuration scenarios of service layers. SOA delivery life cycle phases - Agile strategy - SOA analysis - Service modeling guidelines - Classification of service models.

**Practical Component:**

1. Bring out the differences between DCOM and CORBA. Illustrate by writing a DCOM class and a CORBA service.

## MODULE 4: TECHNOLOGIES AND DESIGN FOR SOA

(6L+6P)



roduction to Service oriented design – WSDL related XML schema language basics – SOAP language basis  
 Service interface design tools - SOA comparison guide lines - Industry standards - XML A WSOA - WSDL and SOA-  
 PAWAOA-SOA extension.

**Practical Component:**

1. Create a WSDL document to describe a web service and illustrate the

(a) WSDL One-Way Operation

(b) WSDL Request-Response Operation (c) WSDL Binding to SOAP.

**MODULE 5: SERVICE DESIGN AND SECURITY**

**(6L+6P)**

Service design - WS - BPEL language basics - WS - BPEL elements - WS coordination - Service oriented process design -  
 Addressing language and messaging basis - WS-Policy language basics - WS-Metadata exchange  
 Security language basis - WSOA platforms - SOA support in J2EE and .NET.

**Practical Component:**

How an employee process service definition is amended to incorporate a WS-BPEL construct and its corresponding  
 namespace. You can assign roles to each of the service that are  
 defined. Usually roles are formally defined by appending existing services with WSDL definitions.

**BOOKS**

Thomas Erl, "Service-Oriented Architecture: Concepts, Technology & Design", Pearson Education, 2007.

Thomas Erl, "Service-Oriented Architecture: A Field Guide to Integrating XML and Web Services ", The Prentice Hall  
 Service Oriented Computing Series, 2004.

**REFERENCE BOOKS**

Thomas Erl, "SOA Principles of Service Design", Prentice Hall Service-Oriented Computing Series, 2007.

**LINKS**

[http://ptgmedia.pearsoncmg.com/imprint\\_downloads/informit/promotions/LearnSOA/SOA\\_eBook-InformIT.pdf](http://ptgmedia.pearsoncmg.com/imprint_downloads/informit/promotions/LearnSOA/SOA_eBook-InformIT.pdf)

<https://www.coursera.org/learn/service-oriented-architecture>

COURSE TITLE	OBJECT ORIENTED SYSTEM DESIGN			CREDITS	3
COURSE CODE	CSC4372	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	

Course Description	The subject object-oriented system design provides a comprehensive knowledge of the entire system life cycle using object-oriented techniques (with the exception of implementation). The subject gives knowledge on fundamental concepts that are applicable to a variety of systems. Furthermore, this help learners to improve the skills on the Object Management Group's unified modeling language (UML) for modeling, describing, analyzing, and designing an application														
Course Objective	<ol style="list-style-type: none"><li>1. To understand the object-oriented concepts for designing object-oriented models</li><li>2. To understand the use of UML (Unified Modeling Language) for object-oriented analysis and design.</li><li>3. To describe the step by step object-oriented methodology of software development from problem statement through analysis, system design, and class design.</li><li>4. To understand the issues for implementing object-oriented designs or models</li><li>5. To understand the concept of different patterns for constructing software architectures through object-oriented models</li><li>6. To understand the problems, communicating with application experts, modeling enterprises, preparing documentation, and designing programs by using object-oriented models.</li></ol>														
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"><li>1. Summarize the Object-oriented life cycle.</li><li>2. Identify the solutions for the problems of complex systems, evolution of object-oriented model, classes, object-oriented methodology and its notations.</li><li>3. Construct various UML models (including use case diagrams, class diagrams, interaction diagrams, state chart diagrams, activity diagrams, an implementation diagrams) using the appropriate notation for an application.</li><li>4. Recall object-oriented analysis and design concepts &amp; apply the object-oriented design process for any application</li><li>5. Gain enough competence in object-oriented analysis and design (OOAD) to tackle a complete object-oriented project.</li></ol>														
Prerequisites:															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO-2	3	3	3	-	-	-	-	-	-	-	-	-	1	1	-
CO-3	3	3	3	3	-	-	-	-	-	-	-	3	1	1	-
CO-4	3	3	3	-	-	-	-	-	-	-	-	3	1	1	-
CO-5	3	3	3	3	-	-	-	-	-	-	-	3	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION (6+6)															

<p>An Overview of Object Oriented Systems Development - Object Basics – Object Oriented Systems Development Life Cycle.</p> <p><b>Practical component:</b></p> <p>Understanding the OOSD cycle and apply in real time scenario</p> <p><b>Suggested Readings:</b></p> <p><a href="http://nptel.ac.in/courses/106105153/6">http://nptel.ac.in/courses/106105153/6</a></p>	<p><b>CO-1</b></p> <p><b>BTL-2</b></p>
<b>MODULE 2: OBJECT ORIENTED METHODOLOGIES (6+6)</b>	
<p>Rumbaugh Methodology - Booch Methodology - Jacobson Methodology - Patterns – Frameworks – Unified Approach – Unified Modeling Language – Use case - class diagram - Interactive Diagram - Package Diagram - Collaboration Diagram - State Diagram - Activity Diagram.</p> <p><b>Practical component:</b></p> <p>Draw use case, class diagram, interactive diagram, package diagram, collaboration, state and activity diagram for an application</p> <p><b>Suggested Readings:</b></p> <p><a href="http://nptel.ac.in/courses/106105153/18">http://nptel.ac.in/courses/106105153/18</a></p>	<p><b>CO-2</b></p> <p><b>BTL-3</b></p>
<b>MODULE 3: OBJECT ORIENTED ANALYSIS (6+6)</b>	
<p>Identifying use cases - Object Analysis - Classification – Identifying Object relationships - Attributes and Methods.</p> <p><b>Practical component:</b></p> <p>Identify object relationship for an application</p> <p><b>Suggested Readings:</b></p> <p><a href="http://nptel.ac.in/courses/106105153/28">http://nptel.ac.in/courses/106105153/28</a></p>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: OBJECT ORIENTED DESIGN (6+6)</b>	
<p>Design axioms - Designing Classes – Access Layer - Object Storage - Object Interoperability.</p> <p><b>Practical component:</b></p> <p>Refine the attributes for ATM (banking)</p> <p><b>Suggested Readings:</b></p> <p><a href="http://nptel.ac.in/courses/106105153/28">http://nptel.ac.in/courses/106105153/28</a></p>	<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<b>MODULE 5: SOFTWARE QUALITY AND USABILITY (6+6)</b>	
<p>Designing Interface Objects – Software Quality Assurance – System Usability - Measuring User Satisfaction- Case study: Application design and development using OOSD tools.</p>	<p><b>CO-5</b></p>

<b>Practical component:</b>  Design an application(banking/stock market/etc..) using OOSD tools.  <b>Suggested Readings:</b>  <a href="https://nptel.ac.in/courses/106/105/106105153/">https://nptel.ac.in/courses/106/105/106105153/</a>		<b>BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Ali Bahrami, “Object Oriented Systems Development”, Tata McGraw-Hill, 2008.	
<b>REFERENCE BOOKS</b>		
1.	Martin Fowler, “UML Distilled”, Second Edition, PHI Pearson Education, 2002.	
2.	Stephen R. Schach, “Introduction to Object Oriented Analysis and Design”, Tata McGraw-Hill, 2003.	
3.	James Rumbaugh, Ivar Jacobson, Grady Booch “The Unified Modeling Language Reference Manual”, Addison Wesley, 1999.	
4.	Hans-Erik Eriksson, Magnus Penker, Brain Lyons, David Fado, “UML Toolkit”, OMG Press Wiley Publishing Inc., 2004.	
<b>E BOOKS</b>		
1.	<a href="http://kmvportal.co.in/Course/OOAD/object-oriented-analysis-and-design-with-applications-2nd-edition.pdf">http://kmvportal.co.in/Course/OOAD/object-oriented-analysis-and-design-with-applications-2nd-edition.pdf</a>	
2.	<a href="https://edutechlearners.com/download/books/OOSE/OOAD.pdf">https://edutechlearners.com/download/books/OOSE/OOAD.pdf</a>	
<b>MOOC</b>		
1.	<a href="https://www.coursera.org/learn/object-oriented-design">https://www.coursera.org/learn/object-oriented-design</a>	

COURSE TITLE	BLOCKCHAIN TECHNOLOGY			CREDITS	3
COURSE CODE	CSC4373	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	

<b>Course Description</b>	This course brief about the, Blockchain - A Technology that Makes Sense with Trust and Coordination. The tools used to build the cryptocurrency systems are discussed and useful for students interested in security system design.														
<b>Course Objective</b>	1. To understand the concept of Bitcoin and Blockchain 2. To learn how to build cryptocurrency 3. To know the project design using tools														
<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. Build a bitcoin payment system. 2. Building their own Cryptocurrency and perform Auctions in Ethereum 3. Create and deploy projects using Web3j 4. Implement an ICO on Ethereum 5. Use Swarm and IPFS for distributed storage.														
<b>Prerequisites: Cryptography and Network Security</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO-1	3	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO-2	3	3	3	-	-	-	-	-	-	-	-	-	1	1	-
CO-3	3	3	3	3	-	-	-	-	-	-	-	3	1	1	-
CO-4	3	3	3	-	-	-	-	-	-	-	-	3	1	1	-
CO-5	3	3	3	3	-	-	-	-	-	-	-	3	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
<b>MODULE 1: BUILDING A BITCOIN PAYMENT SYSTEM</b>													<b>(6+6)</b>		
The emergence of blockchain and cryptocurrency- Interact with the blockchain- Types of blockchains: Classification of blockchains, Building A Bitcoin payment system : Getting started with Bitcoin, Building a payment gateway. <b>Practical Component:</b> 1. Run a bitcoin client. 2. Synchronize the blockchain 3. Set up a Regtest environment 4. Build a payment request URI													<b>CO-1</b> <b>BTL-2</b>		
<b>MODULE 2: CRYPTOCURRENCY AND AUCTIONS IN ETHEREUM (6+6)</b>															

<p>Building Your Own Cryptocurrency- Compiling Bitcoin from source- New cryptocurrency – Readercoin: Cloning Bitcoin, Readercoin rebranding- Peer-to-Peer Auctions in Ethereum: Introduction to Ethereum, Building an auction DApp: Auction description, Auction contract in Solidity- Contract code analysis-Enumerations, Arrays, Mappings, Structures, Functions, Modifiers, Inheritance.</p> <p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1. Prepare your build system and Building Bitcoin Core.</li> <li>2. Write Hello World smart contract in a higher programming language (Solidity).</li> <li>3. Solidity example using arrays and functions.</li> </ol>	<p><b>CO-2</b> <b>BTL-3</b></p>
<p><b>MODULE 3: : BLOCKCHAIN-BASED FUTURES SYSTEM (6+6)</b></p>	
<p>Project presentation- Futures smart contract: Blockchain oracles- Web3j: Setting up the Web3J- Installing web3j- Wallet creation, Java client: The wrapper generator- Initializing web3j- Setting up Ethereum accounts- Deploying the contract</p> <p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1. create a Maven project using Web3j.</li> <li>2. Construct and deploy your contract ( Use deploy method )</li> </ol>	<p><b>CO-3</b> <b>BTL-3</b></p>
<p><b>MODULE 4: BLOCKCHAINS IN BUSINESS AND CREATING ICO (6+6)</b></p>	
<p>Public versus private and permissioned versus permission less blockchains- Privacy and anonymity in Ethereum- privacy and anonymity - The Ethereum Enterprise Alliance Blockchain-as-a-Service- Initial Coin Offering (ICO): Project setup for ICO implementation- Token contracts- Token sale contracts-Contract security and Testing the code.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. implement an ICO on Ethereum.</li> </ol>	<p><b>CO-4</b> <b>BTL-3</b></p>
<p><b>MODULE 5: DISTRIBUTED STORAGE IPFS AND SWARM (6+6)</b></p>	
<p>Ethereum Virtual Machine- Swarm and IPFS: Installing IPFS, Hosting our frontend: Serving your frontend using IPFS, Serving your frontend using Swarm, IPFS file uploader project: Project setup, The web page</p> <p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1. install IPFS locally on our machine, initialize your node, view the nodes in network and add files and directories</li> <li>2. install Swarm and run any test file.</li> </ol>	<p><b>CO-5</b> <b>BTL-3</b></p>
<p><b>TEXT BOOKS</b></p>	
<p>1.</p>	<p>Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, “Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger”, Packt Publishing Limited, 2018.</p>
<p><b>REFERENCE BOOKS</b></p>	
<p>1.</p>	<p>Andreas M. Antonopoulos , “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly Media Inc, 2015</p>

2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press (2016).
<b>E BOOKS</b>	
1.	<a href="https://www.velmie.com/practical-blockchain-study">https://www.velmie.com/practical-blockchain-study</a>
<b>MOOC</b>	
1.	<a href="https://www.udemy.com/course/build-your-blockchain-az/">https://www.udemy.com/course/build-your-blockchain-az/</a>

COURSE TITLE	HIGH PERFORMANCE COMPUTING			CREDITS	3
COURSE CODE	CSC4452	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	In this course you will learn parallel processing concepts, SIMD, MIMD, SIMT, SPMD and parallel programming models, : IBM CELL BE, Nvidia Tesla GPU, Intel Larrabee Micro architecture and Intel Nehalem micro architecture, fundamental design issues in parallel computing, and fundamental limitations facing parallel computing, you will learn about quantum computing and recent development in nanotechnology and its impact on HPC.				
Course Objective	1. To develop parallel processing models and architecture 2. To have an understanding on processor architecture and programming models 3. To be able to analyze parallel algorithms performance 4. To examine the design issues in parallel computing 5. To analyze the limitations of parallel computing & Outline the advances in parallel computing models				
Course Outcome	Upon completion of this course, the students will be able to 1. Develop parallel processing models and architecture. 2. Have an understanding on processor architecture and programming models. 3. Perform analysis of parallel algorithms. 4. Examine the design issues in parallel computing 5. Analyze the limitations of parallel computing & Outline the advances in parallel computing models.				
Prerequisites: Computer Architecture					
CO, PO AND PSO MAPPING					

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO-2	3	3	3	-	-	-	-	-	-	-	-	-	1	1	-
CO-3	3	3	3	3	-	-	-	-	-	-	-	3	1	1	-
CO-4	3	3	3	-	-	-	-	-	-	-	-	3	1	1	-
CO-5	3	3	3	3	-	-	-	-	-	-	-	3	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: PARALLEL PROCESSING CONCEPTS (6+6)															
Modern processors: General-purpose cache-based microprocessor architecture, Memory hierarchies, Multicore processors, Multithreaded processors, Vector processors; Scalar profiling, optimizations, role of compilers. <b>Practical Component:</b> 1. Performance measurement of Multi Processor 2. Multithread programming for complex application														CO-1 BTL-2	
MODULE 2: PARALLEL COMPUTERS (6+6)															
Parallel computing paradigms, Shared-memory computers, Distributed-memory computer, Hierarchical(hybrid)systems;Parallelism-Dataparallelism,Functionalparallelism,Parallelscaleability. <b>PracticalComponent:</b> 1. DistributedMemoryAccess 2. FunctionalParallelism														CO-2 BTL-3	
MODULE 3: SHARED-MEMORY PARALLEL PROGRAMMING WITH OpenMP (6+6)															
OpenMP-Parallelexecution,Datascoping,OpenMPwork sharingforloops,Synchronization,Reductions,Loopscheduling,Tasking;Performancepitfalls;OpenMP-parallelJacobialgorithm. <b>PracticalComponent:</b> 1. DataScopinginparallelenvironment 2. LoopScheduling														CO-3 BTL-3	
MODULE 4: DISTRIBUTED-MEMORY PARALLEL PROGRAMMING WITH MPI (6+6)															
MPI-Messagesandpoint-to-pointcommunication,Messagesandpoint-to-pointcommunication,Nonblocking point-to-point communication; MPI performance tools; MPI/OpenMP programming models. <b>PracticalComponent:</b> 1. MPICommunicationinparallelprocessing 2. ClusterFormation														CO-4 BTL-3	
MODULE 5: ADVANCED HPC (6+6)															
Petascale Computing - Quantum Computers – Parallel Implementation of the NSGA-II, RecentdevelopmentsinHPC.														CO-5	



<b>PracticalComponent:</b> 1. Formation of NSGA-II model 2. install Swarm and run any test file.		<b>BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Georg Hager, Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press, 2011.	
<b>REFERENCE BOOKS</b>		
1.	Wolfgang E. Nagel, Dietmar H. Kröner, Michael M. Resch, “High Performance Computing in Science and Engineering”, Springer, 2018.	
2.	Oscar Humberto Montiel Ross, Roberto Sepulveda, “High Performance Programming for Soft Computing”, CRC Press, 2014.	
<b>E BOOKS</b>		
1.	<a href="https://www.coursera.org/learn/parprog1">https://www.coursera.org/learn/parprog1</a>	
<b>MOOC</b>		
1.	<a href="https://www.coursera.org/learn/parallelnoye-programmirovaniye">https://www.coursera.org/learn/parallelnoye-programmirovaniye</a>	

COURSE TITLE	COMPUTER VISION			CREDITS	3
COURSE CODE	CSC4453	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	In this course you are going to learn about fundamentals of computer vision by implementing Noise reduction and Image smoothing, computing of histogram and color histogram, binary vision and geometric transformation, edge and feature detection, recognition techniques using Open CV and able to detect and track moving object in a video sequence				
Course Objective	1. To explain the fundamentals of computer vision. 2. To describe and implement the binary vision and geometric transformation techniques. 3. To elaborate and implement the edge and feature detection techniques. 4. To implement various recognition techniques. 5. To describe and implement the moving object detection and tracking techniques.				

<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. Explain the fundamentals of computer vision. 2. Describe and implement the binary vision and geometric transformation techniques. 3. Elaborate and implement the edge and feature detection techniques. 4. Implement various recognition techniques. 5. Describe and implement the moving object detection and tracking techniques.														
<b>Prerequisites:</b> Basic knowledge in Matrices and Linear Algebra															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO-1	3	3	-	-	-	-	-	-	-	-	-	3	1	1	-
CO-2	3	3	3	-	3	-	-	-	-	-	-	3	1	1	-
CO-3	3	3	3	-	3	-	-	-	-	-	-	3	1	1	-
CO-4	3	3	3	-	3	-	-	-	-	-	-	3	1	1	-
CO-5	3	3	3	-	3	-	-	-	-	-	-	3	1	1	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: FUNDAMENTALS OF COMPUTER VISION</b>													<b>(6+6)</b>		
Introduction to computer vision- Images: Cameras, Images -Sampling, Quantization - Color images: RGB, CMY, YUV, HLS – Noise: Types, Models, Generation, Evaluation – Smoothing: Image Averaging, Local Averaging and Gaussian Smoothing, Rotating Mask, Median Filter- Histograms. <b>Practical component: (Using OpenCV)</b> (i) Implementation of Noise reduction and Image smoothing. (ii) Computation of Histogram and Colour histogram. <b>Suggested reading:</b> <a href="http://aishack.in/category/computer-vision/">http://aishack.in/category/computer-vision/</a>													<b>CO-1 BTL-3</b>		
<b>MODULE 2: BINARY VISION AND GEOMETRIC TRANSFORMATIONS</b>													<b>(6+6)</b>		
Thresholding: Threshold Detection Methods- Variations on thresholding – Adaptive, Band, Semi, Multispectral- Morphology: Dilation, Erosion, Opening & Closing, Grey-scale and Colour Morphology. Geometric Transformations: Affine, Perspective- Interpolation: Nearest Neighbor, Bilinear, Bi-Cubic- Camera distortions. <b>Practical component: (Using OpenCV)</b> (i) Implementation of Morphological operations (ii) Implementation of Interpolation techniques. <b>Suggested reading:</b> <a href="http://aishack.in/category/computer-vision/">http://aishack.in/category/computer-vision/</a>													<b>CO-2 BTL-3</b>		
<b>MODULE 3: EDGE AND FEATURE DETECTION</b>													<b>(6+6)</b>		
Edges: Edges detection -First and Second directive, Multispectral, Image sharpening - Contour segmentation- Basic representation, border detection, Line segment representation- Hough transform. Features: Moravec Corner Detection, Harris Corner Detection, FAST, SIFT, SURF.													<b>CO-3 BTL-3</b>		

<b>Practical Component: (Using OpenCV)</b> (i) Edge detection (ii) Feature extraction using SIFT <b>Suggested reading:</b> <a href="https://moodle.epfl.ch/pluginfile.php/59501/mod_resource/content/7/Edges.pdf">https://moodle.epfl.ch/pluginfile.php/59501/mod_resource/content/7/Edges.pdf</a>		
<b>MODULE 4: RECOGNITION TECHNIQUES</b>		<b>(6+6)</b>
Template matching: Applications, Algorithm, matching metrics, Finding local maxima or minima- Statistical Pattern Recognition -Cascade of Haar Classifiers- SVM- HoG – Performance: Ground Truth, Classification Performance Metrics. <b>Practical component: (Using OpenCV)</b> (i) Face recognition (ii) People detection in an image <b>Suggested reading:</b> <a href="https://www.mathworks.com/solutions/deep-learning/object-recognition.html">https://www.mathworks.com/solutions/deep-learning/object-recognition.html</a>		<b>CO-4 BTL-3</b>
<b>MODULE 5: MOVING OBJECT DETECTION AND TRACKING</b>		<b>(6+6)</b>
Moving Object Detection: Object of Interest, Common Problems, Difference Images, Background Models, Shadow detection- Tracking: Exhaustive search, Mean Shift, Dense Optical Flow, Feature Based Optical flow- Performance: Metrics for Assessing Video Tracking Performance. <b>Practical component: (Using OpenCV)</b> (i) Detect and Track moving object in a video sequence <b>Suggested reading:</b> <a href="http://www.cse.iitm.ac.in/~vplab/courses/CV_DIP/PDF/Motion_Detection_and_Tracking.pdf">http://www.cse.iitm.ac.in/~vplab/courses/CV_DIP/PDF/Motion_Detection_and_Tracking.pdf</a>		<b>CO-5 BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Kenneth Dawson-Howe, “A Practical Introduction to Computer Vision with OpenCV”, Wiley, 2014.	
<b>REFERENCE BOOKS</b>		
1.	Computer Vision: Algorithms and Applications, Richard Szeliski, Springer International, 2011.	
2.	<a href="#">Joe Minichino, Joseph Howse</a> , “Learning OpenCV 3 Computer Vision with Python”, Packt Publishing Limited, 2nd Revised edition, 2015.	
3.	Concise Computer Vision: An introduction into theory and Algorithms, Reinhard Klette, 2014, Springer-Verlag London..	
4.	<a href="#">David A. Forsyth, Jean Ponce</a> , “Computer Vision: A Modern Approach”, Prentice Hall, 2011.	
<b>E BOOKS</b>		
1.	<a href="http://freecomputerbooks.com/Computer-Vision-Xiong-Zhihui.html">http://freecomputerbooks.com/Computer-Vision-Xiong-Zhihui.html</a>	
<b>MOOC</b>		
1.	<a href="https://in.udacity.com/course/introduction-to-computer-vision--ud810">https://in.udacity.com/course/introduction-to-computer-vision--ud810</a>	
2.	<a href="https://onlinecourses.nptel.ac.in/noc18_ee08">https://onlinecourses.nptel.ac.in/noc18_ee08</a>	
3.	<a href="https://www.edx.org/course/computer-vision-and-image-analysis">https://www.edx.org/course/computer-vision-and-image-analysis</a>	

LEVEL	SECURITY GOVERNANCE RISK AND COMPLIANCE			CREDITS
CODE	CSC4455	COURSE CATEGORY	DE	L-T-P-S
	1.0	Approval Details		LEARNING LEVEL

## COURSE

Assessment	Second Periodical Assessment	Practical Component	
	15%	20%	

**Course Description:** In this course you are going to learn about the basic concepts of GPC, paraphrase security architecture, paraphrase for security architecture, and will be taught how to demonstrate identification of risk and will learn to implement demonstrate and Interpret working with Security metrics

1. To state the basic concepts of GRC
2. To paraphrase security architecture
3. To paraphrase strategic metrics for security architecture
4. To demonstrate identification of risk
5. To implement Security strategy & demonstrate and Interpret working with Security metrics

- Upon completion of this course, the students will be able to
1. State the basic concepts of GRC
  2. Develop a Security policy in line with wide accepted security architecture
  3. Identify the security policy gap and paraphrase the security policy
  4. Identify risks and plan to implement security strategy.
  5. Implement Security strategy & demonstrate and Interpret working with Security metrics

Basic understanding of information security concepts.

## COURSE MAPPING

PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO -10	PO-11	PO-12	PO-13
3	3	-	-	-	-	-	-	-	-	-	3	3
3	3	-	3	-	-	-	-	-	-	-	3	3
3	3	-	3	-	-	-	-	-	-	-	3	3
3	3	-	3	-	-	-	-	-	-	-	3	3
3	3	-	3	-	-	-	-	-	-	-	3	3

1: Weakly related, 2: Moderately related and 3: Strongly related

**INTRODUCTION****(6+6)**

Security Governance and outcomes, The CIA Triad: Confidentiality Integrity and Availability, Benefits of Good Governance, Security Regulation, Applying security governance principles -Organizational Processes, security roles and responsibilities,

**Question**

1. Use network security tool create activity logs (Snort/Wireshark)

2. Use open source server security tool and create activity logs (proxy server (Comodo/Online Armor)

**STRATEGIC METRICS & SECURITY ARCHITECTURE****(6+6)**

1. Strategic Direction, Information Security outcomes-

2. Risk Management, Business process assurance/convergence, Value delivery, Resource management, Performance measurement

**Question**

1. Develop and compose a security policy strategy for a software company using the guidelines of COBIT Framework

2. Develop security policy strategy for an E-business company using the guidelines of Octave Framework.

**MANAGEMENT****(6+6)**

1. Security responsibilities, Managing risk appropriately, Current State of Security, SABSA, CMM, Cyber Security Task Force- Governance

**Question**

1. Rephrase the security policy gap in the given organization to align with SABSA Architecture.

2. Rephrase the security policy gap in the given organization to align with Capability Maturity Model architecture.

**SECURITY STRATEGY****(6+6)**

1. Attributes, Resources, Constraints, Sample Strategy Development – The Process, Implementing Strategy.

**Question**

1. Develop sample security strategy for HITS ERP Server.

2. Implement the strategy by identifying and installing appropriate security software's in the server.

**SECURITY METRICS****(6+6)**

1. Development metrics, Information Security management metrics, CISO Decisions, Information Security operational Metrics  
2. Incident and Response Metrics.

**Question**

1. Develop Security Operational Metrics for E Business/Software Company/Educational Institution.

2. Implement security devices log in the organization and populate the metrics with real time data.

	KragBrot “Information Security Governance: A Practical Development and Implementation Approach”, WILEY, 2009
S	
	Alan Calder, Steve G. Watkins, “Information Security Risk Management for ISO27001/ISO27002”, IT Governance Press, 2019.
	<a href="http://www.freotechbooks.com/managing-risk-and-information-security-protect-to-enable-t1150.html">http://www.freotechbooks.com/managing-risk-and-information-security-protect-to-enable-t1150.html</a>
	<a href="https://www.udemy.com/cissp-domain-1-security-and-risk-management/">https://www.udemy.com/cissp-domain-1-security-and-risk-management/</a>

COURSE TITLE	SOFTWARE QUALITY MANAGEMENT			CREDITS	3
COURSE CODE	CSC4456	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	This course will enable you to: Explain software quality, the factors that impact quality, and the metrics used to assess product quality. Explain software quality assurance (SQA) and how it can be implemented. Describe how to conduct formal technical reviews and why they are the most important SQA activity.				
Course Objective	<div>1. To Review the basic software quality models, quality measurement and metrics.</div> <div>2. To implement Quality plan, implementation and documentation.</div> <div>3. To implement Quality tools including CASE tools, Quality control and reliability of quality process.</div> <div>4. To implement Quality management system model and Complexity metrics and Customer Satisfaction.</div> <div>5. To apply quality management system with various models - Rayleigh, Reliability and complexity models.</div> <div>6. To demonstrate the International quality standards – ISO, CMM.</div>				

<b>Course Outcome</b>	Upon completion of this course, the students will be able to														
	1. Review the basic software quality models, quality measurement and metrics.														
	2. Implement Quality plan, implementation and documentation.														
	3. Implement Quality tools including CASE tools, Quality control and reliability of quality process.														
	4. Implement Quality management system model and Complexity metrics and Customer Satisfaction.														
	5. Apply quality management system with various models - Rayleigh, Reliability and complexity models and demonstrate the International quality standards – ISO, CMM.														
<b>Prerequisites:</b> Software Testing, Software Engineering.															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO -1</b>	<b>PO- 2</b>	<b>PO- 3</b>	<b>PO- 4</b>	<b>PO- 5</b>	<b>PO- 6</b>	<b>PO- 7</b>	<b>PO- 8</b>	<b>PO- 9</b>	<b>PO - 10</b>	<b>PO- 11</b>	<b>PO- 12</b>	<b>PSO- 1</b>	<b>PSO- 2</b>	<b>PSO- 3</b>
CO-1	3	3	3	-	-	-	-	-	-	-	-	3	1	1	-
CO-2	3	3	3	-	3	-	-	-	-	-	-	3	1	1	-
CO-3	3	3	3	-	3	-	-	-	-	-	-	3	1	1	-
CO-4	3	3	3	-	3	-	-	-	-	-	-	3	1	1	-
CO-5	3	3	3	-	3	-	-	-	-	-	-	3	1	1	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: INTRODUCTIONTOSOFTWAREQUALITY(6+6)</b>															
Software Quality – Hierarchical models of Boehm and McCall – Quality measurement – Metrics measurement and analysis – Gilb’s approach – GQM Model  <b>Practical Component:</b>  1. Write the quality of Railway reservation System by following direct and indirect Measurement method.													<b>CO-1</b>  <b>BTL-3</b>		
<b>MODULE 2: SOFTWARE QUALITY ASSURANCE</b>													<b>(6+6)</b>		
Quality tasks – SQA plan – Teams – Characteristics – Implementation – Documentation – Reviews and Audits  <b>Practical Component:</b>  1. Write the test strategy, test plan, automated tests, test scenarios and test cases of Banking Application software as SQA documentation.													<b>CO-2</b>  <b>BTL-3</b>		
<b>MODULE 3: QUALITY CONTROL AND RELIABILITY</b>													<b>(6+6)</b>		
Tools for Quality – Ishikawa’s basic tools – CASE tools – Defect prevention and removal – Reliability models – Rayleigh model – Reliability growth models for quality assessment  <b>Practical Component:</b>  1. Draw and represent banking application using case tools.													<b>CO-3</b>  <b>BTL-3</b>		

MODULE 4: QUALITY MANAGEMENT SYSTEM		(6+6)
Elements of QMS – Rayleigh model framework – Reliability Growth models for QMS – Complexity metrics and models – Customer satisfaction analysis.  <b>Practical Component:</b>  1. Write the customer satisfaction analysis of banking application		<b>CO-4</b>  <b>BTL-3</b>
MODULE 5: QUALITY STANDARDS		(6+6)
Need for standards – ISO 9000 Series – ISO 9000-3 for software development – CMM and CMMI – Six Sigma concepts.  <b>Practical Component:</b>  1. Represent any application project using CMM standards.		<b>CO-5</b>  <b>BTL-3</b>
TEXT BOOKS		
1.	Allan C. Gillies, “Software Quality: Theory and Management”, Thomson, 2011.	
REFERENCE BOOKS		
1.	Stephen H. Kan, “Metrics and Models in Software Quality Engineering”, Pearson, 2015.	
E BOOKS		
1.	<a href="http://www.tutorialspoint.com/softwarequalitymanagment/softwarequalitymanagementtutorial.pdf">http://www.tutorialspoint.com/softwarequalitymanagment/softwarequalitymanagementtutorial.pdf</a>	
MOOC		
1.	<a href="https://nptel.ac.in/courses/106105218/">https://nptel.ac.in/courses/106105218/</a>	

COURSE TITLE	SOFTWARE DESIGN AND SYSTEM INTEGRATION			CREDITS	3
COURSE CODE	CSC4457	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	



<b>Course Description</b>	This course studies the process of integrating different systems and software applications by examining current and emerging trends, strategies, and techniques for developing systems integration solutions effectively. Example topics covered include, but are not limited to: documenting integration requirements using business process models, designing integration solutions reusing patterns, and implementing integration solutions using service oriented architecture. Students will extend course topics via library assignments, programming assignments, tool evaluation assignments, and other assigned activities.														
<b>Course Objective</b>	<ol style="list-style-type: none"><li>1. Define the objectives of and issues associated integration of information systems applications.</li><li>2. Explain alternative strategies for systems integration.</li><li>3. Identify commonly used tools for integrating information systems, describing the benefits of using each.</li><li>4. Explain how Web services can aid in systems integration, identifying the underlying tools and technologies that facilitate the creation of such services.</li><li>5. Discuss the characteristics of systems integration projects, emphasizing the management issues and practices associated with them.</li><li>6. Identify information systems application and organization characteristics that are most likely to cause an organization to employ a systems integration company to carry out the project work.</li></ol>														
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"><li>1 Illustrate the basic concepts of program and project planning</li><li>2 Explain system engineering plan and identify software requirements</li><li>3 Realize the roles of agile process models</li><li>4 Build design and interpret the implementation process</li><li>5 Explain software integration, quality, risk and configuration management concepts</li></ol>														
<b>Prerequisites: Software engineering</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO-1	3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO-2	3	2	1	2	1	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	2	1	2	-	-	-	-	-	-	2	3	3	3
CO-4	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO-5	3	2	2	1	1	-	-	-	-	-	-	2	2	2	2
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															

<b>MODULE 1: INTRODUCTION, PROGRAM &amp; PROJECT PLANNING</b>		<b>(6L+6P)</b>
<p>Introduction : Software and system integration methods - program and project planning - System Design - Software requirements - Software Design and development - Software implementation - Integration - Program and Project Planning: Program - Project - Planning - Senior Management - Senior Management - Program and project planning - Planned schedules - development plan - Team work - Team code of conduct.</p> <p><b>Practical Component:</b></p> <p>An automobile unit asked xxx company to implement new projects that would increase sales and profitability. The project teams faced several significant challenges, including project plans without realistic scheduling or resource allocation. Write how to integrate the new projects with daily activities, and inadequate reporting to the project's stakeholders.</p>		<p><b>CO-1</b></p> <p><b>BTL-3</b></p>
<b>MODULE 2: SYSTEM DESIGN &amp; SOFTWARE REQUIREMENTS</b>		<b>(6L+6P)</b>
<p>Systems Design : Definition - System Engineering plan - Software architecture evaluation - Software requirements: Definition - Requirements documentation - Managing a requirements tool - released software requirements.</p> <p><b>Practical Component:</b></p> <p>Write the requirements of the Automobile company project and convert requirements into architecture design.</p>		<p><b>CO-2</b></p> <p><b>BTL-3</b></p>
<b>MODULE 3: SOFTWARE DESIGN AND IMPLEMENTATION</b>		<b>(6L+6P)</b>
<p>Software Design : Development plan - Software Design decisions -Peer reviews - Software design/development -Agile software process - Configuration Management - Software Standards- CMMI, Software Implementation: Configuration Management - Configuration Management Tools - Software Media and Data- Future trends</p> <p><b>Practical Component:</b></p> <p>Write the development plan of the Automobile company project, consider your role as SCM Manager and produce the complete repository.</p>		<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: SOFTWARE AND SYSTEM INTEGRATION</b>		<b>(6L+6P)</b>
<p>Software Integration : Software Integration strategy - Development facility - Software Integration plan -Software Systems and Integration facility - Integration setup - Test team - Quality participation in software and systems integration - Effective methods for software system integration - Risk Management - Requirements - System integration - continuous integration - configuration management -quality.</p> <p><b>Practical Component:</b></p> <p>Write the integration strategy for the automobile company project and mention the risk involved in the project.</p>		<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<b>MODULE5:SOFTWARE SUBCONTRACTOR &amp; SYSTEM DELIVERY</b>		<b>(6L+6P)</b>

Software Subcontractor - Software and system delivery: Software media and data delivery - Product evaluation.		CO-5  BTL-3
<b>Practical Component:</b>  Mention the deliverables of automobile company project with proper software documentation, version control documentation, and build and installation procedure.		
TEXT BOOKS		
1.	Boyd L. Summers, Effective methods for Software and Systems Integration , CRC, 2013	
REFERENCE BOOKS		
1.	Enterprise Integration by Fred A.Cummins, John Wiley and Sons 2002.	
E BOOKS		
1.	<a href="http://seu1.org/files/level7/IT440/IT440%20-%20Effective%20Methods%20for%20Software%20and%20Systems%20Integration.pdf">http://seu1.org/files/level7/IT440/IT440%20-%20Effective%20Methods%20for%20Software%20and%20Systems%20Integration.pdf</a>	
MOOC		
1.	<a href="https://www.coursera.org/specializations/software-design-architecture">https://www.coursera.org/specializations/software-design-architecture</a>	
2.	<a href="https://nptel.ac.in/courses/106105087/">https://nptel.ac.in/courses/106105087/</a>	
3.	<a href="https://www.edx.org/course/iot-system-design-software-and-hardware-integratio">https://www.edx.org/course/iot-system-design-software-and-hardware-integratio</a>	

COURSE TITLE	MOBILE TECHNOLOGY			CREDITS	3
COURSE CODE	CSC4458	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	This course will cover state-of-the-art topics in wireless networking and mobile computing. The objective of the course is to introduce students to recent advances in mobile networking and sensing, with an emphasis on practical design aspects of mobile systems.				

Course Objective	1. To understand the basic concepts of mobile computing. 2. To learn the basics of mobile telecommunication system . 3. To be familiar with the network layer protocols and Ad-Hoc networks. 4. To know the basis of transport and application layer protocols. 5. To gain knowledge about different mobile platforms and application development.														
Course Outcome	1. Differentiate the various mobile architectures and their applications 2. Apply telephony based mobile application for realtime issues 3. Explain the various messaging environment in mobile environments. 4. Acquire knowledge on 5G and latest technology 5. Develop web applications for mobile devices and apply Web development in iOS and Android Development Platforms.														
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO-2	3	2	1	2	1	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	2	1	2	-	-	-	-	-	-	2	3	3	3
CO-4	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO-5	3	2	2	1	1	-	-	-	-	-	-	2	2	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION													(6L+6L)		
<b>Introduction:</b> Mobility of Bits and Bytes – Wireless-The Beginning – Mobile Computing – Dialogue Control– Networks – Middleware and Gateways – Application and Services (Contents) Developing Mobile Computing Applications- Security in Mobile Computing – Standards- Standard Bodies <b>Mobile Computing Architecture:</b> Internet-The Ubiquitous Network – Architecture for Mobile Computing – Three-Tier Architecture – Design Considerations for Mobile Computing – Mobile Computing through Internet  <b>Practical component:</b>  i. Study of security standards used in your own mobile  ii. Identify the Three-tier architecture used in your mobile													CO-1  BTL-3		
MODULE 2: MOBILE COMPUTING ARCHITECTURE													(6L+6L)		

<p><b>Mobile Computing Through Telephony:</b> Multiple Access Procedures – Mobile Computing through Telephone –Voice XML – Telephony Application Programming Interface (TAPI).</p> <p><b>Global System for Mobile Communications (GSM):</b> GSM Architecture – Entities – Call Routing in GSM – GSM Addresses and Identifiers – Network Aspects in GSM – GSM Frequency Allocation.</p> <p><b>CDMA and 5G:</b> Introduction – Spread-Spectrum Technology – IS-95 – CDMA Vs GSM – Wireless Data – 5G Networks &amp; Applications.</p> <p><b>Practical component:</b></p> <ul style="list-style-type: none"> <li>i. Demonstrate the working of GSM technology</li> <li>ii. Demonstrate the working of CDMA technology</li> </ul>	<p><b>CO-2</b></p> <p><b>BTL-3</b></p>
<p><b>MODULE 3: SOFTWARE DESIGN AND IMPLEMENTATION</b> (6L+6L)</p>	
<p><b>GPRS:</b> Packet Data Network – Network Architecture – Network Operations – Data Services inGPRS –Applications for GPRS – Limitations. Short Message Service (SMS): Mobile Computing over SMS – SMS – Value Added Services through SMS –Accessing the SMS Bearer. Emerging Technologies: Introduction – Bluetooth – Radio Frequency Identification (RFID),WiMAX –Mobile IP – IPv6</p> <p><b>Practical component:</b></p> <ul style="list-style-type: none"> <li>i. Implement Wimax using ns2 simulator</li> <li>ii. Demonstrate IPv6 using ns2 simulator</li> </ul>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<p><b>MODULE 4: MOBILE WEB DEVELOPMENT</b> (6L+6L)</p>	
<p>ANDROID and IOS: History of ios and Android – How Android and iOS Differ – How their Browsers Differ.</p> <p>Web Development for Mobile Devices: overview of HTML5 – CSS3 – JavaScript Support - Different JavaScript Engines –CSS Media Queries – Responsive Design.</p> <p><b>Practical component:</b></p> <ul style="list-style-type: none"> <li>i. Design a sample web page for Android OS</li> <li>ii. Design a sample web page for ios</li> </ul>	<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<p><b>MODULE5:PROGRAMMING FOR THE ANDROID OS</b> (6L+6L)</p>	
<p>Programming for the Android OS: Introduction – Android Architecture – Activities and Fragments – Android Intents – Android Process Model – Android Multimedia – Android Location – Android AR – Android Sensors – Android Local Storage and Databases – Android Networking.</p> <p><b>Practical component:</b></p> <ul style="list-style-type: none"> <li>i. Implement any project using Android location.</li> </ul>	<p><b>CO-5</b></p> <p><b>BTL-3</b></p>

ii. Use any of the sensors in your mobile and get the input from the sensor and process it.	
<b>TEXT BOOKS</b>	
1.	Asoke K Talukder & Roopa R. Yavagal, "Mobile Computing – Technology Applications and Service Creation", TMH 2010.
2.	David Griffiths, Dawn Griffiths, "Head First Android Development: A Brain-Friendly Guide", 2nd Edition Publisher: O'Reilly Media 2017
<b>REFERENCE BOOKS</b>	
1.	J. Schiller, "Mobile communications", Addison-Wesley, 2003
<b>E BOOKS</b>	
1.	<a href="https://manybooks.org/download/head_first_android_development_2e.pdf">https://manybooks.org/download/head_first_android_development_2e.pdf</a>
<b>MOOC</b>	
1.	<a href="https://nptel.ac.in/courses/106106147/">https://nptel.ac.in/courses/106106147/</a>

### DEPARTMENTAL ELECTIVES FOR SPECIALIZATION IN DATA ANALYTICS

COURSE TITLE	PYTHON FOR DATA SCIENCE			CREDITS	3
COURSE CODE	CSC4273	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment		Second Periodical Assessment	Lab Component		ESE
15%		15%	20%		50%
Course Description	Learn the programming fundamentals required for a career in data science. Course is heavily focused on learning the basic tools of data science, but firmly believes that you learn the most about data science by doing data science. So, the latter half of the course is a combination of working on large projects and introductions to advanced data analysis techniques.				
Course Objective	<div>1. To know the basic process of data science</div> <div>2. To understand the usage of Python and Jupyter notebooks</div> <div>3. To understand, how to manipulate and analyze uncured datasets</div> <div>4. To learn the basic statistical analysis and machine learning methods</div> <div>5. To know, how to effectively visualize results</div>				

Course Outcome	Upon completion of this course, the students will be able to  1. Appreciate the need for data science and relevant Python functions and libraries. 2. Accomplish efficient storage and data operations using NumPy arrays. 3. Handle powerful data operations using Pandas. 4. Create visualization using Matplotlib and Seaborn 5. Perform model building and data analysis.														
Prerequisites: Python Programming															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO-2	3	2	1	2	1	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	2	1	2	-	-	-	-	-	-	2	3	3	3
CO-4	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO-5	3	2	2	1	1	-	-	-	-	-	-	2	2	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO DATA SCIENCE, PYTHON AND NUMPY (6L+6P)															
Introduction to Data Science, Why Python? - Essential Python libraries, Installation and Setup. Python Language Basics, Built-in Data Structures, Functions, and Files.  Introduction to NumPy- The Basics of NumPy Arrays, Computation on NumPy Arrays, Aggregations, Comparisons, Masks, and Boolean Logic, Indexing, Sorting.  <b>Practical Component:</b>  1. Manipulation of Python built-in Data Structures, Functions, and Files. 2. Creation of NumPy arrays from Python Data Structures, Intrinsic NumPy objects and Random Functions. 3. Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting. 4. Computation on NumPy arrays using Universal Functions and Aggregate Functions. 5. Import a CSV file and perform various Statistical and Comparison operations on rows/columns. 6. Load an image file and do crop and flip operation using NumPy Indexing.													CO-1  BTL-3		
MODULE 2: DATA MANIPULATION WITH PANDAS (6L+6P)															
Introduction to pandas Data Structures- Series, DataFrame, Index Objects- Essential Functionality- Summarizing and Computing Descriptive Statistics.  Data Loading, Storage, and File Formats: Reading and Writing Data in Text Format, Binary Data Formats, Interacting with Web APIs and Databases.													CO-2  BTL-3		

<p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Creation of Pandas Series and DataFrame from various inputs.</li> <li>2. Import any CSV file to Pandas DataFrame and perform the following:             <ol style="list-style-type: none"> <li>(a) Visualize the first and last 10 records</li> <li>(b) Get the shape, index and column details</li> <li>(c) Convert any column from object type to category type and check its memory usage.</li> <li>(d) Select/Delete the records(rows)/columns based on conditions.</li> <li>(e) Do required statistical operations on the given columns.</li> <li>(f) Find the count and uniqueness of the given categorical values.</li> <li>(g) Rename single/multiple columns.</li> </ol> </li> </ol>	
<b>MODULE 3: DATA PREPARATION, WRANGLING AND AGGREGATION (6L+6P)</b>	
<p>Data Cleaning and Preparation: Handling Missing Data, Data Transformation, String Manipulation.</p> <p>Data Wrangling: Join, Combine, and Reshape- Hierarchical Indexing, Combining and Merging Datasets, Reshaping and Pivoting.</p> <p>Data Aggregation and Group Operations: GroupBy Mechanics, Data Aggregation- Working with Time Series.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1.Import any CSV file to Pandas DataFrame and perform the following:             <ol style="list-style-type: none"> <li>(a) Handle missing data by detecting and dropping/ filling missing values.</li> <li>(b) Transform data using apply() and map() method.</li> <li>(c) Perform Vectorized String operations on Pandas Series.</li> <li>(d) Sort DataFrame based on Single/Multiple Column values</li> <li>(e) Do groupwise data aggregation operations.</li> </ol> </li> <li>2. For a Hierarchical Indexed DataFrame, perform reshaping, sorting and aggregate operation.</li> <li>3. Merge any two DataFrames and find the rank of given Series.</li> <li>4.Create Pivot table to perform GroupBy aggregation.</li> </ol>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: PLOTTING AND VISUALIZATION (6L+6P)</b>	
<p>Introduction to matplotlib -Figures and Subplots- Colors, Markers, and Line Styles- Ticks, Labels, and Legends - Annotations and Drawing on a Subplot - Saving Plots to File.</p> <p>Line Plots, Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms, Binnings, and Density, Multiple Subplots, Three-Dimensional Plotting, Geographic Data with Basemap, Visualization with Seaborn.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Using matplotlib, plot the following:             <ol style="list-style-type: none"> <li>(a) A Line plot with multiple lines with suitable legends, styles, colors, ticks, title and labels on X and Y axis.</li> </ol> </li> </ol>	<p><b>CO-4</b></p> <p><b>BTL-4</b></p>



<p>(b) A Scatter plot for three different groups comparing their weights and heights and saving the plot to a file.</p> <p>(c) A Histogram with 'Age Group' as X axis and 'No. of People' as Y axis to depict the number of people in each age group.</p> <p>(d) A three-dimensional contour plot of a three-dimensional sinusoidal function.</p> <p>2. Import the Titanic Dataset to Pandas DataFrame and plot the following using Pandas plot()/ Seaborn:</p> <p>(a) A Bar plot of survival by sex/ class.</p> <p>(b) A Scatter plot and Box plot to check for outlier in Fare.</p> <p>(c) Find whether the boarding point is related to survival using suitable plot.</p> <p>3. Import the MovieLens Dataset to Pandas DataFrame and plot the following using Matplotlib/Seaborn:</p> <p>(a) Genres based on ratings (Bar Plot- Genre Vs Rating).</p> <p>(b) Number of Movies released year wise (Line Plot- Year Vs Movie count).</p> <p>(c) Number of Drama movies released year wise (Line Plot- Year Vs Drama count).</p>	
<b>MODULE 5: MODEL BUILDING AND DATA ANALYSIS (6L+6P)</b>	
<p>Modeling Libraries in Python- Introduction to statsmodels, Estimating Linear Models and Time Series Processes- Introduction to scikit-learn.</p> <p>Data Analysis on the following database: USA.gov Data from Bitly, MovieLens 1M Dataset, US Baby Names 1880–2010, USDA Food Database, 2012 Federal Election Commission Database.</p> <p><b>Practical Component:</b></p> <p>1. Import the MovieLens/USDA Food Database/ 2012 Federal Election Commission Dataset to Pandas DataFrame and perform the following:</p> <p>(a) Formulate questions for Analysis</p> <p>(b) Read in and Explore the Data</p> <p>(c) Preprocess /Clean the Data</p> <p>(d) Perform Descriptive Analysis and Visualization</p> <p>(e) Model, Predict and Evaluate using Linear Models</p>	<p><b>CO-5</b></p> <p><b>BTL-4</b></p>
<b>REFERENCE BOOKS</b>	
1.	Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly, 2nd Edition, 2018.
2.	Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly, 2017.
<b>E BOOKS</b>	

1.	<a href="https://pdfs.semanticscholar.org/5a56/bbd762e9dd70dd20afe8740a6d09ec85ffed.pdf">https://pdfs.semanticscholar.org/5a56/bbd762e9dd70dd20afe8740a6d09ec85ffed.pdf</a>
2.	<a href="http://nuovolabs.fausser.edu/~valeria/materiale-didattico/python/Packt.Mastering.Aug.2015.ISBN.1784390151.pdf">http://nuovolabs.fausser.edu/~valeria/materiale-didattico/python/Packt.Mastering.Aug.2015.ISBN.1784390151.pdf</a>
<b>MOOC</b>	
1.	<a href="https://www.edx.org/course/python-basics-for-data-science">https://www.edx.org/course/python-basics-for-data-science</a>
2.	<a href="https://www.edx.org/course/analyzing-data-with-python">https://www.edx.org/course/analyzing-data-with-python</a>
3.	<a href="https://www.coursera.org/learn/python-plotting?specialization=data-science-python">https://www.coursera.org/learn/python-plotting?specialization=data-science-python</a>

COURSE TITLE	R FOR DATA SCIENCE			CREDITS	3
COURSE CODE	CSC4274	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component			ESE
15%	15%	20%			50%
Course Description	Programming in R and use of associated Open Source tools. Addressing practical issues in documenting workflow, data management, and scientific computing.				
Course Objective	1. To understand the concepts of R Language 2. To understand the Data Analysis 3. To import a variety of data formats into R using RStudio 4. Prepare or tidy data’s for in preparation for analysis 5. Analyze a data set in R and present findings using the appropriate R packages				
Course Outcome	Upon completion of this course, the students will be able to  1. Describe, the fundamental syntax of R through readings, practice exercises, demonstrations, and writing R code. 2. Apply critical programming language concepts such as data types, iteration, control structures, functions, and boolean operators by writing R programs and through examples 3. Demonstrate an understanding of Data Import and parsing 4. Recognize the principles of the Relations of Data. 5. Generate the Pattern and Regular Expression.				
Prerequisites: Nil					

CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO-2	3	2	1	2	1	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	2	1	2	-	-	-	-	-	-	2	3	3	3
CO-4	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO-5	3	2	2	1	1	-	-	-	-	-	-	2	2	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION (6L+6P)															
History and Overview of R - Getting Started with R - Getting started with the R interface - R Nuts and Bolts- Getting Data In and Out of R - Using the readr Package- Using Textual and Binary Formats for Storing Data- Interfaces to the Outside World - Subsetting R Objects - Vectorized Operations-Dates and Times.  <b>Practical Component:</b>  Installing R on Windows. Install RStudio. Make sure you are connected to the Internet. Run install.Packages ("ggplot2") at the command line. 1. Choose any number and add 2 to it. 2. Multiply the result by 3.													CO-1  BTL-2		
MODULE 2: : CONTROL STRUCTURES (6L+6P)															
Managing Data Frames with the dplyr package-Control Structures-Functions-Scoping Rules of R Coding Standards for R-Loop Functions-Debugging-Profling R Code-Simulation- Data Analysis Case  Study: Changes in Fine Particle Air Pollution in the in Chennai.  <b>Practical Component:</b> 1. Subtract 6 from the answer. 2. Divide what you get by 3. 3. Find the Factorial of a Number with control statement using R Program. 4. Write a program for multiplication of two matrix using R program using any control statements. 5. Write a program to returns the total number of character printed to the console using function.													CO-2  BTL-3		
MODULE 3: PACKAGES & FILES (6L+6P)															

Matrices- Arrays- Factors- Data Frames- Packages- Data Reshaping- CSV Files- Excel File- Binary Files XML Files- JSON File- Web Data- Databases- PIE Charts- BAR Charts- Boxplots- Histograms- Line Graphs- Scatterplots- Mean, Median & Mode- Linear Regression- Multiple Regression- Logistic Regression- Normal Distribution- Binomial Distribution- Poisson Regression- Analysis Of Covariance Time Series Analysis- Nonlinear Least Square- Decision Tree- Random Forest- Survival Analysis- Chi Square Test.

**Practical Component:**

1. Let x3 be the following vector:

```
x3 <- c(0, 1, 1, 2, 2, 2, 3, 3, 4)
```

Imagine what a histogram of x3 would look like. Assume that the histogram has a bin width of 1.

How many bars will the histogram have? Where will they appear? How high will each be?

When you are done, plot a histogram of x3 with binwidth = 1, and see if you are right

2. Rewrite the roll function to roll a pair of weighted dice:

```
roll<-function(){ die <- 1:6
dice <- sample(die, size = 2, replace = TRUE) sum(dice)
}
```

You will need to add a prob argument to the sample function inside of roll. This argument should tell sample to sample the numbers one through five with probability 1/8 and the number 6 with probability 3/8. When you are finished, read on for a model answer.

**CO-3**

**BTL-3**

**MODULE 4: DATA VISUALIZATION (6L+6P)**

Data Visualization with ggplot2: Introduction -First Steps - Aesthetic Mappings - Common Problems – Facets - Geometric Objects - Statistical Transformations - Position Adjustments - Coordinate Systems - The Layered Grammar of Graphics – Workflow Basic - Data Transformation with dplyr – Workflow Scripts. PIE Charts- BAR Charts- Boxplots- Histograms- Line Graphs- Scatterplots.

**Practical Component:**

1. To plot mpg, run this code to put displ on the x-axis and hwy on the y-axis:

```
ggplot(data=mpg)+
geom_point(mapping=aes(x=displ, y=hwy))
```

2. To implement with sample Data Transformation with dplyr

3. To implement color a bar chart using either the color aesthetic, or more usefully.

**CO-4**

**BTL-4**

**MODULE 5: EXPLORATORY DATA ANALYSIS**

**(6L+6P)**

Introduction - Questions - Variation - Missing Values - Covariation - Patterns and Models - ggplot2Calls - Learning More - Workflow: Projects - What Is Real? - Where Does Your Analysis Live? – Paths and Directories - RStudio Projects.		CO-5  BTL-4
<b>Practical Component:</b>		
1. To implement the Visualizing Distributions with sample data with relevant variables		
2. Explore the distribution of each of the x, y, and z variables in diamonds. Think about a diamond and how you might decide which dimension is the length, width, and depth with sample data.		
3. Small Projects:		
➤ Sentiment Analysis Model in R(OR)		
➤ Real Estate Data Analysis Project (OR)		
➤ Credit Card Fraud Detection Project in R ..Etc.		
TEXT BOOKS		
1.	Roger D. Peng, "R Programming for Data Science" Leanpub,2015.	
2.	Hadley Wickham and Garrett Grolemond - “R for Data Science” O’Reilly Media, Inc.,2017.	
REFERENCE BOOKS		
1.	Ross Ihaka and Robert Gentleman, "R Programming" Tutorials Point (I) Pvt. Ltd, 2016.	
2.	Garrett Grolemond , "Hands-On Programming with R" , O’Reilly Media, Inc 2014.	
E BOOKS		
1.	<a href="https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf">https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf</a>	
2.	<a href="https://r4ds.had.co.nz/">https://r4ds.had.co.nz/</a>	
3.	<a href="https://www.listendata.com/2016/05/free-ebooks-on-r-python-and-data-science.html">https://www.listendata.com/2016/05/free-ebooks-on-r-python-and-data-science.html</a>	
MOCC		
1.	<a href="https://nptel.ac.in/courses/106106179/">https://nptel.ac.in/courses/106106179/</a>	
2.	<a href="https://campus.datacamp.com/courses/introduction-to-the-tidyverse/data-wrangling-1?ex=1">https://campus.datacamp.com/courses/introduction-to-the-tidyverse/data-wrangling-1?ex=1</a>	
3.	<a href="https://www.guru99.com/r-programming-introduction-basics.html">https://www.guru99.com/r-programming-introduction-basics.html</a>	

COURSE TITLE	STATISTICAL INFERENCE FOR DATA SCIENCE			CREDITS	3
COURSE CODE	CSC4358	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
<b>ASSESSMENT SCHEME</b>					

First Periodical Assessment		Second Periodical Assessment				Lab Component								ESE	
15%		15%				20%								50%	
Course Description		Statistical inference is the process of drawing conclusions about populations or scientific truths from data. There are many modes of performing inference including statistical modeling, data oriented strategies and explicit use of designs and randomization in analyses. A practitioner can often be left in a debilitating maze of techniques, philosophies and nuance. This course presents the fundamentals of inference in a practical approach for getting things done. After taking this course, students will understand the broad directions of statistical inference and use this information for making informed choices in analyzing data.													
Course Objective		1. Understand the types of questions that the statistical method addresses for decision making. 2. Apply statistical methods to hypotheses testing and inference problems. 3. Interpret the results in a way that addresses the question of interest. 4. Use data to make evidence-based decisions that are technically sound. 5. Communicate the purposes of the analyses, the findings from the analysis, and the implications of those findings													
Course Outcome		Upon completion of this course, the students will be able to  1. Perform exploratory analysis on the datasets 2. Understand the various distribution and sampling 3. Perform Hypothesis Testing on datasets 4. Apply statistical inference for Regression 5. Apply statistical inference for Classification													
Prerequisites: Python for Data Science/ R for Data Science															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO-2	3	2	1	2	1	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	2	1	2	-	-	-	-	-	-	2	3	3	3
CO-4	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2

CO-5	3	2	2	1	1	-	-	-	-	-	2	2	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: EXPLORATORY ANALYSIS													(6L+6P)	
Elements of Structured, Estimates of Location - Mean, Median, Mode, Outliers, Estimates of Variability- Standard Deviation, Z-Score, Frequency Table and Histograms, Correlation  Practical Component:  1. Rainfall prediction data set – draw correlation between the features  2. Find the outliers in the Housing Price dataset													CO-1  BTL-2	
MODULE 2: : DATA SAMPLING AND DISTRIBUTION													(6L+6P)	
Normalization, Sampling Data-Simple Random sampling, Stratified, Cluster Sampling, Sampling Error/Bias. Bootstrapping, Central Limit Theorem, Confidence intervals, Normal distribution, Binomial distribution, Poisson distribution  Practical Component:  1. For a given dataset, display a chosen feature using different mean values  2. Display the confidence interval of a chosen feature based on a sample													CO-2  BTL-3	
MODULE 3: HYPOTHESIS													(6L+6P)	
A/B Testing, Hypothesis Tests- null, one-way, two-way, P-value, Type 1 & 2 errors, t-tests, multiple testing, degrees of freedom, ANOVA, Chi-Square Tests, Power and Sample Size  Practical Component:  1. Perform t-test on a feature in a dataset  2. Create Boxplots for different groups of a feature													CO-3  BTL-3	
MODULE 4: REGRESSION AND PREDICTION (6L+6P)														
Simple Linear Regression, Multiple Linear Regression, Confidence and Prediction Intervals, Categorical Variables, Multicollinearity, Polynomial Regression  Practical Component:  1. Create a Linear Regression model for a dataset and display the error measures  2. Chose a dataset with categorical data and apply linear regression model													CO-4  BTL-3	
MODULE 5: CLASSIFICATION													(6L+6P)	

Naive Bayes, Discriminant Analysis, Logistic Regression, Evaluating Classification Models, Strategies for Imbalanced Data		CO-5  BTL-3
<b>Practical Component:</b>  1. Apply Naïve Bayes algorithm on a dataset and estimate the accuracy  2. Apply Logistic Regression algorithm on a dataset and estimate the accuracy		
<b>TEXT BOOKS</b>		
1	Bruce, Peter, and Andrew Bruce. Practical statistics for data scientists: 50 essential concepts." O'Reilly Media, Inc.", 2017.	
<b>REFERENCE BOOKS</b>		
1.	Dodge, Yadolah, ed. Statistical data analysis and inference. Elsevier, 2014.	
2.	Ismay, Chester, and Albert Y. Kim. Statistical Inference via Data Science: A Modern Dive into R	
<b>E BOOK</b>		
1	<a href="https://leanpub.com/LittleInferenceBook">https://leanpub.com/LittleInferenceBook</a>	
<b>MOCC</b>		
1.	<a href="https://www.coursera.org/learn/statistical-inference">https://www.coursera.org/learn/statistical-inference</a>	
2.	<a href="https://www.datacamp.com/community/open-courses/statistical-inference-and-data-analysis">https://www.datacamp.com/community/open-courses/statistical-inference-and-data-analysis</a>	

COURSE TITLE	PREDICTIVE MODELING AND ANALYTICS			CREDITS	3
COURSE CODE	CSC4359	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component			ESE
15%	15%	20%			50%
Course Description	This course will introduce solid foundation of predictive analytics, which refers to tools and techniques for building statistical or machine learning models to make predictions based on data. To learn how to summarize and visualize datasets using plots so that you can present your results in a compelling and meaningful way. We will use a practical predictive modeling software, XLMiner, which is a popular Excel plug-in. This course is designed for anyone who is interested in using data to gain insights and make better business decisions. The techniques discussed are applied in all functional areas within				



	business organizations including accounting, finance, human resource management, marketing, operations, and strategic planning.
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To learn, how to develop models to predict categorical and continuous outcomes, using such techniques as neural networks, decision trees, logistic regression, support vector machines and Bayesian network models.</li> <li>2. To know the use of the binary classifier and numeric predictor nodes to automate model selection.</li> <li>3. To advice on when and how to use each model. Also learn how to combine two or more models to improve prediction</li> </ol>
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Understand the basics of predictive analytics and summarize Data, Categorize Models, and techniques.</li> <li>2. Apply Decision tree, Support Vector Machine for Data Classification</li> <li>3. Apply Methods such as Naïve Bayes Markov Model, Linear Regression, Neural Networks to Boost Prediction Accuracy for Data Classification.</li> <li>4. Develop predictive models for various Real-Time Applications.</li> <li>5. Analyze and Visualize predictive Model's results using Data Visualization tools.</li> </ol>

**Prerequisites: Data mining, Machine Learning**

#### CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO-2	3	2	1	2	1	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	2	1	2	-	-	-	-	-	-	2	3	3	3
CO-4	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO-5	3	2	2	1	1	-	-	-	-	-	-	2	2	2	2

**1: Weakly related, 2: Moderately related and 3: Strongly related**

#### MODULE 1: DATA PREPARTION(6L+6P)

Introduction – Predictive Analytics in the Wild – Exploring Data types and associated Techniques - Complexities of data - Applying Models: Models and simulation, Categorizing Models, Describing, summarizing data, and decisions – Identify similarities in Data: Data Clustering, converting Raw Data into a Matrix, Identify K-groups in Data.

#### Practical Component:

Using Machine learning approach with R

1. Healthcare Analytics Case Study: Cancer survivability predictors

**CO-1**

**BTL-2**

2. Social and Marketing Analytics Case Study: Tweets as predictors for the stock market Step 1- Collecting data Step 2 – Exploring and preparing the Data	
<b>MODULE 2: : DATA CLASSIFICATION – PART I (6L+6P)</b>	
Background – Exploring Data classification process - Using Data Classification to predict the future: Decision tree, Algorithm for generating Decision Trees, Support Vector Machine.  <b>Practical Component:</b> Using Machine learning approach with R (Case Studies mentioned in Module 1) 1. Apply Decision tree classification model on Healthcare Analytics 2. Apply Support Vector Machine model on Social and Marketing Analytics	<b>CO-2</b> <b>BTL-3</b>
<b>MODULE 3: DATA CLASSIFICATION – PART II (6L+6P)</b>	
Ensemble Methods to Boost Prediction Accuracy: Naïve Bayes Classification Algorithm, The Markov Model, Linear Regression, Neural Networks – Deep learning.  <b>Practical Component:</b> Using Machine learning approach with R (Case Studies mentioned in Module 1) 1. Apply Naïve Bayes Classification Algorithm on Healthcare Analytics 2. Apply Linear Regression Algorithm on Social and Marketing Analytics	<b>CO-3</b> <b>BTL-3</b>
<b>MODULE 4: DATA PREDICTION(6L+6P)</b>	
Adopt predictive analytics - Processing data: identifying, cleaning, generating, reducing dimensionality of data – Structuring Data – Build predictive model: develop and test the model.  <b>Practical Component:</b> Using Machine learning approach with R (Case Studies mentioned in Module 1) 1. Develop and test the model for Healthcare Analytics 2. Develop and test the model for Social and Marketing Analytics 3. Visualize the prediction	<b>CO-4</b> <b>BTL-4</b>
<b>MODULE 5: DATA VISUALIZATION (6L+6P)</b>	

Introduction to visualization tool – Evaluate the data – visualize Model’s Analytical Results: hidden grouping, data classification results, outliers, decision trees, prediction – Novel visualization in Predictive Analytics.					CO-5  BTL-4
<b>Practical Component:</b>  Using Tableau or Matplotlib  1. Visualize Data Classification results  2. Visualize the decision trees					
<b>TEXT BOOKS</b>					
1	Anasse Bari, Mohamed Chaouchi, Tommy Jung, “Predictive Analytics For Dummies”, Wiley Publisher, 2nd Edition, 2016.				
<b>REFERENCE BOOKS</b>					
1.	Bertt Lantz, Machine Learning with R: Expert techniques for predictive modeling to solve all your data analysis problems, Pack Publisher, 2nd Edition, 2015.				
2.	Aurelien,”Hands-On Machine Learning with Scikit-Learn & TensorFlow”, O’Reilly Publisher, 5th Edition, 2017.				
3.	Max Kuhn, Kjell Johnson, “ Applied Predictive Modeling” Springer, 2013.				
<b>E BOOK</b>					
1	<a href="https://vuquangnguyen2016.files.wordpress.com/2018/03/applied-predictive-modeling-maxkuhn-kjell-johnson_1518.pdf">https://vuquangnguyen2016.files.wordpress.com/2018/03/applied-predictive-modeling-maxkuhn-kjell-johnson_1518.pdf</a>				
2	<a href="https://www.researchgate.net/publication/329873035_Prediction_Modeling_Methodology">https://www.researchgate.net/publication/329873035_Prediction_Modeling_Methodology</a>				
3	<a href="https://www.memsql.com/releases/oreilly-predictive-analytics/">https://www.memsql.com/releases/oreilly-predictive-analytics/</a>				
<b>MOCC</b>					
1.	<a href="https://www.coursera.org/learn/predictive-modeling-analytics">https://www.coursera.org/learn/predictive-modeling-analytics</a>				
2.	<a href="https://www.edx.org/course/predictive-analytics">https://www.edx.org/course/predictive-analytics</a>				
3.	<a href="https://www.udemy.com/course/machinelearningandlogisticregression/">https://www.udemy.com/course/machinelearningandlogisticregression/</a>				
<b>COURSE TITLE</b>		<b>TOOLS AND TECHNIQUES FOR DATA SCIENCES</b>		<b>CREDITS</b>	<b>3</b>
<b>COURSE CODE</b>	<b>CSC4374</b>	<b>COURSE CATEGORY</b>	<b>DE</b>	<b>L-T-P-S</b>	<b>2-0-2- 0</b>
<b>Version</b>	<b>1.0</b>	<b>Approval Details</b>		<b>LEARNING LEVEL</b>	<b>BTL-3</b>
<b>ASSESSMENT SCHEME</b>					
<b>First Periodical Assessment</b>	<b>Second Periodical Assessment</b>	<b>Lab Component</b>			<b>ESE</b>

15%	15%	20%										50%			
Course Description	This course focused to familiarize the tools required to learn for data science and techniques which are used for application specific, like Jupyter Notebooks, JupyterLab, RStudio IDE, Git, GitHub, and Watson Studio.														
Course Objective	<div>1. To know the basic concepts in Clean and preprocess the raw data using WEKA and Excel</div> <div>2. To understanding the different models used for data processing.</div> <div>3. To ability to use the text analytics.</div> <div>6. To learn the tools and techniques like Jupyter and R studio.</div>														
Course Outcome	Upon completion of this course, the students will be able to <div>1. Illustrate the Clean and preprocess the raw data using WEKA and Excel</div> <div>2. Apply the given data to the appropriate model using Scikit and TensorFlow</div> <div>3. Use NLTK tool for text analytics</div> <div>4. Create visualization of data using Matplotlib and Tableau.</div> <div>5. Solve the real time problems of data analytics</div>														
Prerequisites: Python Programming															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO-2	3	2	1	2	1	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	2	1	2	-	-	-	-	-	-	2	3	3	3
CO-4	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO-5	3	2	2	1	1	-	-	-	-	-	-	2	2	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: CLEANING AND PREPROCESSING (6L+6P)															
Introduction- Preprocessing Data -File Conversion - Opening File From A Local File System -Opening File From A Web Site - Reading Data From A Database - Preprocessing Window-Building Classifier ,Cluster, Association-Attribute Selection-Data Visualization. Excel: Statistical Capabilities-Average, Mean, Stand Deviation, Median, Graphs-Scatter Plot, Bar Graphs														CO-1  BTL-2	
Practical Component: <div><div>● Preprocessing Data(Any arff Data)</div><div>● File Conversion(arff to Xls)</div><div>● Building “Classifiers(choose the classifier algorithm)</div><div>● Setting Test Options(select the test option )</div></div>															

<ul style="list-style-type: none"> <li>• Visualization of Results</li> <li>• Using Excel find the Average, Standard Deviation</li> <li>• Create an histogram using the features in the dataset</li> </ul>	
<b>MODULE 2: MODELING (6L+6P)</b>	
<p>Introduction to Scikit learn – Installation basics – fitting and predicting (estimator basics) - Transformers and pre-processors - Pipelines: chaining pre-processors and estimator - Model evaluation - Automatic parameter searches</p> <p>TensorFlow Fundamentals- basic computation - Installation of TensorFlow - Tensors and NumPy - Loading and Preprocessing data - Linear and Logistic regression with TensorFlow - Training convolutional neural network in TensorFlow - deploying model</p> <p><b>Practical component:</b></p> <ul style="list-style-type: none"> <li>• Predicting a continuous-valued attribute associated with an object for a stock pricing application using scikit learn estimator basics</li> <li>• Addition and multiplication of array tensors using TensorFlow</li> <li>• Classify the vehicles in a Traffic image data set using Tensorflow.</li> <li>• Regression and visualization of sigmoidal function using TensorFlow</li> </ul>	<p><b>CO-2</b></p> <p><b>BTL-3</b></p>
<b>MODULE 3: APPLICATION(6L+6P)</b>	
<p>Overview of NLTK- Tool Installation -Tokenize Words and Sentences-POS Tagging &amp; Chunking-Stemming and Lemmatization-WordNet with NLTK.</p> <p>Introduction about jupyter notebook-Notebook Basics-Running Code-Markdown cells-Importing Jupyter Notebook as module- connecting to an existing Ipython kernel using Qt Console</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Write a Python NLTK program to split the text sentence/paragraph into a list of words.</li> <li>2. Write a Python NLTK program to tokenize a twitter text.</li> <li>3..DataCleaning and transformation</li> <li>4.Statistical modeling</li> <li>5.Data visualization</li> </ol>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: VISUALIZATION (6L+6P)</b>	

<p>Visualization with Matplotlib- Figures and Subplots- Colors, Line Styles, Ticks, Labels, and Legends - Saving Plots to File - Line Plots, Scatter Plots, Density and Contour Plots, Histograms, Three-Dimensional Plotting and Geographic Data with Basemap.</p> <p>Visualization with Tableau: Introduction – Adding Data Sources in Tabeau – Creating Data Visualizations – Aggregate Functions, Calculated Fields, and Parameters – Table Calculations – Maps – Advanced Analytics: Trends, Forecasts, Clusters and other Statistical Tools</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>Using matplotlib, plot the following: <ul style="list-style-type: none"> <li>A Line plot with multiple lines and suitable legends, styles, colors, ticks, title and labels on X and Y axis.</li> <li>A Scatter plot for two different groups comparing their income and expense and save the plot to a file.</li> <li>A three-dimensional contour plot of a three-dimensional cosine function.</li> </ul> </li> <li>Create Motion Charts using Tableau</li> <li>Design Dashboards using Tableau</li> </ol>	<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<p><b>MODULE 5: CASE STUDY</b> <span style="float: right;"><b>(6L+6P)</b></span></p>	
<p>Case Study 1: Data Science and Machine Learning tools for mining insights from the student data.</p> <p>Case Study 2: Adaptive Learning based on the analysis of student data.</p> <p><b>Practical Component:</b></p> <ul style="list-style-type: none"> <li>To track the courses in which the performance of the students was not up to the mark. It leads to developing a backup program to deal with the cause behind this to improve student performance.</li> <li>To collect various data related to students such as their marks, strengths, weaknesses, cultural areas of interest as well as the scenarios in which they hesitate.</li> </ul>	<p><b>CO-5</b></p> <p><b>BTL-3</b></p>
<p><b>TEXT BOOKS</b></p>	
1.	Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and Tensor Flow” O'Reilly, 2017.
2.	Bharath Ramsundar, Reza Bosagh Zadeh (2018). “TensorFlow for Deep Learning”, O'Reilly, 2018.
<p><b>REFERENCE BOOKS</b></p>	
1.	Statistical Analysis with Excel for Dummies, Joseph Schmuller , John Wiley & Sons, Inc, 2013.
2.	Alexander Loth, “Visual Analytics with Tableau”, Wiley Publisher, First Edition, 2019.
3.	Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O'Reilly, 2017.

E BOOKS	
1.	<a href="https://www.cs.auckland.ac.nz/courses/compsci367s1c/tutorials/IntroductionToWeka.pdf">https://www.cs.auckland.ac.nz/courses/compsci367s1c/tutorials/IntroductionToWeka.pdf</a>
2.	<a href="https://readthedocs.org/projects/jupyter-notebook/downloads/pdf/latest/">https://readthedocs.org/projects/jupyter-notebook/downloads/pdf/latest/</a>
3.	<a href="https://www.tutorialspoint.com/tableau/index.htm">https://www.tutorialspoint.com/tableau/index.htm</a>
MOOC	
1.	<a href="http://scikit-learn.org/stable/">http://scikit-learn.org/stable/</a>
2.	<a href="https://www.tensorflow.org/tutorials/keras/classification">https://www.tensorflow.org/tutorials/keras/classification</a>
3.	<a href="https://www.coursera.org/learn/python-data-analysis#syllabus">https://www.coursera.org/learn/python-data-analysis#syllabus</a>

COURSE TITLE	BUSINESS INTELLIGENCE & DATA ANALYTICS			CREDITS	3
COURSE CODE	CSC4375	COURSE CATEGORY	DE	L-T-P-S	2-0-0- 3
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component			ESE
15%	15%	20%			50%
Course Description	Business Intelligence (BI) refers to technologies, applications, and practices for the collection, integration, analysis, and presentation of business information. The purpose of business intelligence is to support better business decision making. This course provides an overview of the technology of BI and the application of BI to an organization’s strategies and goals. This course is designed to introduce students to business intelligence concepts and provide students with an understanding of data warehousing and data mining along with associated techniques and their benefits to organizations of all sizes.				
Course Objective	<div>1. To know the concepts and components of Business Intelligence (BI)</div> <div>2. To learn, how BI will help an organization and whether it will help yours</div> <div>3. To identify the technological architecture that makes up BI systems</div> <div>4. To understand the essentials of BI &amp; data analytics and the corresponding Terminologies.</div> <div>5. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.</div>				

Course Outcome	Upon completion of this course, the students will be able to														
	1. Evaluate the technologies that make up BI (data warehousing, OLAP)														
	2. Analyze the steps involved in the BI - Analytics process														
	3. Illustrate competently on the topic of Data analytics														
	4. Demonstrate the real time scenario by using BI & Data analytics Techniques.														
5. Create and Visualize Data using Data Visualization tools.															
Prerequisites: AI, Tools and Techniques for Data Sciences															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO-2	3	2	1	2	1	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	2	1	2	-	-	-	-	-	-	2	3	3	3
CO-4	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO-5	3	2	2	1	1	-	-	-	-	-	-	2	2	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: BUSINESS INTELLIGENCE – INTRODUCTION(6L+6P)															
Introduction - History and Evolution: Effective and Timely decisions, Data Information and Knowledge, Architectural Representation, Role of mathematical Models, Real Time Business Intelligent System.													CO-1  BTL-2		
Practical Component :															
Introductory Practical Class in WEKA/ Microsoft Power BI Tool – DEMO (Learning WEKA)															
MODULE 2: BI – DATA MINING & WAREHOUSING													(6L+6P)		



<p>Data Mining - Introduction to Data Mining, Architecture of Data Mining and How Data mining works(Process) , Functionalities &amp; Classifications of Data Mining, Representation of Input Data, Analysis Methodologies. Data Warehousing - Introduction to Data Warehousing, Data Mart, Online Analytical Processing (OLAP) – Tools, Data Modelling, Difference between OLAP and OLTP, Schema – Star and Snowflake Schemas, ETL Process – Role of ETL</p> <p><b>Practical Component :</b></p> <p>Using WEKA/ Microsoft Power BI Tool 1. Create a weather Table with the help of Data Mining Tool Weka. 2. Apply Pre-Processing techniques to the training data set of Weather Table. I. Add II. Remove</p>		<p><b>CO-2</b></p> <p><b>BTL-3</b></p>
<b>MODULE 3: BI – DATA PREPARTTION (6L+6P)</b>		
<p>Data Validation - Introduction to Data Validation, Data Transformation – Standardization and Feature Extraction, Data Reduction – Sampling, Selection, PCA, Data Discretization</p> <p><b>Practical Component :</b></p> <p>Using WEKA/ Microsoft Power BI Tool 1. Normalize the Weather Table Data using Knowledge Flow. 2. To construct Decision Tree for weather data and classify it</p>		<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: DATA PREDICTBI – DATA ANALYTICS PROCESS (6L+6P)</b>		
<p>Introduction to analytics process, Types of Analytical Techniques in BI – Descriptive, Predictive, Perspective, Social Media Analytics, Behavioral</p> <p><b>Practical Component :</b></p> <p>Using WEKA/ Microsoft Power BI Tool Exploring weather relation using experimenter and obtaining results in various schemes.</p>		<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<b>MODULE 5: IMPLEMENTATION OF BI – DATA ANALYTICS PROCESS</b>		<b>(6L+6P)</b>
<p>Operational Intelligence: Technological – Business Activity Monitoring, Complex Event Processing, Business Process Management, Metadata, Root Cause Analysis.</p> <p><b>Practical Component :</b></p> <p>Using WEKA/ Microsoft Power BI Tool Write a procedure for visualization for weather table. This program has to calculate and compare the data set selection of attributes and methods of manipulations have to be been chosen. The Visualization can be shown in a 2-D representation of the information.</p>		<p><b>CO-5</b></p> <p><b>BTL-3</b></p>
<b>TEXT BOOKS</b>		
1	Carlo-Vercellis, “Business Intelligence Data Mining and Optimization for Decision-Making”, Wiley Publisher, First Edition, 2009.	
2	Drew Bentely, “Business Intelligence and Analytics” ,@2017 Library Pres., ISBN: 978-1-9789- 2136-8.	

REFERENCE BOOKS	
1.	Cindi Howson, "Successful Business Intelligence", Second Edition, McGraw-Hill Education, 2013.
2.	Larissa T. Moss & Shaku Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle For Decision-Support Applications", First Edition, Addison-Wesley Professional, 2003
4.	Kimball, R., Ross, M., Thornthwaite, W., Mundy, J., and Becker, B. John, "The Data Warehouse Lifecycle Toolkit: Practical Techniques for Building Data Warehouse and Business Intelligence Systems", Second Edition, Wiley & Sons, 2008.
E BOOKS	
1	<a href="https://bit.ly/2YcuLHK">https://bit.ly/2YcuLHK</a>
2	<a href="https://bit.ly/3d6XxOr">https://bit.ly/3d6XxOr</a>
3	<a href="https://www.academia.edu/40285447/Business_Intelligence_and_Analytics">https://www.academia.edu/40285447/Business_Intelligence_and_Analytics</a>
MOCC	
1.	<a href="https://www.coursera.org/learn/business-intelligence-data-analytics">https://www.coursera.org/learn/business-intelligence-data-analytics</a>

COURSE TITLE	DEEP LEARNING			CREDITS	3
COURSE CODE	CSC4451	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component			ESE
15%	15%	20%			50%
Course Description	This course will help you understand the capabilities, challenges, and consequences of deep learning and prepare you to participate in the development of leading-edge AI technology. It provides a pathway for you to gain the knowledge and skills to apply machine learning to your work, level up your technical career, and take the definitive step in the world of AI.				
Course Objective	<div>1. To design and develop an application using specific neural networks using Linear perceptron.</div> <div>2. To design and develop an application using specific neural networks using Tensorflow.</div> <div>3. To understand the Differentiable Neural Computers</div> <div>4. To apply the Deep Reinforcement Learning algorithms in applications.</div> <div>5. To provide the practical knowledge in handling and analysing real world applications.</div>				

Course Outcome	Upon completion of this course, the students will be able to														
	1. Design a simple Neural Networks using Linear Perceptron.														
	2. Design a Convolutional Neural Networks using TensorFlow.														
	3. Explore the Differentiable Neural Computers.														
	4. Explore the Deep Reinforcement Learning.														
5. Design the simple deep learning algorithms for the given applications.															
Prerequisites: Python Programming															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO-2	3	2	1	2	1	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	2	1	2	-	-	-	-	-	-	2	3	3	3
CO-4	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO-5	3	2	2	1	1	-	-	-	-	-	-	2	2	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE1:NEURALNETWORK													(6L+6P)		
MechanicsofMachineLearning-Neuron-LinearPerceptron-Feed-ForwardNeuralNetworks-Sigmoid, Tanh, and ReLU Neurons- Training Feed-Forward Neural Networks-Fast-Food Problem-Gradient Descent-DeltaRuleandLearningRates. <b>Practical Component:</b> 1. Write a program in Python to Calculate the output of a simple neuron 2. Construct a Perceptron for the classification of data in Python 3. Develop the Python code to Classify the 4-class problem with Multi-layer Perceptron 4. Implement the back propagation algorithm for neural networks and apply it to the task of hand- written digit recognition													CO-1  BTL-2		
MODULE2:CONVOLUTIONALNEURALNETWORKS (6L+6P)															
TensorFlow: Creating and Manipulating TensorFlow Variables-TensorFlow Operations-Neurons in Human Vision-Convolutional Layer-Building a Convolutional Network-Visualizing Learning in Convolutional Networks-Learning Lower Dimensional Representations- Principal Component Analysis- Autoencoder Architecture- Implementing an Autoencoder in TensorFlow. <b>Practical Component:</b> 1. Implement linear regression in TensorFlow 2. Build a simple deep neural network with many layers in Python using TensorFlow 3. Implement binary classification for medical diagnosis for a single medical condition like say disease vs. no disease based on a battery of tests. 4. Explore multi-class with Rock Paper Scissors dataset 5. Implement an Autoencoder in TensorFlow.													CO-2  BTL-3		

MODULE3:RECURRENTNEURALNETWORKS (6L+6P)	
<p>Recurrent Neural Networks- Challenges with Vanishing Gradients- Long Short-Term Memory (LSTM) Units- TensorFlow Primitives for RNN Models- Implementing a Sentiment Analysis Model- Solving seq2seq Tasks with Recurrent Neural Networks-Memory Augmented Neural Networks: Neural Turing Machines, Attention-Based Memory Access, Differentiable neural Computers (DNC) -Memory Reuse - Temporal Linking - DNCController Network – Visualizing – Implementing the DNC in TensorFlow.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Implementing a Sentiment Analysis Model in TensorFlow</li> <li>2. Solve seq2seq Tasks with Recurrent Neural Networks using TensorFlow</li> <li>3. Implementing the DNC in TensorFlow</li> </ol>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
MODULE4:DEEPPREINFORCEMENTLEARNING (6L+6P)	
<p>Deep Reinforcement Learning - Masters Atari Games-Markov Decision Processes-Policy Versus Value Learning, Pole-Cart with Policy Gradients-Q-Learning and Deep RecurrentvQ-Networks.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Implement a policy-gradient agent to solve pole-cart-reinforcement learning problem.</li> <li>2.Implementing Experience Replay in Q-Network using TensorFlow</li> </ol>	<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
MODULE5:APPLICATIONS (6L+6P)	
<p>Applications in Object Recognition and Computer Vision- Unsupervised or generative feature learning- Supervised feature learning and classification- Applications in Multimodal and Multi-task Learning- Multi- modalities: Text and image-Speech and image- Multi-task learning within the speech, NLP or image domain</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1.Build a model to classify movie reviews as positive or negative using TensorFlow</li> <li>2.Develop the CNN Model for Image Classification</li> </ol>	<p><b>CO-5</b></p> <p><b>BTL-3</b></p>
TEXT BOOKS	
1.	Nikhil Buduma, Nicholas Locascio, “Fundamentals of Deep Learning: Designing Next-GenerationMachineIntelligence Algorithms”,O'ReillyMedia,2017. <a href="https://www.oreilly.com/ai/free/files/fundamentals-of-deep-learning-sampler.pdf">https://www.oreilly.com/ai/free/files/fundamentals-of-deep-learning-sampler.pdf</a>
2.	LiDengandDongYu“DeepLearningMethodsandApplications”,FoundationsandTrendsSignal Processing, 2013. <a href="http://link.springer.com/openurl?genre=book&amp;isbn=978-3-319-73004-2">http://link.springer.com/openurl?genre=book&amp;isbn=978-3-319-73004-2</a>
REFERENCE BOOKS	
1.	IanGoodfellow,YoshuaBengio,AaronCourville,“DeepLearning(AdaptiveComputationand MachineLearningseries”,MITPress,2017.
2.	MichaelNielsen,NeuralNetworksandDeepLearning,DeterminationPress,2015.
E BOOKS	

1.	<a href="https://www.deeplearningbook.org/">https://www.deeplearningbook.org/</a>
2.	<a href="https://pythonmachinelearning.pro/free-ebook-deep-learning-with-python/">https://pythonmachinelearning.pro/free-ebook-deep-learning-with-python/</a>
<b>MOOC</b>	
1.	<a href="https://www.classcentral.com/course/kadenze-creative-applications-of-deep-learning-with-tensorflow-6679">https://www.classcentral.com/course/kadenze-creative-applications-of-deep-learning-with-tensorflow-6679</a>
2.	<a href="https://in.udacity.com/course/deep-learning--ud730">https://in.udacity.com/course/deep-learning--ud730</a>
3.	<a href="https://www.edx.org/learn/deep-learning">https://www.edx.org/learn/deep-learning</a>

COURSE TITLE	NATURAL LANGUAGE PROCESSING			CREDITS	3
COURSE CODE	CSC4454	COURSE CATEGORY	DE	L-T-P-S	2-0-2- 0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component			ESE
15%	15%	20%			50%
Course Description	This course focused to Natural language processing and their data analytics models. Case studies used to bring better understanding of RNN and their applications.				
Course Objective	<div>1. To know the basic concepts Natural language processing</div> <div>2. To understanding the different data models used for NLP.</div> <div>3. To ability to use the syntactic analytics.</div> <div>4. To know the application of RNN.</div>				
Course Outcome	<div>Upon completion of this course, the students will be able to</div> <div>1. Describe the basics of Natural language processing</div> <div>2. Analyze the text syntactically</div> <div>3. Analyze the text content Semantically</div> <div>4. Implement recurrent network for language models</div> <div>5. Implement a sentiment classification and chatbot systems</div>				
Prerequisites: Python Programming					

CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO-2	3	2	1	2	1	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	2	1	2	-	-	-	-	-	-	2	3	3	3
CO-4	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO-5	3	2	2	1	1	-	-	-	-	-	-	2	2	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION (6L+6P)															
Introduction to NLP, Regular Expressions, Words, Corpora, Text Normalization, Minimum Edit distance, N gram Language Models, Evaluating LanguageModels <b>Practical Component:</b> <ul style="list-style-type: none"><li>Convert the text intotokens</li><li>Find the wordfrequency</li><li>Demonstrate a bigram languagemodel</li><li>Demonstrate a trigram languagemodel</li><li>Generate regular expression for a given text</li></ul>													CO-1  BTL-2		
MODULE 2: SYNTACTIC ANALYSIS (6L+6P)															
English Word Classes, The Penn Treebank Part-of-Speech Tagset, Part-of-Speech Tagging, HMM Part- of-Speech Tagging, Maximum Entropy Markov Models, Grammar Rules for English, Treebanks, Grammar Equivalence and Normal form, Lexicalized Grammar. <b>Practical Component :</b> <ul style="list-style-type: none"><li>PerformLemmatization</li><li>PerformStemming</li><li>Identify parts-of Speech using Penn Treebank tagset.</li><li>Implement HMM for POSTagging</li><li>Build aChunker</li></ul>													CO-2  BTL-3		
MODULE 3: SEMANTIC ANALYSIS (6L+6P)															
Representation of Sentence Meaning: Computational Desiderata for Representations, Model- Theoretic Semantics, First-Order Logic, Event and State Representations, Description Logics, Semantic roles, Semantic role labeling. <b>Practical Component:</b> <ul style="list-style-type: none"><li>Find the synonym of a word usingWordNet</li><li>Find the antonym of aword</li><li>Implement semantic role labeling to identify namedentities</li><li>Resolve theambiguity</li></ul>													CO-3  BTL-3		

<ul style="list-style-type: none"><li>• Translate the text using First-order logic</li></ul>	
<b>MODULE 4: SEQUENCE PARSING WITH RECURRENT NETWORKS</b>	
<b>(6L+6P)</b>	
Simple Recurrent Networks, Applications of RNNs, Deep Networks: Stacked and Bidirectional RNNs, Managing Context in RNNs: LSTMs and GRUs, Words, Characters and Byte-Pairs. <b>Practical Component:</b> <ul style="list-style-type: none"><li>• Implement RNN for sequence labeling</li><li>• Implement POS tagging using LSTM</li><li>• Implement Named Entity Recognizer</li><li>• Word sense disambiguation by LSTM/GRU</li></ul>	<b>CO-4</b>  <b>BTL-3</b>
<b>MODULE 5: CASE STUDY</b>	
<b>(6L+6P)</b>	
Sentiment Classification, Dialog Systems and Chatbots <b>Practical Component:</b> <ul style="list-style-type: none"><li>• Develop a Movie reviews system</li><li>• Create a chatbot for HITS.</li></ul>	<b>CO-5</b>  <b>BTL-3</b>
<b>TEXT BOOKS</b>	
1.	Dan Jurafsky and James H. Martin. Speech and Language Processing (3rd ed. draft), 2019.
<b>REFERENCE BOOKS</b>	
1.	Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, First
2.	Edition, O'reilly, 2009
3.	Yoav Goldberg, University of Toronto, Neural Network Methods for Natural language Processing,
<b>E BOOKS</b>	
1.	<a href="https://www.cs.vassar.edu/~cs366/docs/Manning_Schuetze_StatisticalNLP.pdf">https://www.cs.vassar.edu/~cs366/docs/Manning_Schuetze_StatisticalNLP.pdf</a>
2.	<a href="https://www.nltk.org/book/">https://www.nltk.org/book/</a>
3.	<a href="https://www.nltk.org/genindex.html">https://www.nltk.org/genindex.html</a>
<b>MOOC</b>	
1.	<a href="https://www.coursera.org/learn/language-processing">https://www.coursera.org/learn/language-processing</a>

COURSE TITLE	TIME SERIES ANALYSIS AND FORECASTING			CREDITS	3
COURSE CODE	CSC4459	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
<b>ASSESSMENT SCHEME</b>					

First Periodical Assessment	Second Periodical Assessment	Lab Component											ESE		
15%	15%	20%											50%		
Course Description	A time series essentially is a series of quantitative values. These values are obtained over time, and often have equal time intervals between them. These intervals can be quite different and may consist of yearly, quarterly, monthly or hourly buckets for instance.														
Course Objective	1. To knowledge of basic concepts in time series analysis and forecasting. 2. To understanding the use of time series models for forecasting and the limitations of the methods. 3. To ability to criticize and judge time series regression models. 4. To distinguish the ARIMA modelling of stationary and nonstationary time series. 5. To Compare with multivariate times series and other methods of applications														
Course Outcome	Upon completion of this course, the students will be able to  1. Describe the basic concepts in time series analysis and forecasting. 2. Apply Aggregation and Smoothing the time series models for forecasting and the limitations of the methods.  3. Criticize and judge time series regression models.  4. Distinguish the ARIMA modelling of stationary and nonstationary time series.  5. Compare with multivariate times series and other methods of applications														
Prerequisites: Python Programming															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	1	-	-	-	-	-	-	2	2	2	2
CO-2	3	2	1	2	1	-	-	-	-	-	-	2	2	2	2
CO-3	3	2	2	1	2	-	-	-	-	-	-	2	3	3	3
CO-4	3	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO-5	3	2	2	1	1	-	-	-	-	-	-	2	2	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION OF TIMESERIES ANALYSIS													(6L+6P)		
Introduction to Time Series and Forecasting -Different types of data-Internal structures of time series-Models for time series analysis-Autocorrelation and Partial autocorrelation. Examples of Time series Nature and uses of forecasting-Forecasting Process-Data for forecasting –Resources for forecasting. Practical Component:													CO-1  BTL-2		



1.Time Series Data Cleaning 2.Loading and Handling Times series data 3. Preprocessing Techniques	
<b>MODULE 2: STATISTICS BACKGROUND FOR FORECASTING (6L+6P)</b>	
Graphical Displays -Time Series Plots - Plotting Smoothed Data - Numerical Description of Time Series Data - Use of Data Transformations and Adjustments- General Approach to Time Series Modeling and Forecasting- Evaluating and Monitoring Forecasting Model Performance. <b>Practical Component:</b> 1.How to Check Stationarity of a Time Series. 2. How to make a Time Series Stationary? 3. Estimating & Eliminating Trend. <ul style="list-style-type: none"> <li>• Aggregation</li> <li>• Smoothing</li> <li>• Polynomial Fitting</li> </ul> 4.Eliminating Trend and Seasonality <ul style="list-style-type: none"> <li>• Differencing</li> <li>• Decomposition</li> </ul>	<b>CO-2</b> <b>BTL-3</b>
<b>MODULE 3: TIME SERIES REGRESSION MODEL (6L+6P)</b>	
Introduction - Least Squares Estimation in Linear Regression Models - Statistical Inference in Linear Regression- Prediction of New Observations - Model Adequacy Checking - Variable Selection Methods in Regression - Generalized and Weighted Least Squares- Regression Models for General Time Series Data- Exponential Smoothing-First order and Second order. <b>Practical Component:</b> 1.Moving Average time analysis data. 2.Smoothing the Time analysis Data. 3.Check out the Time series Linear and non-linear trends. 4.Create a modelling .	<b>CO-3</b> <b>BTL-3</b>
<b>MODULE 4: AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) MODELS (6L+6P)</b>	
Autoregressive Moving Average (ARMA) Models - Stationarity and Invertibility of ARMA Models - Checking for Stationarity using Variogram- Detecting Nonstationarity - Autoregressive Integrated Moving Average (ARIMA) Models - Forecasting using ARIMA - Seasonal Data - Seasonal ARIMA Models- Forecasting using Seasonal ARIMA Models Introduction - Finding the “BEST” Model -Example: Internet Users Data- Model Selection Criteria - Impulse Response Function to Study the Differences in Models - Comparing Impulse Response Functions for Competing Models . <b>Practical Component:</b> 1.Modelling time series <ul style="list-style-type: none"> <li>• Moving average</li> <li>• Exponential smoothing</li> <li>• ARIMA</li> </ul> 2. Seasonal autoregressive integrated moving average model (SARIMA)	<b>CO-4</b> <b>BTL-3</b>

MODULE 5: MULTIVARIATE TIME SERIES MODELS AND FORECASTING		(6L+6P)
Multivariate Time Series Models and Forecasting - Multivariate Stationary Process- Vector ARIMA Models - Vector AR (VAR) Models - Neural Networks and Forecasting -Spectral Analysis - Bayesian Methods in Forecasting. <b>Practical Component:</b> Dependence Techniques <ul style="list-style-type: none"><li>Multivariate Analysis of Variance and Covariance</li><li>Canonical Correlation Analysis</li><li>Structural Equation Modeling</li></ul> Inter-Dependence Techniques <ul style="list-style-type: none"><li>Factor Analysis</li><li>Cluster Analysis</li></ul>		CO-5 BTL-3
TEXT BOOKS		
1.	Introduction To Time Series Analysis And Forecasting, 2nd Edition, Wiley Series In Probability And Statistics, By Douglas C. Montgomery, Cheryl L. Jen(2015)	
2.	Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek Pal Dr. Pks Prakash (2017)	
REFERENCE BOOKS		
1.	Peter J. Brockwell Richard A. Davis Introduction To Time Series And Forecasting, Third Edition. (2016).	
2.	Multivariate Time Series Analysis and ApplicationsWilliam W.S. Wei Department of Statistical Science Temple University, Philadelphia, PA, SA This edition first published 2019 John Wiley & Sons Ltd.	
3.	Time Series Analysis by James D Hamilton Copyright © 1994 by prince town university press	
MOOC		
1.	<a href="https://www.stat.ipb.ac.id/en/uploads/KS/S2%20-%20ADW/3%20Montgomery%20-%20Introduction%20to%20Time%20Series%20Analysis%20and%20Forecasting.pdf">https://www.stat.ipb.ac.id/en/uploads/KS/S2%20-%20ADW/3%20Montgomery%20-%20Introduction%20to%20Time%20Series%20Analysis%20and%20Forecasting.pdf</a>	
2.	<a href="https://ru.b-ok2.org/terms/?q=forecasting">https://ru.b-ok2.org/terms/?q=forecasting</a>	
3.	<a href="https://otexts.com/fpp2/">https://otexts.com/fpp2/</a>	
MOOC		
1.	<a href="https://www.coursera.org/learn/practical-time-series-analysis">https://www.coursera.org/learn/practical-time-series-analysis</a>	
2.	<a href="https://ocw.mit.edu/courses/economics/14-384-time-series-analysis-fall-2013/download-course-materials/">https://ocw.mit.edu/courses/economics/14-384-time-series-analysis-fall-2013/download-course-materials/</a>	
3.	<a href="https://swayam.gov.in/nd1_noc19_mg46/preview">https://swayam.gov.in/nd1_noc19_mg46/preview</a>	

**DEPARTMENTALELECTIVESFORSPECIALIZATIONINIOT**

COURSE TITLE	INTRODUCTION To IoT			Credit	3
COURSE CODE	CSC4280	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defense sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions.				

Course Objective	To understand basic principles of sensing techniques and need of sensors in IoT. 1. Describe what IoT is and how it works today 2. Recognize the factors that contributed to the emergence of IoT 3. Design and program IoT devices 4. Use real IoT protocols for communication 5. Secure the elements of an IoT device 6. Design an IoT device to work with a Cloud Computing infrastructure.														
Course Outcome	Upon completion of this course, the students will be able to  1. Explain the definition and usage of the term “The Internet of Things” in different contexts. 2. Appreciate the role of big data, cloud computing and data analytics in a typical IoT system. 3. Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack. 4. Design a simple IoT system comprising sensors, edge devices, wireless network connections and data analytics capabilities. 5. Use the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.														
Prerequisites: Basic Networking Concepts															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	-	2	-	-	-	1	1	3	2	1	-
CO-2	3	3	2	1	2	1	-	1	2	2	2	3	3	2	1
CO-3	3	3	3	2	3	1	-	1	2	2	2	2	3	2	2
CO-4	2	3	3	3	2	3	2	2	2	2	2	2	3	3	1
CO-5	3	3	3	3	3	3	2	2	3	2	2	2	3	3	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO INTERNET OF THINGS (6L+6P)															
The technology of the internet of things, making the internet of things, Elements of an IoT ecosystem, design principles for connected devices, Web thinking for connected devices. Practical Component: 1. Technologies that led to evolution of IOT 2. IOT and SCADA Addition 3. IOT and M2M 4. IOT and Big Data 5. Requirement of international standard (case study) 6. IOT standards in practice, Operating platforms /systems														CO-1 BTL-3	
MODULE 2: NETWORKS AND COMMUNICATION (6L+6P)															

Networking Technology, Communication Technology, Processes Data Management, Prototyping embedded devices, Sensors and actuators, Embedded computing basics, Introduction to ARDUINO, RASPBERRY PI. <b>Practical Component:</b> 1. Design of IOT systems 2. Development of prototypes		<b>CO-2</b> <b>BTL-3</b>
<b>MODULE 3: FOUNDATIONAL ELEMENTS OF AN IOT SOLUTION (6L+6P)</b>		
The Edge of the IoT, An Abstract Edge Architecture Model, Device Types, The Cloud Cloud-to-Device Connectivity, Topology of the Cloud Data Normalization and Protocol Translation <b>Practical Component:</b> 1. IOT in everyday life 2. Internet of Everything 3. IOT and Individual Privacy		<b>CO-3</b> <b>BTL-3</b>
<b>MODULE 4: SECURITY AND PRIVACY CHALLENGE IN DATA AGGREGATION FOR THE IOT IN SMART CITIES (6L+6P)</b>		
Steps towards a Secure Platform, Privacy-Preserving sharing of IOT Data, Secure Authentication and Access Control in Constrained Devices, Smarties Approach. <b>Practical Component:</b> 1. Lighting as a service ( case study) 2. Intelligent Traffic systems ( case study) 3. Smart Parking ( case study) 4. Smart water management ( case study).		<b>CO-4</b> <b>BTL-3</b>
<b>MODULE 5: IOT APPLICATIONS (6L+6P)</b>		
IoT Applications — Value Creation for Industry , Value Creation and Challenges, The Smart FactoryInitiative, Cost-effective Process Integration of IoT Devices, IoT for Retailing Industry. <b>Practical Component:</b> 1. Big Data Management. 2. Connectivity challenges. 3. Mission critical applications		<b>CO-5</b> <b>BTL-3</b>
<b>TEXT BOOKS</b>		
1	Ovidiu Vermesan ,Peter Friess “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems” River Publishers , 2013 .(Chapter 2,3 & 5)	
<b>REFERENCE BOOKS</b>		
1.	Jacob Fraden, “Handbook of Modern Sensors: Physics, Designs, and Applications”, Fourth Edition, Springer, 2010.	
2.	Joe Biron and Jonathan Follett “ Foundational Elements of an IoT Solution The Edge, The Cloud, and Application Development” ,Printed in the United States of America,2016( Chapter 3&4)	
<b>E BOOKS</b>		
1	<a href="https://www.worldcat.org/title/internet-of-things/oclc/896359016&amp;referer=brief_results">https://www.worldcat.org/title/internet-of-things/oclc/896359016&amp;referer=brief_results</a>	
<b>MOOC</b>		

1	<a href="https://nptel.ac.in/courses/106/105/106105166/">https://nptel.ac.in/courses/106/105/106105166/</a>
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COURSE TITLE	IoT SENSOR TECHNOLOGIES			Credit	3
COURSE CODE	CSC4276	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3

**ASSESSMENT SCHEME**

First Periodical Assessment	Second Periodical Assessment	Practical Component	ESE
15%	15%	20%	50%
<b>Course Description</b>	The Internet of Things (IoT) is expanding at a rapid rate, and it is becoming increasingly important for professionals to understand what it is, how it works, and how to harness its power to improve your business. This course explores various IoT devices and sensor types, how they work, and how we connect them. Map out the process for developing your own IoT ideas.		
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To understand basic principles of sensing techniques and need of sensors in IoT.</li> <li>2. To discuss on sensor interface electronic.</li> <li>3. Train the students to build IoT systems using motion related sensors.</li> <li>4. To impart adequate knowledge on light and radiation sensors.</li> <li>5. Make the students to apply sensors for temperature and chemical-based applications.</li> </ol>		
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Identify the need of sensors in IoT and the fundamental principles of Sensing</li> <li>2. Explore the sensor interface electronic</li> <li>3. Discover the selection of motion-related sensors for specific application.</li> <li>4. Infer light and radiation detectors</li> <li>5. Choose and use appropriate sensors for temperature and chemical-based applications</li> </ol>		

**Prerequisites:** Electronics Devices and Circuits**CO, PO AND PSO MAPPING**

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	-	2	-	-	-	1	1	3	2	1	-
CO-2	3	3	2	1	2	1	-	1	2	2	2	3	3	2	1
CO-3	2	3	3	2	3	1	-	1	2	2	2	2	3	2	2
CO-4	2	3	3	3	2	2	1	1	1	2	2	2	3	3	1
CO-5	3	3	3	3	3	2	1	1	3	2	2	2	3	3	2

**1: Weakly related, 2: Moderately related and 3: Strongly related**

<b>MODULE 1: PRINCIPLES OF SENSING (6L+6P)</b>	
<p>Introduction to IoT- Need for sensors in IoT, Data Acquisition – sensor characteristics – electric charges, field potentials – capacitance – magnetism – inductance – resistance – piezoelectric – pyroelectric – Hall effect thermoelectric effects – sound waves – heat transfer – light – dynamic models of sensors.</p> <p><b>Practical Component:</b> Identification of sensor and actuator for real-time application</p>	<p><b>CO-1</b> <b>BTL-3</b></p>
<b>MODULE 2: INTERFACE ELECTRONICS (6L+6P)</b>	
<p>Radiometry – Photometry – mirrors – lenses – fibre optics – concentrators – Interface circuits – amplifiers – light-to-voltage – excitation circuits – ADC – Digitization – Capacitance-to-voltage – bridge circuits – data transmission – noise in sensors and circuits – calibration – low power sensors</p> <p><b>Practical Component:</b> 1. Identification of sensor and actuator for real-time application 2. Simulate the interface circuits for sensor application</p>	<p><b>CO-2</b> <b>BTL-3</b></p>
<b>MODULE 3: MOTION RELATED SENSORS (6L+6P)</b>	
<p>Occupancy and motion detectors: ultrasonic – microwave – capacitive detectors – triboelectric – Optoelectronic motion sensors – optical presence sensor – Pressure Gradient sensors Velocity and acceleration sensors: Accelerometer characteristics – capacitive accelerometers – Piezoelectric accelerometers – piezoresistive accelerometers – thermal accelerometers – Gyroscopes – piezoelectric cables – gravitational sensors</p> <p><b>Practical Component:</b> Identify the components required and simulate the sensor circuits for motion related application.</p>	<p><b>CO-3</b> <b>BTL-3</b></p>
<b>MODULE 4: LIGHT AND RADIATION DETECTORS (6L+6P)</b>	
<p>Light Detectors: Photo diodes – photo transistor – photo resistor – cooled detectors – CCD and CMOS image sensors – thermal detectors – optical design – gas flame detectors Radiation Detectors: scintillating detectors – ionization detectors – cloud and bubble chambers.</p> <p><b>Practical Component:</b> Identify the components required and simulate the sensor system for Light and radiation-based application.</p>	<p><b>CO-4</b> <b>BTL-3</b></p>
<b>MODULE 5: TEMPERATURE AND CHEMICAL SENSORS (6L+6P)</b>	
<p>Temperature Sensors: coupling with objects – temperature reference points – thermo resistive sensors – thermo electric contact sensors – semiconductor sensors – acoustic sensors – piezoelectric sensors Chemical sensors: characteristics – classes of chemical sensors – biochemical sensors – multisensory arrays – electronic noses and tongues.</p> <p><b>Practical Component:</b> Identify the components required and simulate the sensor system for Temperature and Chemical related application</p>	<p><b>CO-5</b> <b>BTL-3</b></p>
<b>REFERENCE BOOKS</b>	

1.	Jacob Fraden, “Handbook of Modern Sensors: Physics, Designs, and Applications”, Fourth Edition, Springer, 2010.
2.	Patranabis , “Sensors and Transducers” ,PHI Second Edition, 2013.
<b>WEB LINK</b>	
1	<a href="https://www.avnet.com/wps/portal/us/resources/article/nxp-intro-to-iot-components/">https://www.avnet.com/wps/portal/us/resources/article/nxp-intro-to-iot-components/</a>
2	<a href="http://www.steves-internet-guide.com/internet-of-things/">http://www.steves-internet-guide.com/internet-of-things/</a>

COURSE TITLE	SMART SENSOR TECHNOLOGIES			Credit	3
COURSE CODE	CSC4277	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	The course emphasis is on the integration of electronics with sensors to provide a smart transducer or a system on a chip with multiple integrated devices				
Course Objective	1. To understand basic of Smart Sensors Technologies for IoT. 2.. To analyze the right sensor and to understand Sensing method for a given IoT application. 3. To design Real-time circuit building blocks for the applications. 4. To Simulate, synthesize, and layout a complete sensor or sensor system, MEMS device or microsystem ready with MCU. 5. To learn about Wireless Sensing Techniques and build Real-Time applications.				
Course Outcome	Upon completion of this course, the students will be able to 1. Analyze the sensors available in IoT based on application requirement and the Sensing methods 2. Create a Real-time application by choosing appropriate sensors for temperature monitoring. 3. Interfacing different types of Sensors with MCU 4. Infer Wireless Sensing, RF Sensing and RF MEMS 5. Design a real-time application for landslide monitoring and hazard mitigation				
Prerequisites: Electronics Devices and Circuits					
CO, PO AND PSO MAPPING					



CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	-	2	-	-	-	1	1	3	2	1	-
CO-2	3	3	2	1	2	1	-	1	2	2	2	3	3	2	1
CO-3	2	3	3	2	3	1	-	1	2	2	2	2	3	2	2
CO-4	2	3	3	3	2	2	1	1	1	2	2	2	3	3	1
CO-5	3	3	3	3	3	2	1	1	3	2	2	2	3	3	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: BASICSOFSENSORS (6L+6P)															
Introduction-Sensor Vs Transducer, Nature of Sensors, Sensor Output Characteristics, Sensing Technologies, Digital Output Sensors. <b>PracticalComponent:</b> 1. Case study on various sensors and its working Simulate a smart home with various smartdevices														CO-1  BTL-3	
MODULE 2:APPLICATIONSPECIFICSENSORS(6L+6P)															
Occupancy and motion detectors: ultrasonic – microwave – capacitive detectors- optical presencesensor, Light Detectors: Photo diodes – photo transistor – photo resistor- CCD and CMOS imagesensors, TemperatureSensors:thermos-resistivesensors–thermoelectriccontactsensor <b>Practicalcomponent:</b> 1. StudytheTemperaturesensorandsimulateanexperimenttomonitortemperature. SimulationofIndustrialautomation														CO-2  BTL-3	
MODULE 3:SENSORWITHMICROCONTROLLER(6L+6P)															
Introduction,AmplificationandSignalConditioning,IntegratedSignalConditioning,DigitalConversion, MCU Control, MCUs for Sensor Interface, Techniques and Systems Considerations, SensorIntegration <b>PracticalComponent:</b> 1. SimulationofAirQualitymonitoring SimulationofAutonomousvehiclesusingCyberPhysical Systems.														CO-3  BTL-3	
MODULE 4:WIRELESSSENSING(6L+6P)															
Wireless Data and Communications, Wireless Sensing Networks, Industrial Wireless SensingNetworks,RFSensing,Telemetry,RFMEMS,CompleteSystemConsideration. <b>PracticalComponent:</b> 1. SimulationofCommercialbuildingautomation SimulationofroadsafetySensing														CO-4  BTL-3	
MODULE5: SMARTAPPLICATIONSANDSYSTEMREQUIREMENTS (6L+6P)															

Automotive Applications, Industrial (Robotic) Applications, Consumer Applications, Future SensorPlusSemiconductor Capabilities,Future SystemRequirements. <b>Practicalcomponent:</b> 1. SimulationofMotionsensorforlandslidemonitoringandhazardmitigation Casestudyonwearablesensors		<b>CO-5</b>  <b>BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Frank,Randy,“Understandingsmartsensors”,ArtechHouseintegratedmicrosystemsseries, 3rdEdition,2013.	
2.	JacobFraden,“HandbookofModernSensors:Physics,Designs,andApplications”,5thEdition, Springer,2016.	
<b>REFERENCE BOOKS</b>		
1.	VlasiosTsiatsis,StamatisKarnouskos,JanHoller,DavidBoyle,CatherineMulligan,"Internetof Things: Technologies and Applications for a New Age of Intelligence", Academic Press, 16-Nov-2018.	
2.	HenryLeung,SubhasChandraMukhopadhyay,"IntelligentEnvironmentalSensing",Springer, 22-Jan-2015.	
<b>E BOOKS</b>		
1.	<a href="https://www.sciencedirect.com/topics/engineering/smart-sensors">https://www.sciencedirect.com/topics/engineering/smart-sensors</a>	
2.	<a href="https://www.azosensors.com/article.aspx?ArticleID=1289">https://www.azosensors.com/article.aspx?ArticleID=1289</a>	
<b>MOOC</b>		
1	<a href="https://www.coursera.org/learn/internet-of-things-sensing-actuation">https://www.coursera.org/learn/internet-of-things-sensing-actuation</a>	
2	<a href="https://www.udemy.com/course/sensors-sensor-fundamentals/">https://www.udemy.com/course/sensors-sensor-fundamentals/</a>	

**SEMESTER-V**

IoT FOR ARCHITECTS			Credit
CSC4360	COURSE CATEGORY	DE	L-T-P-S
1.0	Approval Details		LEARNING LEVEL
Second Periodical Assessment			ESE
15%	20%		50%

The course emphasis on design futureproof systems that meet the requirements of IoT systems: systems that are secure, i scalable. The course helps to apply best-in-class software architecture methods to help you design complex IoT and other wires to understand the business impact of the technical decisions that make as an IoT system architect.

1. To understand IoT architecture and technical fundamentals.
- 2.. To analyze various types of sensing devices and end points.
3. To infer the functions of WPAN Standards and implement on suitable IoT applications.
4. To Simulate IoT applications using WLAN and WAN protocols.
5. To learn about working of M2M communication protocols.

Upon completion of this course, the students will be able to

1. Describe the architecture IoT and the IoT technical fundamentals
2. Identify various types of sensing devices and endpoints.
3. Analyze the functions of WPAN standards and use it for suitable IoT applications.
4. Implement simple IoT applications using WLAN and WAN protocols.
5. Develop the working of protocols for machine-to-machine communication.

### etofThings(IoT)

PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO -10	PO-11	PO-12
	2	-	-	2	-	-	-	1	1	3
	2	1	2	1	-	1	2	2	2	3
	3	2	3	1	-	1	2	2	2	2
	3	3	2	2	1	1	1	2	2	2
	3	3	3	2	1	1	3	2	2	2

1: Weakly related, 2: Moderately related and 3: Strongly related

### URE (6L+6P)

IoT potential, IoT ecosystem: IoT Vs machine to machine, the value of 'sLaw, Role of an architect, An Architectural Overview-Building an architecture- Main design principles and needed capabilities considerations. M2M and IoT Technology Fundamentals: Devices and gateways-Local and wide area networking-DatagRGBLED using Arduino.

### AND DATA COMMUNICATION(6L+6P)

Topics: Vision system, Sensor fusion, I/O devices, Energy Sources and power management: Energy Harvesting, Energy storage: RF energy, RF spectrum, Theradio spectrum.

rs and Arduino.

## OS(6L+6P)

, IEEE 802.15.4, Zigbee, Z-wave, Internet Protocol and Transmission Control Protocol, 6LoWPAN, Thread.

connect to and Ethernet and Wi-Fi network.

protocol.

## PROTOCOLS(6L+6P)

Communication Systems and Protocols: Cellular Connectivity-LTE, LoRa and LoRaWAN, Sigfox.

using Python modules to send messages

## DPROTOCOLS

(6L+6P)

d Application Protocol, STOMP, AMQP, Comparison of Protocols.

TP Protocol.

and document it.

of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, and analytics.

Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things", Academic Press, 2014.

ing Internet of Things", PACKT publishing, 2015.

, Florian Michahelles, "Architecting the Internet of Things", Springer, 2011.

d Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", 1st Edition,

and Vijai Madisetti: A Hands-on Approach "Internet of Things", Universities

[ustl.edu/~jain/cse570-15/ftp/iot\\_prot/](http://ustl.edu/~jain/cse570-15/ftp/iot_prot/)

[org/course/iot-networks-and-protocols](http://org/course/iot-networks-and-protocols)

[era.org/lecture/iot-wireless-cloud-computing/](http://era.org/lecture/iot-wireless-cloud-computing/)

COURSE TITLE		INTERFACINGANDPROGRAMMINGWITHIOT GATEWAY								Credit		3			
COURSE CODE		CSC4361		COURSE CATEGORY			DE			L-T-P-S		2-0-2-0			
Version		1.0		Approval Details						LEARNING LEVEL		BTL-3			
ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment			Practical Component						ESE				
15%		15%			20%						50%				
Course Description		The course emphasis on design, requirement, data interfacing and capabilities. The course would blend with good industrial practices, which lead to the first-time success of the design and development of sensor node, API development, and data analysis would also be covered in brief. Lab sessions and case studies will supplement the classroom interactions.													
Course Objective		1. To understand functions and client standards of IoT Gateways. 2. To learn basic programming in Arduino. 3. To employ IoT communication protocol to execute Node-RED Flow Code. 4. To infer the configuration of Raspberry pi board. 5. To execute IoT application using Raspberry pi board.													
Course Outcome		Upon completion of this course, the students will be able to  1. Develop gateway for IoT applications to configure client certificate 2. Generate programming code to do basic experiments in Arduino 3. Employ IoT communication protocol to execute Node-RED Flow Code 4. Practice OS installation and IP address configuration in Raspberry pi board 5. Design a system using Raspberry pi to camera Interfacing and data logger with Think speak cloud													
Prerequisites: BasicsofInternetofThings(IoT)															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	2	3	3	2	3	1	1	1	2	2	2	2	3	2	2
CO-2	3	3	2	1	2	1	-	-	2	2	2	3	3	2	1
CO-3	2	3	3	2	3	1	1	1	2	2	2	2	3	2	2

CO-4	3	3	2	1	2	1	-	-	2	2	2	3	3	2	1
CO-5	3	3	2	1	2	1	-	-	2	2	2	3	3	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: IOTGATEWAY														(6L+6P)	
IoT Gateway: Overview – Architectural Summary. General Operation: Configure the gateway -Configuring a Gateway Certificate-User Interface-Configuring an Agent. <b>Practical Component:</b> 1. Importing an MQTT Client Certificate. Configuring a Self-Signed Certificate														CO-1  BTL-3	
MODULE 2: ARDUINO BASICS(6L+6P)															
Hardware Requirements– Software Requirements– Arduino Programming Language Reference– Internet Connectivity: Arduino Uno Wired Connectivity– Arduino Uno Wireless Connectivity. <b>Practical Component:</b> 1. Execute LED blink program in Arduino.. Execute Traffic Light pattern program in Arduino.														CO-2  BTL-3	
MODULE 3: COMMUNICATION PROTOCOLS AND PROTOTYPES(6L+6P)															
HTTP - MQTT -. Complex Flows: Node-RED- Node-RED Flow Code (Arduino)- IoT Patterns: Real-time Clients. <b>Practical Component:</b> 1. Write a program to execute MQTT: Publish/subscribe log messages. Write a program to execute Light sensor tweets system														CO-3  BTL-3	
MODULE 4: RASPBERRY PI BASICS(6L+6P)															
Introduction to Raspberry pi - Installation of NOOBS on SD Card - Installation of Raspbian on SD Card -Terminal Commands - Installation of Libraries on Raspberry Pi - Getting the static IP address of Raspberry Pi. <b>Practical Component:</b> 1. Interfacing of Relay with Raspberry Pi Interfacing of DHT11 sensor with Raspberry Pi														CO-4  BTL-3	
MODULE 5: INTERFACING PROGRAM WITH RASPBERRY PI														(6L+6P)	
Run a Program on Raspberry Pi - Installing the Remote Desktop Server - Pi Camera installation- Face Recognition using Raspberry Pi- SPI (serial peripheral interface) with Raspberry Pi- Reading the digital input-DHT11 Data Logger with ThingSpeak Server. <b>Practical Component:</b> 1. Interfacing of ultrasonic sensor with Raspberry Pi Interfacing of camera with Raspberry pi														CO-5  BTL-3	
TEXT BOOKS															

1.	AdeelJaved,“BuildingArduinoprojectsfortheInternetofThings”Firstedition,Apress,2017.
2.	RajeshSingh,AnitaGehlot,LoviRajGupta,BhupendraSingh,MahendraSwain.“InternetofThings withRaspberryPiandArduino”1stEdition,CRCPress,2019.
<b>REFERENCE BOOKS</b>	
1.	ManeeshRao“InternetofthingswithRaspberryPi3”Firstedition,Packt,2018.
<b>EBOOKS</b>	
1.	<a href="http://ebook.nexcom.com/Express/2015-Summer/NEXCOM_Express_Summer_2015_opf_files/pdfs/NEXCOM_Express_Summer_2015.pdf">http://ebook.nexcom.com/Express/2015-Summer/NEXCOM_Express_Summer_2015_opf_files/pdfs/NEXCOM_Express_Summer_2015.pdf</a>
2.	<a href="https://www.kepware.com/getattachment/96bdb7bb-4f9a-4cfe-be30-ef048d16dd83/iot-gateway-manual.pdf">https://www.kepware.com/getattachment/96bdb7bb-4f9a-4cfe-be30-ef048d16dd83/iot-gateway-manual.pdf</a>
<b>MOOC</b>	
1.	<a href="https://www.coursera.org/learn/raspberry-pi-interface">https://www.coursera.org/learn/raspberry-pi-interface</a>
2.	<a href="https://www.classcentral.com/course/arduino-platform-4206">https://www.classcentral.com/course/arduino-platform-4206</a>

COURSE TITLE	IoT CLOUD AND DATA ANALYTICS			Credit	
COURSE CODE	CSC4376	COURSE CATEGORY	DE	L-T-P-S	
Version	1.0	Approval Details		LEARNING LEVEL	

**ASSESSMENT SCHEME**

Periodical Assessment	Second Periodical Assessment	Practical Component	ESE
15%	15%	20%	50%
Description	The course emphasis on design, requirement, data interfacing and capabilities. The course would blend with industrial practices, which lead to the first-time success of the design and development of sensor node, API development, and data analysis would also be covered in brief. Lab sessions and case studies will supplement classroom interactions.		
Objective	1. To understand the basics of IoT. 2. To infer the incorporation of IoT and Cloud. 3. To learn the reworkings of IoT and Machine Learning. 4. To infer the data analytics techniques like prediction and visualization using IoT data. 5. To learn various security aspects in IoT.		

<b>Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Demonstrate the working of IoT</li> <li>2. Identify the need of cloud computing for IoT</li> <li>3. Apply Machine Learning Algorithms for IoT data</li> <li>4. Predict and visualize output using Data Analytic tools</li> <li>5. Identify the Vulnerability in connected networks</li> </ol>
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**Prerequisites: Basic Network Concepts**

#### PO AND PSO MAPPING

PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO -10	PO-11	PO-12	PSO-1	PSO-2
3	3	3	3	3	2	2	2	2	2	2	3	3	3
3	3	3	3	2	1	2	1	1	2	1	3	3	3
3	3	3	3	1	1	2	1	2	2	1	3	3	3
3	3	2	2	2	1	2	1	1	2	2	3	3	3
3	3	3	3	3	2	2	2	2	2	2	3	3	3

**1: Weakly related, 2: Moderately related and 3: Strongly related**

#### UNIT 1: INTRODUCTION TO IoT

**(6L+6P)**

Introduction to Internet of Things (IoT)- Concepts and definitions of IoT-History of IoT –IoT data vs big data-analytics lifecycle and Techniques-IoT complete Technology chain-Applications of IoT-Opportunities and challenges in IoT.

##### **Practical Component:**

Study of IoT Simulators.

Simulated data collection using IoT simulators (IOTIFY/NETSIM)

Study of Hardware platforms Arduino/Raspberry pi/NodeMCU

Sensors data collection using IoT gateways (Arduino/Raspberry pi/NodeMCU)

#### UNIT 2: IoT and CLOUD (6L+6P)

Cloud computing – Cloud service models – Cloud Deployment models – Need of cloud computing for IoT-Fog computing Vs Cloud Computing for IoT-IoT Cloud Platforms –Microsoft Azure IoT-Amazon Web Services IoT-IBM WATSON IoT-Google's Cloud IoT.

##### **Practical Component:**

Develop your own Application that stores IoT data in open source IoT cloud platform analytic tools.

Stream IoT data into Google cloud platform using Qwiklab environment.

#### UNIT 3: IOT AND MACHINE LEARNING (6L+6P)



Principles and foundation of Artificial intelligence and IoT – Machine Learning Paradigms for IoT –Supervised learning for Linear regression-Logistic regression-SVM – Decision Tree -Naïve’s bayes-DeepLearningfor IoT-Neural Network.

**Practical Component:**

Write a program to implement the Linear regression for a sample training dataset stored as a CSV file. Compute the accuracy of the classifier, considering few test datasets.

Build a decision tree classifier for weather prediction dataset. Compute the accuracy of the classifier, considering few test datasets.

#### UNIT 4: DATA ANALYTICS FOR IoT (6L+6P)

IoT Analytics-IoT Analytics challenges-IoT Analytics for the cloud-Microsoft Azure overview– Designing data processing analytics – Designing visual analysis for IoT data-Data science for IoT-Feature engineering with IoT data.

**Practical Component:**

Develop an application for Smart Traffic that analyzes the IoT data and predicts the Traffic Jam.

Use the predicted output using Data Analytics tool.

#### UNIT 5: IoT SECURITY

(6L+6P)

Review of IoT Security- security Threats in IoT- APIs in IoT-Authentication in IoT-Strategies for securing IoT- Key Cryptography.

**Practical Component:**

Implement pentest and identify the vulnerable device in your network using Kali Linux.

Implement Password Guess attack after identifying Vulnerable device using Kali Linux.

#### BOOKS

Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Elsevier, 2016.

R.Chandrasekaran, "Essentials of Cloud computing", 2<sup>nd</sup> Edition, Chapman and Hall/CRC, 2015.

Amita Kapoor, "Hands on Artificial intelligence for IoT", 1<sup>st</sup> Edition, Packt Publishing, 2019.

David Etter, "IoT Security: Practical Guide Book", Create Space Independent Publishing Platform, 2016.

#### ONLINE BOOKS

John Soldatos, "Building Blocks for IoT Analytics", River Publishers, 2016.

John E. Rossman, "The Amazon way on IoT", Volume 2, John E. Rossman publication, 2016.

[http://index-of.co.uk/Cloud-Computing-books/Essentials%20of%20cloud%20computing%20\(2015\).pdf](http://index-of.co.uk/Cloud-Computing-books/Essentials%20of%20cloud%20computing%20(2015).pdf)

<https://www.iottechexpo.com/2018/11/iot/the-iot-analytics-lifecycle-from-generating-data-to-predicting-the-future>

<https://www.coursera.org/learn/cloud-iot-platform>

<https://www.udemy.com/course/iotehacking1/>

<b>COURSE TITLE</b>	<b>IOTSYSTEMDESIGN</b>				<b>Credit</b>	<b>3</b>
<b>COURSE CODE</b>	<b>CSC4377</b>	<b>COURSE CATEGORY</b>	<b>DE</b>	<b>L-T-P-S</b>	<b>2-0-2-0</b>	
<b>Version</b>	<b>1.0</b>	<b>Approval Details</b>		<b>LEARNING LEVEL</b>	<b>BTL-4</b>	

**ASSESSMENT SCHEME**

First Periodical Assessment	Second Periodical Assessment	Practical Component	ESE
15%	15%	20%	50%
Course Description	The course emphasis on design, requirement, data interfacing and capabilities. The course would blend with good industrial practices, which lead to the first-time success of the design and development of sensor node, API development, and data analysis would also be covered in brief. Lab sessions and case studies will supplement the classroom interactions.		
Course Objective	1. To understand list of technologies for system design and function of various platforms. 2. To infer difference between Analog and Digital I/O and role of PWM. 3. To learn to design digital interfacing methods to connect systems to real world devices. 4. To infer the usage of communication protocols and ethernet sockets. 5. To understand about various components in IoT System design		
Course Outcome	Upon completion of this course, the students will be able to 1. Prepare the list of Technologies required to enable a specific System design and the functioning of different platforms. 2. Compose the difference between Analog and Digital input and output and describe the role of PWM 3. Setup a digital interfacing method which is used to connect system with real world devices for selected application. 4. Infer the usage of communication protocols and ethernet sockets 5. Choose and use appropriate components to develop a design for real-time problem		

**Prerequisites:** Electronics Devices and Circuits**CO, PO AND PSO MAPPING**

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	2	2	2	-	-	-	1	1	3	2	1	-
CO-2	3	3	2	1	2	1	-	-	2	2	2	3	3	2	1
CO-3	2	3	3	2	3	1	1	1	2	2	2	2	3	2	2

CO-4	2	3	3	3	2	2	1	1	1	2	2	2	3	3	1
CO-5	3	3	2	1	2	1	-	-	2	2	2	3	3	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: IOTENABLINGTECHNOLOGIES (6L+6P)															
Sensors and Actuators, Communications, RFID and NFC (Near-Field Communication), Bluetooth LowEnergy(BLE),LiFi,6LowPAN,ZigBee,Z-Wave,LoRa,Protocols,HTTP,WebSocket,,Node-RED,Platforms. PracticalComponents: SimulationusingAWSIoT,MicrosoftAzureIoTsuite,GoogleCloudIoT.														CO-1 BTL-3	
MODULE 2:INPUTANDOUTPUTMETHODS(6L+6P)															
DigitalInputsandOutputs,AnalogInputsandOutputs,PulseWidthModulation(PWM),Accelerometerand Magnetometer, SDCard,LocalFileSystem PracticalComponents 1. Simulatorusagefori/os CasestudyforRealtimeapplicationsi/os														CO-2 BTL-3	
MODULE 3:DIGITALINTERFACES(6L+6P)															
Serial interface, Serial Peripheral Interface (SPI), I2C (Inter-Integrated Circuit), Controller AreaNetwork(CAN),MiddlewareTechnologies, CommunicationProtocolsandModels. PracticalComponents Programingwithinterface inArduino,MBed and RaspberryPi														CO-3 BTL-3	
MODULE 4:CLOUDANDFOGCOMPUTING(6L+6P)															
IoT System Requirements, Cloud Computing in IoT- Advantages of Using the Cloud -Examples of Cloud- Based IoT- Key Challenges, Fog Computing in IoT-Advantages-Fog Use Cases and Examples - Key Challenges PracticalComponents ProgrammingwithNetworkingandcommunicationdevices														CO-4 BTL-3	
MODULE 5: APPLICATIONDESIGN (6L+6P)															
Wi-Fi Signal Strength Reader and Haptic Feedback, Arduino Security Camera with Motion Detection,Tweet-a-Light–Twitter-EnabledElectricLight,ControllingInfraredDevicesUsingIRRemote PracticalComponents Designaprojectforreal-timeproblemaddocumentit.														CO-5 BTL-4	
TEXT BOOKS															

1.	PerryXiao, “Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed”, First Edition, John Wiley & Sons Ltd, 2018.
2.	Pradeeka Seneviratne, “Internet of Things with Arduino Blueprints”, First Edition, Packt Publishing, 2015.

**REFERENCE BOOKS**

1.	Qusay F. Hassan, “Internet of Things A to Z: Technologies and Applications”, John Wiley & Sons, 2018.
2.	Alessandro Bassi, Martin Bauer, “Enabling Things to Talk: Designing IoT solutions with the IoT Architectural Reference Model”, Springer, 2013.
3.	David Hanes, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, First Edition. Cisco Press, 2017.

**EBOOKS**

1	<a href="https://www.seebo.com/iot-design/">https://www.seebo.com/iot-design/</a>
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**MOOC**

1.	<a href="https://www.coursera.org/learn/introduction-iot-boards/home/welcome">https://www.coursera.org/learn/introduction-iot-boards/home/welcome</a>
2.	<a href="https://www.coursera.org/learn/internet-of-things-sensing-actuation">https://www.coursera.org/learn/internet-of-things-sensing-actuation</a>

**SEMESTER-VII**

COURSE TITLE	IoT INFRASTRUCTURE MANAGEMENT			Credit	3
COURSE CODE	CSC4460	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4

**ASSESSMENT SCHEME**

First Periodical Assessment	Second Periodical Assessment	Practical Component	ESE
15%	15%	20%	50%
<b>Course Description</b>	The course emphasis on Acquiring knowledge of IoT Infrastructure management and understanding various security techniques in IoT infrastructure management. The course also focuses on developing new security models based on emerging trends in IoT.		
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To understand the challenges in IoT Data Management.</li> <li>2. To learn the use of Cloud and various vulnerabilities in Cloud</li> <li>3. To develop user requirement modeling for User specification</li> <li>4. To analyze the threats in Connected Network</li> <li>5. To deploy a model to prevent an IoT connected network from a security threat</li> </ol>		

<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Identify the challenges in IoT data Management.</li> <li>2. handle the cloud and its vulnerabilities.</li> <li>3. Develop a user requirements model for specific application.</li> <li>4. Analyze the threats in IoT connected network.</li> <li>5. Develop a model to prevent an IoT connected network from a security threat.</li> </ol>
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**Prerequisites: Basic Network concepts**

#### CO, PO AND PSO MAPPING

CO	PO - 1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO - 10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	-	2	2	-	-	-	-	1	2	2	1	-
CO-2	3	3	3	-	2	2	-	-	-	-	1	2	2	1	-
CO-3	2	3	3	2	3	1	-	1	2	2	2	2	3	2	2
CO-4	2	3	3	3	2	2	1	1	1	2	2	2	3	3	1
CO-5	2	3	3	2	3	1	-	1	2	2	2	2	3	2	2

**1: Weakly related, 2: Moderately related and 3: Strongly related**

#### MODULE 1: INTRODUCTION IoT DATA MANAGEMENT & FOG COMPUTING (6L+6P)

Introduction to IoT data Management-Benefits-Challenges-Strategies-Fog computing basics-Fog based IoT-Characteristicsoffogcomputing-designandorganizationofFoglayers-fogcomputingservices.

##### **Practical Component:**

1. Perform Case study for health care application which provides health care services to patients in home through cloud based mobile application. Generate analysis report for the data generated and report the various challenges for this application.

**CO-1**  
**BTL-**

#### MODULE 2: CLOUD STRUCTURE (6L+6P)

Introduction-Cloud Structure-Infrastructure components-Cloud layers- Cloud relations-Cloud dynamics-datatypes.

##### **Practical Component:**

1. For the health care application which provides health care services to patients in home. Consider the system is maintained as IaaS, prepare the design model for the application (e.g. Identification of deployment model (public, private, hybrid), Identification of factors)

**CO-2**  
**BTL-**

#### MODULE 3: CLOUD MANAGEMENT (6L+6P)

Introduction-Cloud management services-Virtual Control-Management of User Requirements-Cloud Properties-Challenges for Establishing trusts in cloud-Establishing trust in cloud.

##### **Practical Component:**

**CO-3**  
**BTL-**

1.Forabovehealthcareapplicationperformanalysisofuserrequirementsforcloudoptimization.		
<b>MODULE 4: SECURITY MANAGEMENT</b>		<b>(6L+6P)</b>
IoT Attacks-Threat Modeling on an IoT system-Security Engineering for IoT development-The IoTSecurityLifecycle-SystemSecurityverificationandvalidation. <b>PracticalComponent:</b> 1.ForabovetheHealthcaresystemperforminsiderthreatanalysisusingpentest.		<b>CO-4</b> <b>BTL-3</b>
<b>MODULE 5: SECURITY ATTACKS AND ITS PREVENTION</b>		<b>(6L+6P)</b>
Anatomy Of IoT Security attacks-Physical and hardware security-Cryptography-Software definedperimeter-Blockchain andCryptocurrencies inIoT. <b>PracticalComponent:</b> 1. Perform analysis that whether above health care application is prone to Krack keyreinstallationattackonpatientshealthrecord. 2. PreparepreventionchecklistreportbycombiningtechnologieslikeblockchainorSDN.		<b>CO-5</b> <b>BTL-4</b>
<b>TEXT BOOKS</b>		
1.	HanesDavid,SalgueiroGonzalo“IoTFundamentals:NetworkingTechnologies,ProtocolsandUse CasesfortheInternetofThings”Pearsoneducation,August2017.	
2.	ImadM.Abbadi,”CloudManagementandSecurity”,wiley,2014.	
<b>REFERENCE BOOKS</b>		
1.	PerryLea,“InternetofthingsforArchitects”,PacktPublicationLtd,2018.	
2.	BrianRussell,DrewVanDuren,“PracticalInternetofThingsSecurity”,PacktPacktPublicationLtd,2016.	
<b>EBOOK</b>		
1	<a href="http://ptgmedia.pearsoncmg.com/images/9781587144561/samplepages/9781587144561_CH08.pdf">http://ptgmedia.pearsoncmg.com/images/9781587144561/samplepages/9781587144561_CH08.pdf</a>	
2	<a href="http://coolfire.insomnia247.nl/Imad%20M.%20Abbadi%20-%20Cloud%20Management%20and%20Security.pdf">http://coolfire.insomnia247.nl/Imad%20M.%20Abbadi%20-%20Cloud%20Management%20and%20Security.pdf</a>	
<b>MOOC</b>		
1	<a href="https://www.udemy.com/course/i0thacking1/learn/lecture/9357638#overview">https://www.udemy.com/course/i0thacking1/learn/lecture/9357638#overview</a>	

COURSE TITLE	INDUSTRIAL IOT 4.0										CREDITS		3		
COURSE CODE	CSC4461			COURSE CATEGORY					L-T-P-S		2-0-2-0				
Version	1.0			Approval Details					LEARNING LEVEL		BTL-4				
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment			Practical Component						ESE					
15%	15%			20%						50%					
Course Description	The industrial internet of things refers to interconnected sensors, instruments, and other devices networked together with computers' industrial applications, including manufacturing and energy management.														
Course Objective	1. To understand the Industrial IoT. 2. To demonstrate the use of Cloud in Industrial IoT. 3. To analyze the industrial IoT Three tier topology. 4. To learn the functionalities of modern communication protocols. 5. To describe Middleware Architecture, LoRaWAN- and Augmented reality.														
Course Outcome	Upon completion of this course, the students will be able to  1. Identify the Key opportunities and benefits in Industrial IoT 2. Apply virtual network to demonstrate the use of Cloud in Industrial IoT 3. Analyze industrial IoT Three tier topology and data management system 4. Summarize Legacy Industrial and Modern Communication Protocols 5. Describe Middleware Architecture, LoRaWAN- and Augmented reality														
Prerequisites: Basics of Internet of Things (IoT)															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	2	2	2	-	2	1	-	2	2	3	3	2	3
CO-2	3	3	-	3	3	2	-	-	2	2	2	-	3	-	-
CO-3	3	3	3	3	2	-	2	1	-	2	1	3	-	2	3
CO-4	3	3	3	3	-	1	2	-	2	2	1	3	3	2	-
CO-5	3	3	-	2	2	-	2	1	1	2	2	3	-	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related															

<b>MODULE 1: INTRODUCTION TO INDUSTRIAL INTERNET AND USE-CASES (6L+6P)</b>	
<p>Industrial Internet- Key IIoT Technologies- Innovation and the IIoT -Key Opportunities and Benefits - The Digital and Human Workforce - Logistics and the Industrial Internet- IOT Innovations in Retail.</p> <p><b>Practical component:</b>            Experiment on IIoT technology in Healthcare- Take the patient's daily readings of their weight, heart rate and blood pressure then upload the data to the smartphone via Bluetooth or internet.            Experiment on smart city features</p> <p><b>Suggested Readings:</b>            Industrial IoT (IIoT)</p>	<b>CO-1 BTL-3</b>
<b>MODULE 2: THE TECHNICAL AND BUSINESS INNOVATORS OF THE INDUSTRIAL INTERNET (6L+6P)</b>	
<p>Cyber Physical Systems (CPS) – IP Mobility – Network Virtualization - SDN (Software Defined Networks)- The Cloud and Fog – Role of Big Data in IIOT - Role of Machine learning and AI in IIOT</p> <p><b>Practical component:</b>            Setting up Smart office - When a visitor arrives, the CMS can turn on the lights in the reception area and play music and video, to provide a welcoming atmosphere.            Demonstrate the use of IPv6, with a focus on energy management.</p> <p><b>Suggested Readings:</b> Cyber Physical Systems (CPS)</p>	<b>CO-2 BTL-3</b>
<b>MODULE 3: IIOT REFERENCE ARCHITECTURE(6L+6P)</b>	
<p>Industrial Internet Architecture Framework (IIAF) -Industrial Internet Viewpoints - Architectural Topology: The Three-Tier Topology- Key System Characteristics- Data Management- Advanced data analytics.</p> <p><b>Practical component:</b>            Develop an IoT Setup for safety and security focused on intrusion detection and fire-detection. (Temperature sensors or smoke detectors can trigger fire-alarm)            Create Inventory Control- use embedded RFID tags and RFID readers to scan inbound stacks (automatically records the order ID, the manufacturer, product model, type, and quantity)</p> <p><b>Suggested Readings:</b>            Industrial Internet Architecture Framework (IIAF) - Three-Tier Topology</p>	<b>CO-3 BTL-3</b>
<b>MODULE 4: DESIGNING INDUSTRIAL INTERNET SYSTEMS(6L+6P)</b>	
<p>Legacy Industrial Protocols - Modern Communication Protocols-Proximity Network Communication Protocols- Wireless Communication Technologies- Gateways: industrial gateways - CoAP (Constrained Application Protocol)- NFC.</p> <p><b>Practical component:</b>            Develop an IoT application for Retail to promote product directly to customers through, web promotions, social media, video, and augmented reality.            Develop an application for payment using NFC technology.</p> <p><b>Suggested Readings:</b> Establish the Modern Communication Protocols with IIoT systems</p>	<b>CO-4 BTL-3</b>



MODULE 5: MIDDLEWARE SOFTWARE PATTERNS AND IIOT PLATFORMS (6L+6P)	
Publish/Subscribe Pattern: MQTT, XMPP, AMQP, DDS- Middleware Architecture- SigFox- LoRaWAN-Augmented reality- Real-World Smart Factories. <b>Practical component:</b> Develop an Augmented reality application to compare and consider suitable environment for IoT products. Develop smart energy meter and update the data in cloud. <b>Suggested Readings:</b> Implement Intercloud scenarios for real time applications.	<b>CO-5 BTL-4</b>
TEXT BOOKS	
1.	Gilchrist, Alasdair, "Industry4.0 The Industrial Internet of Things", Apress, 2017.
REFERENCE BOOKS	
1.	Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat "Industrial Internet of Things: Cyber manufacturing Systems" (Springer), 2017.
2.	Zaigham Mahmood , "The Internet of Things in the Industrial Sector: Security and Device connectivity, smart environments and Industry 4.0 (Springer), 2019.
E BOOKS	
1.	<a href="https://www.apress.com/gp/book/9781484220467">https://www.apress.com/gp/book/9781484220467</a>
MOOC	
1.	<a href="https://www.apress.com/gp/book/9781484220467">https://www.apress.com/gp/book/9781484220467</a>

COURSE TITLE	INTERNET OF MEDICAL THINGS			CREDITS	3
COURSE CODE	CSC4462	COURSE CATEGORY		L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	The Internet of Medical Things (IoMT) is an amalgamation of medical devices and applications that can connect to health care information technology systems using networking technologies.				

<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To understand the Implantable Electronics in the healthcare monitoring system.</li> <li>2. To analyze challenges in software design.</li> <li>3. To develop an application and hardware model for healthcare robotics.</li> <li>4. To learn the different sensors used for medical processing and develop a IoMT system for real-time application.</li> <li>5. To differentiate between classical Cryptography with Quantum Cryptography.</li> </ol>
<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Identify the Implantable Electronics in the healthcare monitoring system and elaborate the wearable sensors and bio sensors.</li> <li>2. Analyze the Challenges in software architecture design and their database. Apply and Understand where the IoT concept fits in the health monitoring system. Analyze industrial IoT Three tier topology and data management system</li> <li>3. Develop an application and hardware model for healthcare robotics.</li> <li>4. Explain different sensors used for medical processing and develop a IoMT system for real-time application.</li> <li>5. Differentiate classical Cryptography with Quantum Cryptography and develop a protocol with Quantum Cryptography.</li> </ol>

**Prerequisites:** Basic Knowledge in IOT

#### CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
CO-2	3	3	3	3	3	2	2	2	2	2	2	3	3	2	3
CO-3	3	3	3	3	2	1	2	1	1	2	1	3	3	2	3
CO-4	3	3	3	3	1	1	2	1	2	2	1	3	3	2	3
CO-5	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3

1: Weakly related, 2: Moderately related and 3: Strongly related

#### MODULE 1: INTEGRATION OF BIO-INTERFACES, DEVICES AND SENSORS (6L+6P)

Classification of Wearable Sensors for Health Monitoring, Types of Wearable Sensors with Activity Monitored, Fast Evolving Wearable Sensors in Healthcare, Placement of Wearable Sensor, Biosensors in Healthcare, Wireless Technology for Data Transmission, Interfacing of Sensor in BAN (Body Area Network), Power Consumption of Wearable Nodes, Implantable Devices, Common Characteristics of Medical Sensors, Sensor Evaluation Metrics, Design and Implementation of an Example System.

##### Practical component:

Design and interface wearable devices with IoT for activity monitoring Study of Power consumption level for different Bio sensors

##### Suggested Readings:

Body Area Network (BAN)

**CO-1  
BTL-3**

<b>MODULE 2: CHALLENGES IN DESIGNING SOFTWARE ARCHITECTURES (6L+6P)</b>	
<p>Overview of Web-based Systems for Biomedical Time Series Analysis, Architectural Challenges in Web-Based Biomedical Signal Analysis Software - Data Privacy, Security and User Roles- Frontend Workflow Organization- Frontend and Backend Interactions- Changes in Implementation Languages and Libraries- Database Design- Integration of Existing Data Analysis and Reporting Libraries, Requirements for Constructing a Biomedical Signal Analysis Web Platform.</p> <p><b>Practical component:</b> Collect and analysis medical data set for automation. Prepare a report for data privacy and security issues in medical information in cloud.</p> <p><b>Suggested Readings:</b> Web-based Systems for Biomedical Time Series Analysis</p>	<b>CO-2 BTL-3</b>
<b>MODULE 3: IOT AND ROBOTICS IN HEALTHCARE (6L+6P)</b>	
<p>Application of Robotics in Healthcare, Systems and Application- BIOTEX- RFID Technology, Internet of Things- Requirements-Use of IoT and Robotics in Healthcare- Open Source IoT Platforms- Internet of Nano Technology (IoNT)</p> <p><b>Practical component:</b> Simulation of Robotic based medical system application design Case study on Internet of Nano Technology (IoNT) for medical application.</p> <p><b>Suggested Readings:</b> Internet of Nano Technology (IoNT)</p>	<b>CO-3 BTL-3</b>
<b>MODULE 4: : INTERNET OF MEDICAL THINGS(6L+6P)</b>	
<p>Overview of Internet of Medical Things (IoMT)- Requirements- Remote Patient Healthcare and Health Monitoring System, Network Architecture of Internet of Medical Things, Real-Time Analysis Remote Patient Health Monitoring, Methodology and Analysis- Data Sensing and Acquisition- Sensor Interface Circuits, Physical Sensors- Pulse Rate Sensor- Heart Rate Sensor- Respiratory Sensor- ECG Sensor, Experimental Evaluation - Experimental Analysis - Security and Privacy Concerns of IoMT, Advantage and Applications of Remote Patient Monitoring, Limitations and Challenges.</p> <p><b>Practical component:</b> Design of wearable band for your desired sports person under surveillance. Case study on IoMT system security issues and challenges</p> <p><b>Suggested Readings:</b> Analyze the Internet of Medical Things (IoMT)</p>	<b>CO-4 BTL-3</b>
<b>MODULE 5: WEB OF MEDICAL THINGS (WOMT) AND QUANTUM CRYPTOGRAPHY (6L+6P)</b>	
<p>WoMT and Security, Mathematical Foundations, overview of Classical Cryptography, Quantum Cryptography - Secret-Key Distillation, Overview of Basic Protocol- Phases – Design and Analysis Communication and Computation Complexity Analysis - Attack Resistance Capability - Security Property Analysis, Overview of Improved Protocol- System Architecture- Quantum Key Generation and Distribution- Security Analysis- Experimental Analysis- Attack Resistance Capability- Security Property Analysis.</p> <p><b>Practical component:</b> Design a system for WoMT which can be used for hospital with specific application.</p> <p><b>Suggested Readings:</b> Web of Medical Things (WoMT)</p>	<b>CO-5 BTL-4</b>

TEXT BOOKS	
1.	About Ella Hassanien, Nilanjan Dey, Surekha Borra, “Medical Big Data and Internet of Medical Things: Advances, Challenges and Applications”, CRC Press, 2019.
REFERENCE BOOKS	
1.	Toshiyo Tamura , Wenxi Chen “Seamless Health Care Monitoring – Advancements in Wearable Attachable and Invisible Devices ”, Springer , 2018.
2.	Dac-Nhuong Le, Chung Van Le “Emerging Technologies for Health and Medicine ”, John Wiley & Sons, 2018.
E BOOKS	
1.	<a href="https://jwcn-eurasipjournals.springeropen.com/track/pdf/10.1186/s13638-018-1308-x">https://jwcn-eurasipjournals.springeropen.com/track/pdf/10.1186/s13638-018-1308-x</a>
MOOC	
1.	<a href="https://www.udemy.com/course/iot-based-emergency-health-care-system/">https://www.udemy.com/course/iot-based-emergency-health-care-system/</a>

### DEPARTMENTAL ELECTIVES FOR SPECIALIZATION IN CYBER SECURITY

LE	FUNDAMENTALS OF CYBER SECURITY			CREDITS
DE	CSC4278	COURSE CATEGORY	DE	L-T-P-S
	1.0	Approval Details		LEARNING LEVEL
HEME				
cal t	Second Periodical Assessment	Lab Component		
	15%	20%		
otion	This course will enable the students to explore the various cyber-attacks, practice the security tools and employ p			
e	<div>1. To outline the key components and principles of security.</div> <div>2. To explore the various attacks and management roles</div> <div>3. To apply the security policies and procedures for organizations</div> <div>4. To practice the security tools and hardening techniques</div> <div>5. To employ the penetration testing.</div>			
	<div>Upon completion of this course, the students will be able to</div> <div>1. Outlinethekeycomponentsandprinciplesofsecurity</div> <div>2. Exploresethesecurityattacksandmanagementroles.</div> <div>3. Applythecybersecuritypoliciesandproceduresfororganizations.</div> <div>4. Practicethesecuritytoolsandhardeningtechniques</div> <div>5. EmploythePenetrationTestingandexploretheNextGenerationSecurity.</div>			

**Cryptography and Network Security****MAPPING**

1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO -10	PO-11	PO-12	PSO
	3	2	2	3	2	2	1	1	-	-	1	2
	3	2	2	3	2	2	1	2	-	2	2	3
	3	2	2	3	2	1	1	2	-	2	2	2
	3	2	2	3	2	1	1	2	-	2	2	2
	3	3	2	3	2	2	1	-	-	1	2	2

1: Weakly related, 2: Moderately related and 3: Strongly related

**INTRODUCTION TO CYBER SECURITY****(12)**

Cyber Security, Need for security, Concept of Cyber Space, Cyber Crimes and Cyber-attack. Fundamental security principles and vulnerability. Key Security triad – Confidentiality, Integrity and Availability. Key components of cyber security network architecture. Introduction to basic Security Management and Policy. Authorization, Access control, Identification and Accounting.

**Content:**

Analysis of cyber-attacks using Wireshark.

**Outcomes:**

Understand security

**SECURITY ATTACKS, PRINCIPLES AND MANAGEMENT****(12)**

Identify different classes of security attacks - active and passive. Impact of attacks on an organization and individuals. Principles of security architecture. Apply cybersecurity architecture principles. Cyber security models (the CIA triad, the star model, the Parkerian hexad). Threats and attacks by Hackers - The Reconnaissance Phase: Active and Passive Scanning Techniques. Risk Management and Strategies - The Risk Management Framework (RMF). Cyber security Management concepts – Security Governance and its components, models and functions.

**Content:**

Analysis of cyber-attacks using Wireshark.

**Outcomes:**

Understand Security: Principles, Techniques, and Applications

**SECURITY PLANS, POLICIES AND PROCEDURES****(12)**

Develop security policy, General security expectations, roles and responsibilities in the organization – Stakeholders. Cyber security standards and Certification and accreditation (C&A) process. Audit goals - Updating and auditing cyber security procedures. Implement organization's cyber security policy to actual practices.

**Content:**

Develop policies using tcpdump, dumpcap using Wireshark.

**Outcomes:**

Understand cyber security standards

**VIEW OF SECURITY COUNTERMEASURE TOOLS****(12)**

key security tools including firewalls, anti-virus and cryptography – Identify security tools and hardening techniques for attacks.

measure tools and techniques - Encryption standards - Modern Methods - Legitimate versus Fraudulent Encryption Methods. Threat and Risk exposure - Determine the organization's exposure to internal threats - Evaluate the risk of external security threats.

**ent:**

and reporting using Wireshark.

**gs:**

countermeasures and protection schemes

**SECURITY TESTING, DIGITAL FORENSICS AND NEXT GENERATION SECURITY****(12)**

ing – Penetration testing. System Level Solutions -

n System (IDS) and Intrusion Protection System (IPS). Basic Concept of Ethical Hacking.

Cyber Crime – Identity Theft, Cyber Stalking and Investment fraud. Introduction to digital forensics - Digital Forensics Tools and Investigative Process. Introduction to Next-Generation Firewall – Preventing Infection and Finding Infected Hosts. Smart Policies for

**ent:**

ion Testing) using Wireshark.

**gs:**

digital forensics

TEXTBOOKS	
1.	Lawrence C. Miller, "Cybersecurity for Dummies" - Palo Alto Networks, by John Wiley & Sons, Inc., 2 <sup>nd</sup> Edition, 2016.
2.	William Stallings, "Effective Cybersecurity: A Guide to Using Best Practices and Standards", Addison-Wesley Professional Publishers, 1 <sup>st</sup> Edition, 2018.
REFERENCE BOOKS	
1.	Raef Meeuwisse, "Cybersecurity for Beginners", Cyber Simplicity Publications, 2 <sup>nd</sup> Edition, 2017.
2.	Mehdi Khosrow-Pour, DBA, Information Resources Management Association, USA, "Cyber security and threats: concepts, methodologies, tools, and applications", IGI Global, Vol. 1, 2018.
EBOOKS	
1.	<a href="http://www.uou.ac.in/sites/default/files/slm/Introduction-cyber-security.pdf">http://www.uou.ac.in/sites/default/files/slm/Introduction-cyber-security.pdf</a>
MOOC	
1.	<a href="https://www.edx.org/course/cybersecurity-fundamentals">https://www.edx.org/course/cybersecurity-fundamentals</a>
2.	<a href="https://www.coursera.org/specializations/cyber-security">https://www.coursera.org/specializations/cyber-security</a>
3.	<a href="https://www.udemy.com/topic/cyber-security/">https://www.udemy.com/topic/cyber-security/</a>

COURSE TITLE	CYBERSECURITY ALGORITHMS			CREDITS	3
COURSE CODE	CSC4279	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0

Version	1.0	Approval Details		LEARNING LEVEL	BTL-3										
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment	Lab Component			ESE										
15%	15%	20%			50%										
Course Description	This course will enable the students to employ symmetric and asymmetric cipher cryptography algorithms, practice data integrity algorithms and machine learning algorithms for cyber security.														
Course Objective	1. To use the symmetric cipher cryptography algorithms. 2. To employ the asymmetric cipher cryptography algorithms. 3. To apply the cryptanalysis algorithms. 4. To practice data integrity algorithms. 5. To use machine learning algorithms for cyber security.														
Course Outcome	Upon completion of this course, the students will be able to 1. Use the symmetric cipher Cryptography algorithms. 2. Employ the asymmetric cipher Cryptography algorithms. 3. Apply the Cryptanalysis algorithms. 4. Practice Data Integrity algorithms. 5. Use machine learning algorithms for cyber security.														
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO -11	PO- 12	PSO -1	PSO -2	PSO -3
CO-1	3	3	2	2	3	2	2	1	1	-	-	1	2	3	3
CO-2	3	3	2	2	3	2	2	1	2	-	2	2	2	3	3
CO-3	3	3	2	2	3	2	1	1	2	-	2	2	2	3	3
CO-4	3	3	2	2	3	2	1	1	2	-	2	2	2	3	3
CO-5	3	3	3	2	3	2	2	1	-	-	1	2	2	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE1:SYMMETRICCIPHERS (12)															
Cryptography – Private key Cryptography - Classical Encryption Techniques - Substitution Techniques -Transposition Techniques- Rotor Machines- Steganography - Data Encryption Standard- AdvancedEncryptionStandard-MultipleEncryptionand TripleDES PracticalComponent: 1. TranspositionTechnique 2. AdvancedEncryptionStandard. SuggestedReadings:StreamCiphers													CO-1  BTL-3		

MODULE2:ASYMMETRICCIPHERS		(12)
Public-Key Cryptography - RSA algorithm - Diffie-Hellman Key Exchange - Elgamal Cryptographic System -Elliptic Curve Arithmetic - Elliptic Curve Cryptography - Pseudorandom Number Generation based onasymmetriccipher. <b>PracticalComponent:</b> 1. RSA algorithm 2. EllipticCurveCryptography <b>SuggestedReadings:</b> ApplicationsofRSAAlgorithm.		<b>CO-2</b> <b>BTL-3</b>
MODULE3:CRYPTANALYTICMETHODS		(12)
General Cryptanalytic Methods – Brute-Force - Rainbow Tables - Slide Attacks - Matsui’s Algorithms -Linear Expressions for S-Boxes - Linear Cryptanalysis of DES - S-Box Differentials - Boomerang Attack <b>PracticalComponent:</b> 1. BruteForceAlgorithm 2. BoomerangAttack <b>SuggestedReadings:</b> DifferentialCryptanalysisCode		<b>CO-3</b> <b>BTL-3</b>
MODULE4:DATAINTEGRITYALGORITHMS		(12)
Hash Functions – Two Simple Hash Function – Hash Function based on Cipher Block Chaining – SecureHash Function – SHA-3 – Message Authentication Code – HMAC – CMAC – Digital Signatures - EllipticCurveDigitalSignatureAlgorithm-RSA-PSSDigitalSignatureAlgorithm <b>PracticalComponent:</b> 1. SHA3Algorithms 2. CRSA-PSSDigitalAlgorithm <b>SuggestedReadings:</b> PseudorandomNumberGenerationUsingHashFunctionsandMACs		<b>CO-4</b> <b>BTL-3</b>
MODULE5:MACHINELEARNINGINCYBERSECURITY		(12)
Algorithms in Machine learning - Abnormalities in URLs – Detecting Malicious Pages using Heuristicalgorithm-DetectingMaliciousURLsusingmachinelearning–CrackingCAPTCHAusingAI–SpamDetection. <b>PracticalComponent:</b> 1. MaliciousURLs 2. E-MailSpamming <b>SuggestedReadings:</b> NetworkAnomalydetectionusing“k”means.		<b>CO-5</b> <b>BTL-3</b>
TEXTBOOKS		
1.	ByWilliam,Stallings,CryptographyandNetworkSecurity-PrinciplesandPractice,7thEdition, Pearson,2017.	
2.	ChristopherSwenson,“ModernCryptanalysisTechniquesforAdvancedCodeBreaking”,2016.	
REFERENCE BOOKS		



1.	HelenF.Gaines,“Cryptanalysis:ASTudyofCiphersandTheirSolution”,DiverPublications,2014.
2.	SomaHalder,SinanOzdemir,“Hands-OnMachineLearningforCybersecurity”,BIRMINGHAM,2018.
<b>E-BOOK</b>	
1	<a href="https://tsoungui.fr/ebooks/CYBER-Security.pdf">https://tsoungui.fr/ebooks/CYBER-Security.pdf</a>
<b>MOOC</b>	
1.	<a href="https://www.coursera.org/specializations/applied-crypto">https://www.coursera.org/specializations/applied-crypto</a>

**SEMESTER-V**

COURSE TITLE			CYBERSECURITYRISKMANAGEMENTAND MITIGATION								CREDITS			3	
COURSE CODE			CSC4362			COURSE CATEGORY			DE		L-T-P-S			2-0-2-0	
Version			1.0			Approval Details					LEARNING LEVEL			BTL-3	
ASSESSMENT SCHEME															
First Periodical Assessment			Second Periodical Assessment			Lab Component								ESE	
15%			15%			20%								50%	
Course Description			This course will enable the students to identify the various IT assets, to elaborate the security policies and counter measures and the various risk mitigation process.												
Course Objective			1. To identify the various IT assets. 2. To analyze and demonstrate various threat models. 3. To create a checklist for risk assessment. 4. To elaborate the security policies and counter measures. 5. To explain the various risk mitigation processes.												
Course Outcome			Upon completion of this course, the students will be able to 1. IdentifythevariousITassets 2. Analyzethethreatsanddemonstratevariousthreatmodels 3. Createachecklistforriskassessment 4. Elaboratethesecuritypoliciesandcountermeasures 5. ExplainthevariousRiskmitigationprocesses.												
Prerequisites:															
CO, PO AND PSO MAPPING															
CO	PO - 1	PO- 2	PO-3	PO-4	PO- 5	PO-6	PO-7	PO-8	PO- 9	PO - 10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3

CO-1	3	3	2	2	3	2	2	1	1	-	-	1	3	3	2
CO-2	3	3	2	2	3	2	2	1	2	-	2	2	3	2	3
CO-3	3	3	2	2	3	2	1	1	2	-	2	2	3	1	2
CO-4	3	3	2	2	3	2	1	1	2	-	2	2	3	1	3
CO-5	3	3	3	2	3	2	2	1	-	-	1	2	3	2	2

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE1:ITASSETS (12)														
Asset Characterization and Identification – Asset Categorization – IT asset management – Asset Lifecycle–IT Asset ManagementProcess– BenefitsofAssetmanagement. <b>PracticalComponent:</b> CreateCatalogoninformationandphysicalassets. <b>SuggestedReadings:</b> <a href="https://www.ivanti.com/blog/what-is-it-asset-management">https://www.ivanti.com/blog/what-is-it-asset-management</a>														<b>CO-1</b>  <b>BTL-2</b>
MODULE2:THREATANALYSIS (12)														
ThreatvsHazards–ThreatModels–STRIDE,PASTA,AttackTrees,OCTAVE,SecurityCards– QuantitativeThreatModeling-PredictiveThreatAssessment. <b>PracticalComponent:</b> Identifythethreatsourcesorevents. <b>SuggestedReadings:</b> <a href="https://insights.sei.cmu.edu/sei_blog/2018/12/threat-modeling-12-available-methods.html">https://insights.sei.cmu.edu/sei_blog/2018/12/threat-modeling-12-available-methods.html</a>														<b>CO-2</b>  <b>BTL-3</b>
MODULE3:RISKASSESSMENTANDANALYSIS (12)														
What is risk? - Cyber Risk Assessment – Need to perform Risk Assessment – Process to perform Riskassessment– RiskanalysisProcess– RiskassessmentChecklist. <b>PracticalComponent:</b> DeterminethepotentialrisksposestotheassetsmentionedintheAssetCatalog. Define the risk tolerance of an organization such as to accept, transfer, refuse and mitigateriskbasedonthe riskanalysis. <b>SuggestedReadings:</b> <a href="https://www.thesslstore.com/blog/cyber-risk-assessment/">https://www.thesslstore.com/blog/cyber-risk-assessment/</a>														<b>CO-3</b>  <b>BTL-3</b>
MODULE4:SECURITYPOLICIESANDCOUNTER MEASURES (12)														
Risk management process – Counter measures for IT risks. Prioritization of Risks – Communication ofpriorities – Security policy introduction – Key role of policies in security program- Benefits of havingproperpolicies-RoleofPoliciesinSecurityprogram–RoleofCountermeasuresinSecurityprograms– GoalsofsecuritypoliciesandCountermeasures. <b>PracticalComponent:</b> FindtheriskleveltoPrioritizetherisktotakecountermeasures. <b>SuggestedReadings:</b> <a href="https://www.upguard.com/blog/cyber-security-risk-assessment">https://www.upguard.com/blog/cyber-security-risk-assessment</a>														<b>CO-4</b>  <b>BTL-2</b>
MODULE5:RISKMITIGATION (12)														

CO-5  
BTL-3

Addressing people risks – Personnel and training – Security Awareness training. Addressing process risk–Operational security risks–Insecure Software development lifecycle risk–Physical security risk–Third party relationship risks. Addressing Technology Risks–Network risk–Platform risk–Application layer risk.

Suggested Activities: Identify the monitoring and preventive measures to mitigate various types of risks to create cyber hygiene in an organization.

Suggested Readings: <https://www.cooperative.com/programs-services/bts/Documents/guide-cybersecurity-mitigation-plan.pdf> <https://itsecurity.uiowa.edu/sites/itsecurity.uiowa.edu/files/sampleriskassessmentreport.pdf>

**REFERENCE BOOKS**

1.	Thomas L Norman., “Risk analysis and Security countermeasure selection”, 2 <sup>nd</sup> Edition, CRC press, 2016.
2.	<a href="#">Christopher J Hodson</a> “Cyber Risk Management: Prioritize Threats, Identify Vulnerabilities and Apply Controls”, 2017.
3.	Ariel Evans, “Managing Cyber Risk”, 1 <sup>st</sup> Edition, Routledge, 2019

**EBOOKS**

1.	<a href="https://www.honeywellprocess.com/en-US/online_campaigns/IndustrialCyberSecurity/Pages/document/Risk%20Management%20eBook_Part%201.pdf">https://www.honeywellprocess.com/en-US/online_campaigns/IndustrialCyberSecurity/Pages/document/Risk%20Management%20eBook_Part%201.pdf</a>
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**MOOC**

1.	<a href="https://www.coursera.org/lecture/cyber-security-domain/information-security-governance-and-risk-management-FLyKS">https://www.coursera.org/lecture/cyber-security-domain/information-security-governance-and-risk-management-FLyKS</a>
2.	<a href="https://www.udemy.com/course/cyber-security-risk-management/">https://www.udemy.com/course/cyber-security-risk-management/</a>

COURSE TITLE	CYBERSECURITY IN CRITICAL INFRASTRUCTURE			CREDITS	3
COURSE CODE	CSC4363	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component			ESE
15%	15%	20%			50%
Course Description	This course will enable the students to explore the cyber critical infrastructure and the security in WSN and to use the evaluation methods to critical information infrastructure.				

<b>Course Objective</b>	1. To outline the cyber critical infrastructure 2. To explore the critical infrastructure modeling 3. To use the evaluation methods to critical information infrastructure 4. To explore the security in wireless sensor networks 5. To outline the security in CPS.														
<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. OutlinetheCyberCriticalinfrastructure 2. ExploretetheCriticalInfrastructureModeling 3. UsetheEvaluationmethodstoCriticalinformationinfrastructure 4. ExploretetheSecurityinWirelessSensorNetworks 5. OutlinetheSecurityinCyberPhysicalSystem(CPS)														
<b>Prerequisites: Nil</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO-1	3	3	2	2	3	2	2	1	1	-	-	1	3	3	2
CO-2	3	3	2	2	3	2	2	1	2	-	2	2	3	2	3
CO-3	3	3	2	2	3	2	1	1	2	-	2	2	3	1	2
CO-4	3	3	2	2	3	2	1	1	2	-	2	2	3	1	3
CO-5	3	3	3	2	3	2	2	1	-	-	1	2	3	2	2
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE1:CRITICALINFRASTRUCTURE</b>														<b>(12)</b>	
Critical Infrastructure – Challenges – Risk Analysis - Tools - Multi Criterion Tools – CARVER – MSRAM –Vulnerability Assessment- Security Audit – Delphi Method – Design Basis Threat (DBT), Delphi Method –FaultTreeAnalysis. <b>PracticalComponent:</b> 1. CARVER 2. DelphiMethod <b>SuggestedReadings:</b> AdversarialVulnerabilityAssessments														<b>CO-1</b> <b>BTL-3</b>	
<b>MODULE2:CRITICALINFRASTRUCTUREMODELING</b>														<b>(12)</b>	

Modeling and Simulation – Requirements - Topological analysis – Functional Analysis – Agent based approach – Multilayer approach – Graph Based Technique - Agent based modeling and simulation. <b>Practical Component:</b> 1. Topological analysis 2. Agent based simulation <b>Suggested Readings:</b> DIESI Sproject		<b>CO-2</b>  <b>BTL-3</b>
<b>MODULE3:EVALUATION OF CRITICAL INFORMATION INFRASTRUCTURE</b>		<b>(12)</b>
Dependability–Security Evaluation approaches–Financial Infrastructure Protection–Critical Information Infrastructure – Design Requirement - Peer to Peer Model – Evaluation - Mitigation – Node Crashes– SCADA data modification. <b>Practical Component:</b> 1. Peer to Peer Model 2. SCADA data modification <b>Suggested Readings:</b> Metric-based FIP trustworthiness evaluation		<b>CO-3</b>  <b>BTL-3</b>
<b>MODULE4:Wireless Sensor Security</b>		<b>(12)</b>
Wireless Sensor Networks – Issues – Secure Data aggregation – Computing and verifying an approximate median – GC Approach – Attack Resilient Median Computation – Geographical analysis - Privacy in Data Aggregation-Twin Key Agreement–Data Aggregations. <b>Practical Component:</b> 1. GC Approach 2. Twin Key Agreement <b>Suggested Readings:</b> Greenwald et.al., approximate Median algorithm		<b>CO-4</b>  <b>BTL-3</b>
<b>MODULE5:CYBERPHYSICAL SYSTEM</b>		<b>(12)</b>
CyberPhysical System– Architecture– Key Management-Security-Wearable, Appliances– Port Attack – CPS Reference Model – Protection of CPS Data – Access Control of CPS – National Security Concerns with CPS-Security in IoT -CPS and IoT Security. <b>Practical Component:</b> 1. Smart Car hacking 2. IoT Device Hacking <b>Suggested Readings:</b> CPS Key Management Challenges and Open Research Issues		<b>CO-5</b>  <b>BTL-3</b>
<b>TEXTBOOKS</b>		
1.	Francesco Flammini, "Critical Infrastructure Security: Assessment, Prevention, Detection, Response", WIT Press, 2012.	

2.	ThomasA.Johnson,“Cybersecurity:ProtectingCriticalInfrastructuresfromCyberAttackandCyber warfare”,CRCPress, 2018.
<b>REFERENCE BOOKS</b>	
1.	GeorgeS.Oreku,TamaraPazynyuk,“SecurityinWirelessSensorNetworks”,Springer,2016.
2.	HoubingSong,GlennA.Fink,SabinaJeschke,“SecurityandPrivacyinCyber-PhysicalSystems: Foundations,Principles,andApplications”,WILEY,2017.
<b>E-BOOK</b>	
1	<a href="https://arxiv.org/ftp/arxiv/papers/1301/1301.5065.pdf">https://arxiv.org/ftp/arxiv/papers/1301/1301.5065.pdf</a>
2	<a href="https://ercim-news.ercim.eu/en89/books/critical-infrastructure-security-assessment-prevention-detection-response">https://ercim-news.ercim.eu/en89/books/critical-infrastructure-security-assessment-prevention-detection-response</a>
<b>MOOC</b>	
1.	<a href="https://www.coursera.org/learn/enterprise-infrastructure-security">https://www.coursera.org/learn/enterprise-infrastructure-security</a>

**SEMESTER-VI**

COURSE TITLE	CYBER FORENSICS, INVESTIGATIONS AND LAWS			CREDITS	3
COURSE CODE	CSC4378	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component			ESE
15%	15%	20%			50%
Course Description	This course will enable the students to understand the types of cyber crimes, explore and use various cyber forensics, investigation and cyber evidence management techniques.				
Course Objective	1. To outline the cyber crime and its types 2. To explore the cyber Forensics techniques 3. To use the Cyber Investigation Techniques 4. To explore the Cyber Evidence Management Techniques 5. To outline the Cyber Laws in India				
Course Outcome	Upon completion of this course, the students will be able to 1. Outline the Cyber crime and its types 2. Explore the Cyber Forensics Techniques 3. Use the Cyber Investigation Techniques 4. Explore the Cyber Evidence Management Techniques 5. Outline the Cyber Laws in India				
Prerequisites: Nil					
CO, PO AND PSO MAPPING					

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	3	2	2	1	1	-	-	1	2	3	3
CO-2	3	3	2	2	3	2	2	1	2	-	2	2	3	3	3
CO-3	3	3	2	2	3	2	1	1	2	-	2	2	2	3	3
CO-4	3	3	2	2	3	2	1	1	2	-	2	2	2	3	3
CO-5	3	3	3	2	3	2	2	1	-	-	1	2	2	3	3
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE1:CYBERCRIME</b>														<b>(12)</b>	
White collar crimes – Economic offense – cyber stalking - cyber extortion – cyber terrorism - cyberespionage - cyber warfare –cyber weapons - Data frauds – cybersquatting - Child Pornography - obscenemessages - Job Racketing - Marketing and Advertisement Rackets - Nigerian frauds- pay per click scams –webdefacement-ATMfrauds-IPspoofing. <b>PracticalComponent:</b> 1. IPSpoofing 2. Key logger 3. EmailFraud <b>SuggestedReadings:</b> TelecommunicationFraud-Softwarepiracy														<b>CO-1 BTL-3</b>	
<b>MODULE2:CYBERFORENSICS</b>														<b>(12)</b>	
Digital device – Hard disk –Disk characteristics - Disk imaging - Data Carving – techniques - commercialpiracy - soft lifting – Steganography – Network components - Port scans - Wireshark - pcap analysis -TrojansandBackdoors– Botnets-DoS– DDoSAttacks-HoneyPots. <b>PracticalComponent:</b> 1. PcabfileAnalysis–CaseStudy 2. NetworkPortScan–Forensics <b>SuggestedReadings:</b> ActiveandPassiveSniffing														<b>CO-2 BTL-3</b>	
<b>MODULE3::CYBERINVESTIGATION</b>														<b>(12)</b>	
ConceptsofInvestigation-cyberinvestigation,NetworkInvestigation-Investigatingauditlogs- Investigating Web attacks - Investigating Computer Intrusions - Profiling – Cyber Criminal profiling –Stylometric <b>PracticalComponent:</b> 1. InvestigatingAudit Logs 2. InvestigatingWebattacks <b>SuggestedReadings:</b> Surveyingandpreservingdigitalcrimescene														<b>CO-3 BTL-3</b>	
<b>MODULE4:EVIDENCEMANAGEMENT INVESTIGATION</b>														<b>(12)</b>	

Evidence – Digital Evidence - Types – physical evidence – Real evidence – Circumstantial evidence –network evidence- digital evidence– Evidence collection – Evidence Analysis - Contextual Information –EvidenceManagement. <b>PracticalComponent:</b> 1. DigitalEvidenceAnalysis 2. NetworkAnalysis <b>SuggestedReadings:</b> InvestigativeReconstructionwithDigitalEvidence		<b>CO-4</b> <b>BTL-3</b>
<b>MODULE5:CYBERLAWSANDAUTHORITIES (12)</b>		
InformationTechnologyAct2000–Digitalsignature-ElectronicGovernance- Secureelectronicrecords -Regulationofcertifyingauthorities–CERNTin- Electronicsignaturecertificates-Penaltiescompensation <b>PracticalComponent:</b> 1.DigitalSignature <b>SuggestedReadings:</b> IPRLaws		<b>CO-5</b> <b>BTL-3</b>
<b>TEXTBOOKS</b>		
1.	MarjieT.Britz,“ComputerForensicsandCyberCrime”,Pearson,2013.	
2.	GarimaTiwari,“UnderstandingLaws–CyberLawsAndCyberCrimes”,LexisNexis,2014.	
<b>REFERENCE BOOKS</b>		
1.	ChuckEasttom,JeffTaylor,“ComputerCrime,Investigation,andtheLaw”,CourseTechnology,2018.	
2.	EoghanCasey,“DigitalEvidenceandComputerCrime:ForensicScience,Computers,andthe Internet”,EoghanCasey,2018.	
<b>E-BOOK</b>		
1	http://index-of.es/Miscellaneous/LIVRES/Syngress.Cyber.May.2014.ISBN.0128007435.pdf	
<b>MOOC</b>		
1.	<a href="https://www.coursera.org/lecture/cyber-conflicts/introduction-to-cybercrime-and-fundamental-issues-xndSq">https://www.coursera.org/lecture/cyber-conflicts/introduction-to-cybercrime-and-fundamental-issues-xndSq</a>	



COURSE TITLE	BLOCKCHAIN AND CRYPTOCURRENCIES FUNDAMENTALS			CREDITS	3
COURSE CODE	CSC4379	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component			ESE
15%	15%	20%			50%
Course Description	This course will enable the students to understand the types and applications of blockchain, acquire knowledge about cryptocurrencies and its functions and to familiarize with cryptography and consensus algorithms.				
Course Objective	1. To discuss and describe the history, types and applications of Blockchain 2. To gain familiarity with cryptography and Consensus algorithms 3. To grasp what is Cryptocurrency and how it functions 4. To acquire knowledge about Bitcoin and Ethereum 5. To understand role of cryptography in Blockchain Technology				
Course Outcome	Upon completion of this course, the students will be able to 1. Contentedly discuss and describe the history, types and applications of Blockchain 2. Gains familiarity with cryptography and Consensus algorithms 3. Grasp what is Cryptocurrency and how it functions 4. Acquire knowledge about Bitcoin and Ethereum 5. Understand role of cryptography in Blockchain Technology				
Prerequisites: DBMS, Cryptography, Computer Networks					

CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	3	2	2	1	1	-	-	1	2	3	3
CO-2	3	3	2	2	3	2	2	1	2	-	2	2	2	3	3
CO-3	3	3	2	2	3	2	1	1	2	-	2	2	2	3	3
CO-4	3	3	2	2	3	2	1	1	2	-	2	2	2	3	3
CO-5	3	3	3	2	3	2	2	1	-	-	1	2	2	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE1:INTRODUCTIONTOBLOCKCHAIN														(12)	
<p>Distributed DBMS – Limitations of Distributed DBMS, Introduction to Block chain – History, Definition, DistributedLedger,BlockchainCategories–Public,Private,Consortium,BlockchainNetworkandNodes,Peer-to-PeerNetwork, Mining Mechanism, Generic elements of Blockchain, Features of Blockchain, and Types of Blockchain.</p> <p><b>PracticalComponent:</b></p> <ol style="list-style-type: none"> <li>1. Create a Public Ledger vs. Private Ledger with the various attributes like Access, Network Actors, Nativetoken,Security,Speedandexamples.</li> <li>2. How would a blockchain help in processing insurance claims of the insurance industry, which suffers from anumber of issues like fraud, contract complexity, human error, information flows in reinsurance and claimsprocessing?Use variousaspectstosummarizethesolution.</li> </ol> <p><b>SuggestedReadings:</b></p> <p><a href="https://blockchainhub.net/blockchains-and-distributed-ledger-technologies-in-general/">https://blockchainhub.net/blockchains-and-distributed-ledger-technologies-in-general/</a><a href="https://blog.todotnet.com/2019/03/solving-real-world-problems-with-distributed-ledger-technology/">https://blog.todotnet.com/2019/03/solving-real-world-problems-with-distributed-ledger-technology/</a></p>														CO-1 BTL-3	

**MODULE2: CRYPTOGRAPHY AND BLOCKCHAIN ARCHITECTURE****(12)**

Cryptography, Encryption – Public Key, Private Key, Symmetric Encryption, Asymmetric Encryption, Message Signing, Private VS Public Blockchains, Internet of Blockchains, Blockchain Architecture – Block, Hash, Distributer P2P, Structure of Blockchain, Data Distribution of Blockchain, Consensus, Consensus Algorithms - Proof of Work (PoW), Proof of Stake (PoS), Proof of Elapsed Time (PoET).

**Practical Component:**

Decrypt the given ciphertext to obtain the plaintext using Symmetric cryptographic algorithm.

Implement SHA-256 cryptographic algorithm to retrieve the cryptographic hash or signature for the given message.

**Suggested Readings:**

<https://s3.eu-west-2.amazonaws.com/blockchainhub.media/Blockchain+Handbook.pdf>  
<https://www.movable-type.co.uk/scripts/sha256.html>

**MODULE3: CRYPTOCURRENCY BASICS AND BITCOIN****(12)**

Introduction to Cryptocurrencies, Tokens – Cryptosecurities, Players involved - Cryptocurrency Users, Miners, Cryptocurrency Exchanges, Trading platforms, Wallet providers, Coin inventors, Coin offerors. Distributed Ledger Technology (DLT), Bitcoin (BTC) Genesis Block, Buy Bitcoin, Transactions, Unspent Transaction Output (UTXO), Bitcoin Mining, Value of Bitcoin, Advantages and Disadvantages,

**Practical Component:**

Find the exchange rate for Bitcoin with the help of necessary data.

Find the number of Bitcoins by applying the equation over the defined values.

**Suggested Readings:**

<https://www.investopedia.com/tech/most-important-cryptocurrencies-other-than-bitcoin/>  
<https://intelligenttrading.org/guides/cryptoasset-classifications/>

**MODULE4: ETHEREUM CRYPTOCURRENCY****(12)**

Ethereum (ETH) – Smart Contracts, UTXO, Types of Accounts - Externally controlled accounts and contract account, Merkle Tree, Ether, Components of Ethereum Transaction, DApps, Hard & Soft Fork, Bitcoin Stack vs Ethereum Stack.

**Practical Component:**

Calculate the 'number of ethers' for the transaction of gas limit for the scenario in which the sender sets the gas limit to 50,000 and a gas price to 20 gwei.

Represent the Ethereum Merkle Tree for the given list of Transactions.

**Suggested Readings:**

<https://medium.com/@preethikasireddy/how-does-ethereum-work-anyway-bd506369>  
<https://medium.com/@jochasinga/implementing-a-bitcoin-merkle-tree-cb0af3d53ec9>

**MODULE5: USE CASES IN BLOCKCHAIN****(12)**

Blockchain in Supply Chain - Blockchain in Manufacturing - Blockchain in Automobiles - Blockchain in Healthcare - Blockchain in Cybersecurity - Blockchain in Financial Industry

**Practical Component:**

Do a survey on the various real-time applications in cryptocurrencies (Bitcoin and Ethereum) and give pictorial representation of the same by considering the common aspects.

**Suggested Readings:** <https://builtin.com/blockchain/blockchain-applications>

REFERENCE BOOKS	
1.	Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2 <sup>nd</sup> Edition, Packt Publishing Ltd, March 2018.
2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies", Princeton University Press, 2016.
EBOOKS	
1.	<a href="https://users.cs.fiu.edu/~prabakar/cen5079/Common/textbooks/Mastering_Blockchain_2nd_Edition.pdf">https://users.cs.fiu.edu/~prabakar/cen5079/Common/textbooks/Mastering_Blockchain_2nd_Edition.pdf</a>
2.	<a href="https://www.lopp.net/pdf/princeton_bitcoin_book.pdf">https://www.lopp.net/pdf/princeton_bitcoin_book.pdf</a>
3.	<a href="https://www.blockchainexpert.uk/book/blockchain-book.pdf">https://www.blockchainexpert.uk/book/blockchain-book.pdf</a>
MOOC	
1.	<a href="https://www.coursera.org/specializations/introduction-to-blockchain">https://www.coursera.org/specializations/introduction-to-blockchain</a>
2.	<a href="https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency">https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency</a>

**SEMESTER-VII**

COURSE TITLE	OFFENSIVE, DEFENSIVE CYBER SECURITY TECHNIQUES			CREDITS	3
COURSE CODE	CSC4463	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component			ESE
15%	15%	20%			50%
Course Description	This course will enable the students to identify the various IT assets, to elaborate the security policies and counter measures and the various risk mitigation process.				
Course Objective	1. To explore the ethical hacking and penetration testing skills 2. To examine organization's readiness for threat hunting 3. To develop the vulnerability assessment skills 4. To explore the key concepts of malware analysis 5. To develop your SIEM security analyst skills				

<b>Course Outcome</b>	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Explore the ethical hacking and penetration testing skills</li> <li>2. Examine organization's readiness for threat hunting</li> <li>3. Develop the vulnerability assessment skills</li> <li>4. Explore the key concepts of malware analysis</li> <li>5. Develop your SIEM security analyst skills</li> </ol>
<b>Prerequisites:</b> Basics of computer networks and Information Security	

## PO AND PSO MAPPING

PO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO -10	PO-11	PO-12	PSO-1	PSO-2
1	3	3	3	2	3	3	2	3	1	-	2	3	2	3
2	3	3	3	2	3	2	2	2	2	-	2	3	2	3
3	3	3	3	2	3	2	1	2	2	-	2	3	2	3
4	3	3	3	2	3	2	1	2	2	-	2	3	2	3
5	3	3	3	2	3	2	2	2	-	-	2	2	2	3

1: Weakly related, 2: Moderately related and 3: Strongly related

## MODULE1: ETHICAL HACKING AND PENETRATION TESTING

(12)

Introduction - penetration Testing - Reconnaissance - Scanning - Exploitation - Web-Based Exploitation Maintaining Access with Backdoors and Rootkits.

**Practical Component:**

- 1. Backtrack Linux
- 2. The harvester: discovering and leveraging E-mail addresses

**Suggested Readings:**

Hacking Topologies

CO  
BT

## MODULE2: OFFENSIVE: CYBER THREAT HUNTING

(12)

Introduction – Threat Hunting and its goals - Threat Hunting Requirements – Hunting Process – Threat Hunting Techniques-

**Practical Component:**

- 1. Proactive Detection of malicious activities
- 2. Proactive Detection of malicious E-mail

**Suggested Readings:**

Threat hunting maturity model

CO  
BT

## MODULE3: IDENTIFYING AND FIXING VULNERABILITIES

(12)

Computer Network Vulnerabilities: Sources of Vulnerabilities, Vulnerability Assessment; Vulnerability Identification and Assessment : Hardware, Software Humanware Policies, Procedures, and Practices

**Practical Component:**

CO

. Identify the assets . Detection of vulnerabilities <b>Suggested Readings:</b> Vulnerability assessment tools	BT
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<b>MODULE 4: INCIDENT RESPONSE AND MALWARE ANALYSIS</b>	<b>(12)</b>
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Incident response – Production, concepts, tools and techniques; Learning Malware Analysis: Explore the concepts, tools, and techniques to analyze and investigate malware <b>Practical Component:</b> . Malware threat analysis . Detection of incident responses <b>Suggested Readings:</b> Investigate malware threats	CO BT
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<b>MODULE 5: SECURITY INFORMATION AND EVENT MANAGEMENT</b>	<b>(12)</b>
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Production; deployment of SIEM technologies - monitor, identify, document, and respond to security threats, alerts Management: implement SIEM products; SIEM capabilities for business intelligence; Real-world case studies <b>Practical Component:</b> . Identify the security threats . Event monitoring <b>Suggested Readings:</b> Developing incident response program	CO BT
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TEXTBOOKS	
1.	Patrick Engebretson, The basics of hacking and penetration testing, Syngress, 2011
2	Michael Collins, Threat Hunting, O'Reilly Media, Inc., 2018
3	Joseph Migga Kizza, A Guide to Computer Network Security, Springer, 2009
4	David Miller, Shon Harris, Allen Harper, Stephen Vandyke, Chris Blask, Security Information and Event Management (SIEM) Implementation, 2010
REFERENCE BOOKS	
1.	Monnappa KA, Learning Malware Analysis, Kindle edition, 2018
2.	Jae K. Shim, Anique A. Qureshi, Joel G. Siegel, The International Handbook of Computer Security, Glenlake Publications, 2000
MOOC	
1.	<a href="https://www.nist.gov">https://www.nist.gov</a>
2.	<a href="https://www.comperitech.com">https://www.comperitech.com</a>

COURSE TITLE	CYBERSECURITYSTANDARDS,POLICIESANDPRACTICES										CREDITS	3			
COURSE CODE	CSC4464				COURSE CATEGORY				DE		L-T-P-S		2-0-2-0		
Version	1.0				Approval Details						LEARNING LEVEL		BTL-3		
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment				Lab Component								ESE		
15%	15%				20%								50%		
Course Description	This course will enable the students to understand the various security concepts, information security policies and framework, apply cyber defense techniques and analyze the security procedures.														
Course Objective	1. To describethesecurityconcepts. 2. To applycyberdefensetechniques. 3. To describeinformationsecuritypolicyandframework 4. To summarizevarioussecuritypolicies. 5. To analysetheinformationsecurityprocedures.														
Course Outcome	Upon completion of this course, the students will be able to 1. Describethesecurityconcepts. 2. Applycyberdefensetechniques. 3. Describeinformationsecuritypolicyandframework 4. Summarizevarioussecuritypolicies. 5. Analysisoftheinformationsecurityprocedures.														
Prerequisites: NetworkSecurity															
CO, PO AND PSO MAPPING															
CO	PO - 1	PO- 2	PO-3	PO-4	PO- 5	PO-6	PO-7	PO-8	PO- 9	PO-10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	2	2	3	2	2	1	1	-	-	1	3	3	2
CO-2	3	3	2	2	3	2	2	1	2	-	2	2	3	2	3
CO-3	3	3	2	2	3	2	1	1	2	-	2	2	3	1	2
CO-4	3	3	2	2	3	2	1	1	2	-	2	2	3	1	3
CO-5	3	3	3	2	3	2	2	1	-	-	1	2	3	2	2

1: Weakly related, 2: Moderately related and 3: Strongly related	
<b>MODULE1: SECURITYCONCEPTSANDMECHANISMS (12)</b>	
<p>Networking Concepts Overview - Basics of Communication Systems - Wireless Networks - Internet -Information Security Concepts - Overview and services - Types of Attacks - Security Goal - E-commercesecurity-SecurityThreatsand vulnerabilities--HackingTechniques-Passwordcracking</p> <p><b>PracticalComponent</b></p> <p>Informationsecuritypolicyprojects,Scopeoftheproject,projectRoles</p> <p><b>SuggestedReading</b></p> <p>SecurityAttacks</p>	<p><b>CO-1</b></p> <p><b>BTL-3</b></p>
<b>MODULE2: CYBERDEFENSETECHNIQUES (12)</b>	
<p>E-Mail Security - Web security - Web Injection Attack - Cross Site Scripting (XSS) - Secure SoftwareDevelopment - Cyber crime and cyber terrorism - Cyber operations and Defense Techniques- Phasesof a cyber attack- Information warfare and surveillance - Steganography - Security Engineering</p> <p><b>PracticalComponent</b></p> <p>WebInjectionattack.</p> <p><b>SuggestedReading</b></p> <p>SecurityDefenseMechanisms</p>	<p><b>CO-2</b></p> <p><b>BTL-3</b></p>
<b>MODULE3:INFORMATIONSECURITYPOLICYBASICSANDFRAMEWORK (12)</b>	
<p>Current information security policy sets- Effectiveness of information security policy sets Informationsecuritypolicytypes:Policies,standard,guidelines,procedures- Informationsecuritypolicyframework- Information security policy sets without frameworks - Information security policy withframeworks - Common information security policy frameworks: FISMA framework, NIST 800-53, ISO27001,andCOBIT,andregulationssuchasHIPAAandPCIDSS- TailoringinformationisSPFs-Deliveringapolicyset fromaframework</p> <p><b>PracticalComponent:</b></p> <p>Information security policy projects, project Phases, revision project and application Monitoringtools</p> <p><b>SuggestedReading</b></p> <p>InformationSecurityFrameworks</p>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE4: INFORMATIONSECURITYPOLICYDETAILS (12)</b>	
<p>Information security policy details- Front matter- Policy statements- black matter- policy requirementexpectations - specific information security policies - organisational-level policies- security program-levelpolicies-usersecuritypolicies-systemand control policies-Policy documentexamples</p> <p><b>PracticalComponent:</b></p> <p>InformationSecurityapplicationMonitoringtools</p> <p><b>SuggestedReading</b></p> <p>InformationSecurityPolicies.</p>	<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<b>MODULE5:INFORMATION SECURITYPROCEDURESANDSTANDARDS (12)</b>	



Less Formal languages and structure- various purposes of the standard and guidelines- Information security procedures. <b>Practical Component:</b> Traffic analysis, Trend analysis. <b>Suggested Reading</b> Information security procedures.	<b>CO-5</b>  <b>BTL-3</b>
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Text BOOKS	
1.	Douglas J. Landoll. Information Security Policies, Procedures, and Standards: A Practitioner's Reference 1 <sup>st</sup> edition, CRC press, 2016, ISBN 9781482245899.
2.	Ross J. Anderson. Security Engineering: A Guide to Building Dependable Distributed Systems. John Wiley, New York, NY, 2001. ISBN: 0471389226.
3.	Matt Bishop. Computer Security: Art and Science. Addison Wesley, Boston, MA, 2003. ISBN: 0-201-44099-7.
Reference BOOKS	
1.	Frank Stajano. Security for Ubiquitous Computing. John Wiley, 2002. ISBN: 0470844930.
2.	McClure, Stuart & Scambray, Joel, et al, Hacking Exposed 5th Edition. McGraw-Hill Osborne Media, 2005.
MOOC Course	
1	<a href="https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks">https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks</a>

COURSE TITLE		CRYPTOGRAPHY AND NETWORK SECURITY						Credit		3					
COURSE CODE		CSC4281		COURSE CATEGORY			DE		L-T-P-S		2-0-2-0				
Version		1.0		Approval Details					LEARNING LEVEL		BTL-3				
ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment		Lab Component								ESE			
15%		15%		20%								50%			
Course Description		This course will enable the students to acquire knowledge about security fundamentals and cryptographic algorithms, apply email and IP security and design a trusted system.													
Course Objective		1. To acquire knowledge about network security fundamentals. 2. To acquire knowledge of several cryptographic algorithms. 3. To illustrate data integrity algorithms. 4. To apply Email and IP security. 5. To design a trusted system.													
Course Outcome		Upon completion of this course, the students will be able to  1. Acquire knowledge about network security fundamentals. 2. Acquire knowledge of several Cryptographic Algorithms. 3. Illustrate data integrity algorithms. 4. Apply Email and IP security. 5. Design a trusted system.													
Prerequisites: Basics of Networks															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO -4	PO -5	PO -6	PO -7	PO- 8	PO -9	PO -10	PO- 11	PO -12	PSO -1	PSO -2	PSO -3
CO-1	3	3	2	-	-	2	-	-	-	1	1	3	2	1	-
CO-2	3	3	3	3	3	1	-	1	3	2	2	3	3	2	1
CO-3	3	3	3	3	3	1	-	1	3	2	2	2	3	2	2
CO-4	3	3	3	3	3	2	1	1	3	2	2	2	3	3	1
CO-5	3	3	3	3	3	2	1	1	3	2	2	2	3	3	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION(6L+6P)															

Security Trends-The OSI Security Architecture, Security Attacks, Security Services and Security Mechanisms, A model for Network security-Classical Encryption Techniques. <b>Practical Component:</b> 1. Implementation of Caesar Cipher technique 2. Implement the Play fair Cipher 3. Implement the Pure Transposition Cipher		CO1 BTL3
MODULE 2: CRYPTOGRAPHIC ALGORITHMS (6L+6P)		
Number Theory- Modern Block Ciphers: DES, 3DES, AES, Blowfish, CAST-128 - Stream Cipher - Public Key Cryptography : RSA, Diffie-Hellman, Elgamal, ECC. <b>Practical Component:</b> 1. Implement Simple DES Encryption and Decryption 2. Implement the AES Encryption and decryption 3.Implement RSA Encryption Algorithm		CO2/BTL3
MODULE 3: DATA INTEGRITY ALGORITHMS (6L+6P)		
MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authentication service - electronic mail security-pretty good privacy (PGP) - S/MIME. <b>Practical Component:</b> 1. Calculate the message digest of a text using the SHA-1 algorithm 2. Implement the SIGNATURE SCHEME - Digital Signature Standard		CO3/BTL3
MODULE 4: EMAIL AND IP SECURITY		(6L+6P)
Pretty Good Privacy (PGP) and S/MIME. IP SECURITY: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management. <b>Practical Component:</b> 1.Study of GnuPG tool. 2. Demonstrate how to provide secure data storage and secure data transmission.		CO4/BTL3
MODULE 5: WEB AND SYSTEM SECURITY		(6L+6P)
Web Security: Secure socket layer and transport layer security - secure electronic transaction - System Security: Intruders - Viruses and related threads - firewall design principals – trusted systems. <b>Practical Component:</b> 1. Installation of Rootkits.		CO5/BTL3
TEXT BOOKS		
1.	William Stallings, “Cryptography and Network security Principles and Practices”, Pearson/PHI,2017.	
2.	William Stallings, Network Security Essentials (Applications and Standards), Pearson Education, India,2017	
REFERENCE BOOKS		

1.	W. Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, 2004.
2.	Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing, Prentice Hall of India, 2015.
3.	Atul Kahate, Cryptography and Network Security, Tata Mc Grawhill, India, 2019.
<b>E BOOKS</b>	
1.	<a href="http://uru.ac.in/uruonlinelibrary/Cyber_Security/Cryptography_and_Network_Security.pdf">http://uru.ac.in/uruonlinelibrary/Cyber_Security/Cryptography_and_Network_Security.pdf</a>
2.	<a href="https://www.pearson.com/us/higher-education/product/Stallings-Cryptography-and-Network-Security-Principles-and-Practice-5th-Edition/9780136097044.html">https://www.pearson.com/us/higher-education/product/Stallings-Cryptography-and-Network-Security-Principles-and-Practice-5th-Edition/9780136097044.html</a>
<b>MOOC</b>	
1.	<a href="http://nptel.ac.in/courses/106105031/">http://nptel.ac.in/courses/106105031/</a>
2.	<a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-033-computer-system-engineering-spring-2009/video-lectures/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-033-computer-system-engineering-spring-2009/video-lectures/</a>

COURSE TITLE	CRYPTOCURRENCY AND CYBER SECURITY			Credit	3
COURSE CODE	CSC4282	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component			ESE
15%	15%	20%			50%
Course Description	This course will enable the students to acquire knowledge about security fundamentals and cryptographic algorithms, explore the basics of cryptocurrencies and use Ethereum programming.				
Course Objective	<div><div>1.</div><div>To acquire knowledge about network security fundamentals.</div></div> <div><div>2.</div><div>To employ various symmetric ciphers.</div></div> <div><div>3.</div><div>To apply asymmetric ciphers and data integrity algorithms.</div></div> <div><div>4.</div><div>To explore the basics of cryptocurrencies.</div></div> <div><div>5.</div><div>To use Ethereum programming</div></div>				
Course Outcome	<div>Upon completion of this course, the students will be able to</div> <div><div>6.</div><div>Acquire knowledge about network security fundamentals.</div></div> <div><div>7.</div><div>Employ various symmetric ciphers.</div></div> <div><div>8.</div><div>Apply asymmetric ciphers and data integrity algorithms.</div></div> <div><div>9.</div><div>Explore the basics of cryptocurrencies.</div></div> <div><div>10.</div><div>Use Ethereum programming</div></div>				

Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	-	2	-	-	-	1	1	3	2	1	-
CO-2	3	3	3	3	3	1	-	1	3	2	2	3	3	2	1
CO-3	3	3	3	3	3	1	-	1	3	2	2	2	3	2	2
CO-4	3	3	3	3	3	2	1	1	3	2	2	2	3	3	1
CO-5	3	3	3	3	3	2	1	1	3	2	2	2	3	3	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO CYBER SECURITY (6L+6P)															
Introduction to Cyber Security, Need for security, Concept of Cyber Space, Cyber Crimes and Cyber-attack.Fundamentals security principles– threats,attacksandvulnerability.Key Security triad– Confidentiality,IntegrityandAvailability.Key components of cyber security network architecture. Introduction to basic Security Management and Policies- Authentication,Authorization,Access control,Identification and Accounting. <b>Practical component:</b> Detection of various cyber-attacks using Wireshark.														CO1/BTL3	
MODULE 2: SYMMETRIC CIPHERS (6L+6P)															
Cryptography – Private key Cryptography - Classical Encryption Techniques - Substitution Techniques -Transposition Techniques- Rotor Machines- Steganography - Data Encryption Standard- Advanced Encryption Standard-Multiple Encryption and Triple DES- <b>Practical Component:</b> 3. Transposition Technique 4. Data Encryption Standard. <b>Suggested Readings:</b> Stream Ciphers														CO2/BTL3	
MODULE 3: ASYMMETRIC CIPHERS AND DATA INTEGRITY ALGORITHMS (6L+6P)															
Public-Key Cryptography - RSA algorithm - Diffie-Hellman Key Exchange - Elgamal Cryptographic System -Elliptic Curve Arithmetic - Elliptic Curve Cryptography . MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - <b>Practical Component:</b> 3. RSA algorithm 4. Elliptic Curve Cryptography 5. Calculate the message digest of a text using the SHA-1 algorithm. <b>Suggested Readings:</b>														CO3/BTL3	

ApplicationsofRSAAlgorithm.		
<b>MODULE 4: CRYPTOCURRENCIES</b>		<b>(6L+6P)</b>
History, A basic crypto currency, Creation of coins, Payments and double spending, Bitcoin – Digital Signatures as Identities – eWallets – Personal Crypto security - Bitcoin Mining – Mining Hardware – Energy Consumption – Mining Pools – Mining Incentives and Strategies. <b>Practical Component:</b>  1.Find the exchange rate of cryptocurrencies with necessary data.  2. Mining Puzzles		<b>CO4/BTL3</b>
<b>MODULE 5: ETHEREUM</b>		<b>(6L+6P)</b>
The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language. <b>Practical Component:</b>  1. Study of Ethereum tool -Ganache.		<b>CO5/BTL3</b>
<b>TEXT BOOKS</b>		
1.	William Stallings, “Cryptography and Network security Principles and Practices”, Pearson/PHI,2017.	
2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press ,July, 2016.	
<b>REFERENCE BOOKS</b>		
1.	William Stallings, Network Security Essentials (Applications and Standards), Pearson Education, India,2017	
2.	Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.	
<b>E BOOKS</b>		
1.	<a href="https://www.pearson.com/us/higher-education/product/Stallings-Cryptography-and-Network-Security-Principles-and-Practice-5th-Edition/9780136097044.html">https://www.pearson.com/us/higher-education/product/Stallings-Cryptography-and-Network-Security-Principles-and-Practice-5th-Edition/9780136097044.html</a>	
2.	<a href="https://www.lopp.net/pdf/princeton_bitcoin_book.pdf">https://www.lopp.net/pdf/princeton_bitcoin_book.pdf</a>	
3.	<a href="https://www.blockchainexpert.uk/book/blockchain-book.pdf">https://www.blockchainexpert.uk/book/blockchain-book.pdf</a>	
<b>MOOC</b>		
1.	<a href="http://nptel.ac.in/courses/106105031/">http://nptel.ac.in/courses/106105031/</a>	
2.	<a href="https://www.coursera.org/specializations/introduction-to-blockchain">https://www.coursera.org/specializations/introduction-to-blockchain</a>	
3.	<a href="https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency">https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency</a>	

**SEMESTER-V**

COURSE TITLE	FUNDAMENTALS OF BLOCKCHAIN TECHNOLOGY			CREDITS	3
COURSE CODE	CSC4382	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0

Version	1.0	Approval Details		LEARNING LEVEL	BTL-3										
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment	Lab Component	ESE												
15%	15%	20%	50%												
Course Description	This course provides a broad overview of the essential concepts of blockchain technology – by initially exploring the Bitcoin protocol followed by the Ethereum protocol – to lay the foundation necessary for developing applications and programming.														
Course Objective	1. To contentedly discuss and describe the history, types and applications of Blockchain 2. To gains familiarity with cryptography and Consensus algorithms. 3. To create and deploy projects using Web3j. 4. To implement an ICO on Ethereum 5. To design blockchain bases application with Swarm and IPFS														
Course Outcome	Upon completion of this course, the students will be able to 1. Contentedly discuss and describe the history, types and applications of Blockchain 2. Gains familiarity with cryptography and Consensus algorithms. 3. Create and deploy projects using Web3j. 4. Implement an ICO on Ethereum 5. Design blockchain bases application with Swarm and IPFS														
Prerequisites: NIL															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PS O-3
CO-1	3	3	2	-	1	1	-	-	1	1	-	3	2	3	-
CO-2	3	3	3	2	2	2	-	-	1	2	-	3	2	3	-
CO-3	3	3	3	1	2	2	-	1	2	2	1	3	2	3	2
CO-4	3	3	3	1	2	2	-	1	2	2	1	3	2	3	2
CO-5	3	3	3	-	2	2	-	1`	2	2	1	3	2	3	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO BLOCKCHAIN (6L+6P)															

<p>Distributed DBMS – Limitations of Distributed DBMS, Introduction to Block chain – History, Definition, Distributed Ledger, Blockchain Categories – Public, Private, Consortium, Blockchain Network and Nodes, Peer-to-Peer Network, Mining Mechanism, Generic elements of Blockchain, Features of Blockchain, and Types of Blockchain.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Create a Public Ledger vs. Private Ledger with the various attributes like Access, Network Actors, Native token, Security, Speed and examples.</li> <li>2. How would a blockchain help in processing insurance claims of the insurance industry, which suffers from a number of issues like fraud, contract complexity, human error, information flows in reinsurance and claims processing? Use various aspects to summarize the solution.</li> </ol> <p><b>Suggested Readings:</b></p> <p><a href="https://blockchainhub.net/blockchains-and-distributed-ledger-technologies-in-general/">https://blockchainhub.net/blockchains-and-distributed-ledger-technologies-in-general/</a></p> <p><a href="https://blog.todotnet.com/2019/03/solving-real-world-problems-with-distributed-ledger-technology/">https://blog.todotnet.com/2019/03/solving-real-world-problems-with-distributed-ledger-technology/</a></p>	<p><b>CO-1</b></p> <p><b>BTL-2</b></p>
<b>MODULE 2: BLOCKCHAIN ARCHITECTURE (6L+6P)</b>	
<p>Operation of Bitcoin Blockchain, Blockchain Architecture – Block, Hash, Distributer P2P, Structure of Blockchain- Consensus mechanism: Proof of Work (PoW), Proof of Stake (PoS), Byzantine Fault Tolerance (BFT), Proof of Authority (PoA) and Proof of Elapsed Time (PoET)</p> <p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1. Prepare your build system and Building Bitcoin Core.</li> <li>2. Write Hello World smart contract in a higher programming language (Solidity).</li> <li>3. Solidity example using arrays and functions</li> </ol>	<p><b>CO-2</b></p> <p><b>BTL-2</b></p>
<b>MODULE 3: BLOCKCHAIN-BASED FUTURES SYSTEM (6L+6P)</b>	
<p>Project presentation-Futures smart contract: Blockchain oracles-Web3j: Setting up the Web3J-Installing web3j-Wallet creation,Java client: The wrapper generator-Initializing web3j-Setting up Ethereum accounts-Deploying the contract</p> <p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1. create a Maven project using Web3j.</li> <li>2. Construct and deploy your contract (Use deploy method)</li> </ol>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: BLOCKCHAINS IN BUSINESS AND CREATING ICO (6L+6P)</b>	
<p>Public versus private and permissioned versus permission less blockchains- Privacy and anonymity in Ethereum- Why are privacy and anonymity important?- The Ethereum Enterprise Alliance- Blockchain-as-a-Service- Initial Coin Offering (ICO): Project setup for ICO implementation- Token contracts- Token sale contracts-Contract security and Testing the code.</p> <p><b>Practical Component:</b></p> <p>Implement an ICO on Ethereum.</p>	<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<b>MODULE 5: DISTRIBUTED STORAGE IPFS AND SWARM (6L+6P)</b>	



<p>Ethereum Virtual Machine- Swarm and IPFS:Installing IPFS, Hosting our frontend: Serving your frontend using IFPS, Serving your frontend using Swarm, IPFS file uploader project:Project setup the web page</p> <p><b>Practical component:</b></p> <p>Install IPFS locally on our machine, initialize your node, view the nodes in network and add files and directories install Swarm and run any test file.</p>	<p><b>CO-5</b></p> <p><b>BTL-3</b></p>
<b>TEXT BOOKS</b>	
Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained”, 2 <sup>nd</sup> Edition, Packt Publishing Ltd, March 2018.	
Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, “Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger”, Packt Publishing Limited, 2018.	
<b>REFERENCE BOOKS</b>	
Andreas M. Antonopoulos , “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly Media Inc, 2015	
Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.	
<b>E BOOKS</b>	
1.	<a href="https://www.velmie.com/practical-blockchain-study">https://www.velmie.com/practical-blockchain-study</a>
<b>MOOC</b>	
1.	<a href="https://www.udemy.com/course/build-your-blockchain-az/">https://www.udemy.com/course/build-your-blockchain-az/</a>

COURSE TITLE	BITCOIN ESSENTIALS AND USE CASES			CREDITS	3
COURSE CODE	CSC4383	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component	ESE		
15%	15%	20%	50%		
Course Description	This course was designed who want to learn how to navigate investment in cryptocurrencies. You'll learn how to define a currency, analyze the foundations of digital signatures and blockchain technology in cryptocurrency, and accurately assess the risks of cryptocurrency in a modern investment portfolio.				

<b>Course Objective</b>	1. To contentedly discuss and describe the history, types and applications of Blockchain 2. To gains familiarity with cryptography and Consensus algorithms. 3. To create and deploy projects using Web3j. 4. To implement an ICO on Ethereum 5. To design blockchain bases application with Swarm and IPFS														
<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. Build a bitcoin payment system. 2. Building their own Cryptocurrency and perform Auctions in Ethereum. 3. Grasp what is Cryptocurrency and how it functions 4. Acquire knowledge about Bitcoin and Ethereum 5. Understand role of Blockchain in various domains														
<b>Prerequisites: NIL</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO -1</b>	<b>PO- 2</b>	<b>PO- 3</b>	<b>PO- 4</b>	<b>PO- 5</b>	<b>PO- 6</b>	<b>PO- 7</b>	<b>PO- 8</b>	<b>PO- 9</b>	<b>PO - 10</b>	<b>PO- 11</b>	<b>PO- 12</b>	<b>PSO- 1</b>	<b>PSO- 2</b>	<b>PSO- 3</b>
CO-1	3	3	2	-	3	1	-	-	1	1	-	3	2	3	2
CO-2	3	3	3	2	3	2	-	-	1	2	-	3	2	3	2
CO-3	3	3	3	1	3	2	-	1	2	2	1	3	2	3	-
CO-4	3	3	3	1	3	2	-	1	2	2	1	3	2	3	2
CO-5	3	3	3	-	3	2	-	1`	2	2	1	3	2	3	1
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: BUILDING A BITCOIN PAYMENT SYSTEM (6L+6P)</b>															
The emergence of blockchain and cryptocurrency-What is blockchain?- Interact with the blockchain- Types of blockchains: Classification of blockchains, Building A Bitcoin payment system : Getting started with Bitcoin, Building a payment gateway.  <b>Practical Component:</b>  1. Run a bitcoin client. 2. Synchronize the blockchain 3. Set up a Regtest environment 4. Build a payment request URI													<b>CO-1</b>  <b>BTL-3</b>		
<b>MODULE 2: CRYPTOCURRENCY AND AUCTIONS IN ETHEREUM (6L+6P)</b>															
Building Your Own Cryptocurrency- Compiling Bitcoin from source- New cryptocurrency – Readercoin: Cloning Bitcoin, Readercoin rebranding- Peer-to-Peer Auctions in Ethereum: Introduction to Ethereum, Building an auction DApp: Auction description, Auction contract in Solidity- Contract code analysis-Enumerations, Arrays, Mappings, Structures, Functions, Modifiers, Inheritance.													<b>CO-2</b>  <b>BTL-3</b>		

<b>Practical component:</b> 1.Prepare your build system and Building Bitcoin Core. 2.Write Hello World smart contract in a higher programming language (Solidity). 3. Solidity example using arrays and functions.	
<b>MODULE 3: CRYPTOCURRENCIES AND BITCOIN (6L+6P)</b>	
Introduction to Cryptocurrencies, Tokens – Cryptosecurities, Players involved - Cryptocurrency Users, Miners, Cryptocurrency exchanges, Trading platforms, Wallet providers, Coin inventors, Coin offerors. Distributed Ledger Technology (DLT), Bitcoin (BTC) – Genesis Block, Buy Bitcoin, Transactions, Unspent Transaction Output (UTXO), Bitcoin Mining, Value of Bitcoin, Advantages and Disadvantages,  <b>Practical Component:</b> 1. Find the exchange rate for bitcoin with the help of necessary data. 2. Find the number of bitcoins by applying the equation over the defined values. <b>Suggested Readings:</b> <a href="https://www.investopedia.com/tech/most-important-cryptocurrencies-other-than-bitcoin/">https://www.investopedia.com/tech/most-important-cryptocurrencies-other-than-bitcoin/</a> <a href="https://intelligenttrading.org/guides/cryptoasset-classifications/">https://intelligenttrading.org/guides/cryptoasset-classifications/</a>	<b>CO-3</b>  <b>BTL-3</b>
<b>MODULE 4: ETHEREUM CRYPTOCURRENCY (6L+6P)</b>	
Ethereum (ETH) – Smart Contracts, UTXO, Types of Accounts - Externally controlled accounts and Contract account, Merkle Tree, Ether, Components of Ethereum Transaction, DApps, Hard & Soft Fork, Bitcoin Stack versus Ethereum Stack.  <b>Practical Component:</b> 1. Calculate the ‘number of ethers’ for the transaction of gas limit for the scenario in which the sender sets the gas limit to 50,000 and a gas price to 20 gwei. 2. Represent the Ethereum Merkle Tree for the given list of Transactions. <b>Suggested Readings:</b> <a href="https://medium.com/@preethikasireddy/how-does-ethereum-work-anyway-22d1df506369">https://medium.com/@preethikasireddy/how-does-ethereum-work-anyway-22d1df506369</a> <a href="https://medium.com/@jochasinga/implementing-a-bitcoin-merkle-tree-cb0af3d53ec9">https://medium.com/@jochasinga/implementing-a-bitcoin-merkle-tree-cb0af3d53ec9</a>	<b>CO-4</b>  <b>BTL-3</b>
<b>MODULE 5: USE CASES (6L+6P)</b>	
Blockchain in Supply Chain - Blockchain in Manufacturing - Blockchain in Automobiles - Blockchain in Healthcare - Blockchain in Cyber security - Blockchain in Financial Industry  <b>Practical Component:</b> 1. Do a survey on the various real-time applications in cryptocurrencies (Bitcoin and Ethereum) and give pictorial representation of the same by considering the common aspects. <b>Suggested Readings:</b> <a href="https://builtin.com/blockchain/blockchain-applications">https://builtin.com/blockchain/blockchain-applications</a>	<b>CO-5</b>  <b>BTL-3</b>

REFERENCE BOOKS	
1.	Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained”, 2 <sup>nd</sup> Edition, Packt Publishing Ltd, March 2018.
2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies”, Princeton University Press, 2016.
E BOOKS	
1.	<a href="https://users.cs.fiu.edu/~prabakar/cen5079/Common/textbooks/Mastering_Blockchain_2nd_Edition.pdf">https://users.cs.fiu.edu/~prabakar/cen5079/Common/textbooks/Mastering_Blockchain_2nd_Edition.pdf</a>
2.	<a href="https://www.lopp.net/pdf/princeton_bitcoin_book.pdf">https://www.lopp.net/pdf/princeton_bitcoin_book.pdf</a>
3.	<a href="https://www.blockchainexpert.uk/book/blockchain-book.pdf">https://www.blockchainexpert.uk/book/blockchain-book.pdf</a>
MOOC	
1.	<a href="https://www.coursera.org/specializations/introduction-to-blockchain">https://www.coursera.org/specializations/introduction-to-blockchain</a>
2.	<a href="https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency">https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency</a>
1.	<a href="https://www.velmie.com/practical-blockchain-study">https://www.velmie.com/practical-blockchain-study</a>

**SEMESTER- VI**

COURSE TITLE	BUILDING PRIVATE BLOCKCHAIN			CREDITS	3
COURSE CODE	CSC4384	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component	ESE		
15%	15%	20%	50%		
Course Description	This course is intended to study the basics of Blockchain technology. During this course learner will explore various aspects of Blockchain technology like application in various domains. By implementing learner will have idea about private and public Blockchain, and smart contract.				
Course Objective	Students will be able to Create and Deploy Your Private Blockchain On MultiChain				

Course Outcome	Upon completion of this course, the students will be able to														
	6. Acquire knowledge about the structure and mechanism of Bitcoin, Ethereum, Hyperledger and Multichain Blockchain platforms														
	7. Understand the importance of consensus in transactions and how transactions are stored on Blockchain.														
	8. Setup your own private Blockchain and deploy smart contracts on Ethereum.														
	9. Learn to deploy the business network using Hyperledger Composer.														
10. Implement Blockchain for various use cases															
Prerequisites: Nil															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-2	-	-	1	-	-	-	-	-	-	2	-	2	-	-	-
CO-3	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-
CO-4	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-5	-	-	3	-	-	-	3	-	-	2	-	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO BLOCKCHAIN (6L+6P)															
What is Block chain? Basic ideas behind Blockchain, how it is changing the landscape of digitalization, Uses of Blockchain. Abstract Models for BLOCKCHAIN - GARAY model - RLA Model, what is Multichain? Objective of Multichain, Features of Multichain, Uses of Multichain, Process of mining in Multichain technology , Analyse Multichain platform, why it is better than other open platforms Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hash chain to Blockchain, Basic consensus mechanisms													CO-1 BTL-2		
MODULE 2: CONSENSUS & DAPPS (6L+6P)															
Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains (DAPPS) - Characteristics of Decentralized application, Setting up a Private Blockchain, Multiple configurable Blockchains using Multichain Deployment scenarios of Multichain, Centralized currency settlement, Bond issuance and peer-to-peer trading Consumer-facing rewards scheme in Decentralized Applications													CO-2 BTL-2		
MODULE 3: HYPERLEDGER FABRIC (6L+6P)															
Hyperledger Fabric (A): Decomposing the consensus process , Hyperledger fabric components, Chain code Design and Implementation Hyperledger Fabric (B): Beyond Chain code: fabric SDK and Front End (b) Hyperledger composer tool													CO-3 BTL-3		
MODULE 4: USECASE MODEL – PRIVACY BLOCKCHAIN (6L+6P)															

Use case 1: Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance		CO-4 BTL-2
Use case 2: Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc		
MODULE 5: USECASE MODEL – BLOCKCHAIN DIGITAL IDENTITY (6L+6P)		
Use case 3: Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social welfare systems Blockchain Cryptography, Privacy and Security on Blockchain		CO-5 BTL-2
TEXT BOOKS		
1.	Andreas M. Antonopoulos , “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly Media Inc, 2015	
2.	Blockchain by Melanie Swa, O’Reilly	
REFERENCE BOOKS		
1.	Hyperledger Fabric - <a href="https://www.hyperledger.org/projects/fabric">https://www.hyperledger.org/projects/fabric</a>	
2.	Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - <a href="https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html">https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html</a>	
MOOC		
1.	<a href="https://www.udemy.com/course/build-blockchain/">https://www.udemy.com/course/build-blockchain/</a>	

COURSE TITLE	BLOCKCHAIN BUSINESS MODELS			CREDITS	3
COURSE CODE	CSC4385	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component	ESE		
15%	15%	20%	50%		
Course Description	This course helps to apply Blockchain for Business models.				
Course Objective	1. To Discuss the basics of Blockchain 2. To Apply the Cryptographic techniques in Blockchain 3. To Identify the appropriate Consensus methods for application 4. To Describe the technology stack for Blockchain 5. To Apply the Blockchain for business models				

<b>Course Outcome</b>	1. Discuss the basics of Blockchain 2. Apply the Cryptographic techniques in Blockchain 3. Identify the appropriate Consensus methods for application 4. Describe the technology stack for Blockchain 5. Apply the Blockchain for business models														
<b>Prerequisites: Basic Networking concepts</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO-1	3	3	-	-	1	-	-	-	-	-	-	-	2	2	-
CO-2	3	3	-	-	1	-	-	-	-	2	-	-	2	2	-
CO-3	3	3	3	-	-	1	-	-	-	-	-	-	2	-	2
CO-4	3	3	-	-	1	-	-	-	-	-	-	-	2	2	-
CO-5	3	3	3	-	3	-	-	-	-	-	-	3	-	2	-
CO-6	3	3	-	-	1	-	-	-	-	2	-	3	2	2	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: Introduction (6L+6P)</b>															
History of Blockchain-Terminologies in Blockchain-Types of Blockchain-Applications of Blockchain-How blockchain works-Ingredients of Blockchain.  <b>Practical Component:</b>  1. Create Survey report of various types of Blockchain and its real time use cases.														<b>CO-1</b>  <b>BTL-3</b>	
<b>Module 2: Cryptography Algorithms (6L+6P)</b>															
Introduction to cryptography-Encryption and Decryption-Ciphers-Cryptography using arithmetic modulo primes-hashing algorithms-SHA-256 algorithm-Application of SHA algorithm.  <b>Practical Component:</b>  1.Implement program to convert given text in to hashes using SHA 256 algorithm.														<b>CO-2</b>  <b>BTL-3</b>	
<b>MODULE 3: Consensus Methods(6L+6P)</b>															
Introduction to Consensus Methods-Proof of Work(PoW)-Proof of Stake(PoS)-Proof of Burn(PoB)-Proof of Activity(PoA)-Proof of Elapsed Time(PoET)-Simplified Byzantine fault Tolerance-Mining.  <b>Practical Component:</b>  Prepare comparison study report of various Consensus methods for financial transaction.														<b>CO-3</b>  <b>BTL-3</b>	

MODULE 4: Blockchain Technology Stack(6L+6P)	
Data structures for Blockchain-Merkle trees-Shared data- Protocols—Fat protocols- Platforms-DAPPS-Smart Contracts.  <b>Practical Component:</b>  1. Create simple smart contract for User identity management using Solidity language.	<b>CO-4</b>  <b>BTL-3</b>
MODULE 5: Blockchain Business models(6L+6P)	
Introduction to Blockchain Business Models-Need for Blockchain business models- Traditional business models-Types of Blockchain Business Models- Blockchain As A Service (BaaS)-Token Economy- Utility Token Business Model-Blockchain-Based Software Products- P2P Blockchain Business Model-Blockchain Professional Services. Block chain for Banking and Financial transactions.  <b>Practical Component:</b>  1.Create simple wallet transaction from one account to another account using Metamask.	<b>CO-5,</b>  <b>BTL-3</b>
TEXT BOOKS	
1.	<b>Brojo Kishore Mishra , Sanjay Kumar Kuanar</b> “Handbook of IoT and Blockchain: Methods, Solutions, and Recent Advancements (Internet of Everything (IoE)) “, CRC Press; 1st edition , November 2020.
2.	<b>Jai Singh Arun , Jerry Cuomo , Nitin Gaur</b> Blockchain for Business- For Understanding transformation, growth and new models of Business -First Edition Published by Pearson Paperback—12December2019
REFERENCES	
1.	<a href="https://iabtechlab.com/wp-content/uploads/2018/07/Blockchain-Technology-Primer.pdf">https://iabtechlab.com/wp-content/uploads/2018/07/Blockchain-Technology-Primer.pdf</a>
2.	<a href="https://www.blockchain-council.org/blockchain/the-best-blockchain-business-models/">https://www.blockchain-council.org/blockchain/the-best-blockchain-business-models/</a>
E BOOKS	
1.	<a href="https://www.researchgate.net/publication/337649428_Handbook_of_IoT_and_Blockchain_-_Methods_Solutions_and_Recent_Advancements.">https://www.researchgate.net/publication/337649428_Handbook_of_IoT_and_Blockchain_-_Methods_Solutions_and_Recent_Advancements.</a>
MOOC	
1.	<a href="https://www.coursera.org/learn/blockchain-business-models">https://www.coursera.org/learn/blockchain-business-models</a>

**SEMESTER-VII**

COURSE TITLE	BLOCKCHAIN AND IoT			CREDITS	3
COURSE CODE	CSC4468	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0



Version	1.0	Approval Details		LEARNING LEVEL	BTL-3										
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment	Lab Component	ESE												
15%	15%	20%	50%												
Course Description	This course helps to apply Blockchain to IoT applications														
Course Objective	1. To Demonstrate the working of IoT and Blockchain 2. To Identify Consensus mechanism for Blockchain Application 3. To Discover the security challenges in IoT 4. To Analyze the need of BaaS for Organizations 5. To Apply the Blockchain usecases for IoT sector														
Course Outcome	1. Demonstrate the working of IoT and Blockchain 2. Identify Consensus mechanism for Blockchain Application 3. Discover the security challenges in IoT 4. Analyze the need of BaaS for Organizations 5. Apply the Blockchain usecases for IoT sector														
Prerequisites: Basic Networking concepts															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	-	-	1	-	-	-	-	-	-	-	2	2	-
CO-2	3	3	-	-	1	-	-	-	-	2	-	-	2	2	-
CO-3	3	3	3	-	-	1	-	-	-	-	-	-	2	-	2
CO-4	3	3	-	-	1	-	-	-	-	-	-	-	2	2	-
CO-5	3	3	3	-	3	-	-	-	-	-	-	3	-	2	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO IoT & BLOCKCHAIN (6L+6P)															

<p>Introduction to Internet of Things (IoT)- Concepts and definitions of IoT-History of IoT –IoT vs Conventional Network-IoT Architecture- Introduction to Blockchain-Generations of Blockchain- Structure of Blockchain- Opportunities and challenges in IoT and Blockchain.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Study of IoT simulators (Tinker cad/Cisco Packet Tracer).</li> <li>2. Study of Blockchain development frame works (Truffle/Hyperledger fabric).</li> </ol>	<p><b>CO-1</b></p> <p><b>BTL-3</b></p>
<b>MODULE 2: CONSENSUS ALGORITHMS (6L+6P)</b>	
<p>Building Blocks of Blockchain-Database-Block-Hash-Minor-Transaction-Smart contracts- Consensus Mechanisms-PoW-PoS-Characteristics of Blockchain-Types of Blockchain- Permissioned Blockchain-Permissionless Blockchain-Consortium Blockchain.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Use the MetaMask plugin to conduct transactions with Ether, a cryptocurrency</li> <li>2. Deploy a simple contract to the Ethereum blockchain</li> </ol>	<p><b>CO-2</b></p> <p><b>BTL-4</b></p>
<b>MODULE 3: IOT SECURITY(6L+6P)</b>	
<p>IoT Layer Challenges – Sensing layer– Challenges in end nodes –Threat based on Network layer-Service layer based threats-Application Interface layer –Cross layer Challenges- Challenge to implementation of IoT in Blockchain-IoT Device Integration challenges.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Develop your own Application that stores IoT data in open source IoT cloud platform analytic tools.</li> <li>2.</li> <li>3. Study of Cryptocurrencies and wallet in blockchain.</li> </ol>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: BLOCKCHAIN AS A SERVICE (BAAS) (6L+6P)</b>	
<p>Defining of Blockchain as a Service - IoT Cloud server security challenges– Cloud computing with BaaS-Hybrid Cloud server with BaaS for Remote Monitoring-Case study: Industries adopting BaaS for security.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Create study report of BaaS is adopted in industries.</li> <li>2. Create two Ether accounts and perform transactions using Metamask Wallet and analyze the gas consumption.</li> </ol>	<p><b>CO-4</b></p> <p><b>BTL-4</b></p>
<b>MODULE 5: BLOCKCHAIN USECASES IN IOT SECTOR (6L+6P)</b>	
<p>Autonomous Decentralized peer to peer telemetry-Blockchain Enabled Security for Smart cities- Blockchain Enabled Smart Home Architecture-Blockchain based self-managed VANETs-Security and privacy of data.</p> <p><b>Practical Component:</b></p> <ol style="list-style-type: none"> <li>1. Develop application for Smart Traffic that analyze the IoT data and predict the Traffic Jam.</li> </ol>	<p><b>CO-5,</b></p> <p><b>BTL-4</b></p>

2. Create study report of how blockchain can be applied to IoT supply chain Management		
TEXT BOOKS		
1.	<b>Brojo Kishore Mishra , Sanjay Kumar Kuanar</b> “Handbook of IoT and Blockchain: Methods, Solutions, and Recent Advancements (Internet of Everything (IoE)) “, CRC Press; 1st edition , November 2020.	
2.	<b>Shiho Kim ,Ganesh, Chandra Deka, Peng Zhang,</b> “ <i>Role of Blockchain Technology in IoT Applications</i> ”, Volume 115 in the <i>Advances in Computers series</i> ,first edition ,Academic Press 2019	
3.	<b>Harshita Patel , Ghanshyam Singh Thakur,</b> “Blockchain Applications in IoT Security” 1st Edition by IGI Global; 1st edition 2020	
4.	David Etter,” IoT Security: Practical Guide Book”, CreateSpace Independent Publishing Platform, 2016.	
REFERENCE BOOKS		
1.	John Soldatos, “Building Blocks for IoT Analytics”,River Publishers,2016	
E BOOKS		
1.	<a href="https://www.researchgate.net/publication/337649428_Handbook_of_IoT_and_Blockchain_-_Methods_Solutions_and_Recent_Advancements.">https://www.researchgate.net/publication/337649428_Handbook_of_IoT_and_Blockchain_-_Methods_Solutions_and_Recent_Advancements.</a>	
MOOC		
1.	<a href="https://www.coursera.org/learn/blockchain-basics">https://www.coursera.org/learn/blockchain-basics</a>	

COURSE TITLE	AI & BLOCKCHAIN TECHNOLOGY			CREDITS	3
COURSE CODE	CSC4469	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Lab Component	ESE		
15%	15%	20%	50%		
Course Description	This course provides an overview of the world of blockchain, AI, and machine learning. We explore artificial intelligence and machine learning and seek to understand the philosophical and ethical issues, relationship with consciousness and self-awareness, the categories and applications of the different families of AI algorithms, and what challenges and opportunities lie in the future.				

Course Objective	Students acquire an understanding and appreciation of these technologies so they can explore further on their own.														
Course Outcome	Upon completion of this course, the students will be able to 1. Apply Hyperledger Fabric and Ethereum platform to implement the Block Chain Application 2. Identify and apply the appropriate machine learning techniques for classification, Pattern recognition, optimization and decision problems. 3. Provide conceptual understanding of the function of Blockchain & AI as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable. 4. Identify major research challenges and technical gaps existing between theory and practice in crypto currency domain. 5. Develop techniques in information science applications by applying Computational intelligence and appropriate machine learning techniques in Blockchain														
Prerequisites:															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-2	-	-	1	-	-	-	-	-	-	2	-	2	-	-	-
CO-3	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-
CO-4	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO-5	-	-	3	-	-	-	3	-	-	2	-	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: OVERVIEW OF BLOCKCHAIN (6L+6P)															
Getting Started with Blockchain: Blockchain versus distributed ledger technology versus distributed databases - Comparing the technologies with examples - Public versus private versus permissioned Blockchain - Comparing usage scenarios - Privacy in Blockchain - Understanding Bitcoin - A brief overview of Bitcoin, Ethereum: A brief overview of Ethereum, Introduction to Hyperledger - Overview of the project - Hyperledger Fabric - Hyperledger Saw tooth - Other Hyperledger frameworks and tools.													CO-1 BTL-2		
Practical Component:  1. Creation of Hyperledger Fabric & Saw tooth.Real case scenarios of setting up privacy in Blockchain															
MODULE 2: INTRODUCTION TO AI LANDSCAPE													(6L+6P)		

<p>AI – key concepts - History of AI - AI winter - Types of AI : Weak AI, Strong AI, Super AI - Forms of AI and approaches : Statistical and expert systems, Machine learning, Supervised learning, Unsupervised learning, Reinforcement learning - Neural networks - Evolutionary computation - Swarm computation - AI in digital transformation: Data extraction - Data transformation - Processing - Storyboarding - Data utilization, AI platforms and tools : Tensor Flow - Microsoft Cognitive Toolkit - IBM Watson</p> <p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1. Study of PROLOG &amp; Work on PROLOG</li> <li>2. In this problem, you will complete a simple computer algebra system that reduces nested expressions made of sums and products into a single sum of products. For example, it turns the expression <math>(2 * (x + 1) * (y + 3))</math> into <math>((2 * x * y) + (2 * x * 3) + (2 * 1 * y) + (2 * 1 * 3))</math>. You could choose to simplify further, such as to <math>((2 * x * y) + (6 * x) + (2 * y) + 6)</math>, but it is not necessary.</li> </ol>	<p><b>CO-2 BTL-2</b></p>
<p><b>MODULE 3: BLOCKCHAIN AND ARTIFICIAL INTELLIGENCE (6L+6P)</b></p>	
<p>Domain Specific Applications - Applying AI &amp; Blockchain: Healthcare, Supply chain, Financial Services, Information Security, Document management, AI &amp; Blockchain Driven Databases - Centralized versus distributed data, Big data for AI analysis, Data Management in a DAO, Emerging patterns for Database Solutions</p> <p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1. Real Case study working model of Applying AI &amp; Blockchain Applications in Healthcare, Supply chain &amp; Information Security.</li> </ol>	<p><b>CO-3 BTL-3</b></p>
<p><b>MODULE 4: CRYPTOCURRENCY AND AI (6L+6P)</b></p>	
<p>Role of AI in Cryptocurrency - Cryptocurrency Trading: Issues &amp; Considerations, Benefits of AI in Crypto Trading - Making Price Predictions with AI: Issues with Price Prediction, Benefits of AI in Prediction, Time series forecasting with ARIMA, Applications of algorithmic or quant trading in Cryptocurrency</p> <p><b>Practical Component:</b></p> <p>Deployment of Cryptocurrencies &amp; Predictions using AI</p>	<p><b>CO-4 BTL-2</b></p>
<p><b>MODULE 5: DEVELOPING AND FUTURE OF AI WITH BLOCKCHAINS (6L+6P)</b></p>	
<p>Applying SDLC practices in Blockchain: Introduction to DIApp - Architecture of a DIApp - Developing a DIApp - Testing a DIApp - Deploying DIApp - Monitoring a DIApp, Implementing DIApp - Evolution of decentralized applications, building a sample DIApp, Developing Smart Contracts, Solution approach with AI, Developing: Client code, Backend, Frontend, Future of converging AI &amp; Blockchain in enterprises &amp; Government.</p> <p><b>Practical component:</b></p> <ol style="list-style-type: none"> <li>1. Deploy DIApp and Smart Contracts.</li> <li>2. NPacket publishing in client code using AI &amp; Blockchain</li> </ol>	<p><b>CO-5 BTL-2</b></p>
<p><b>TEXT BOOKS</b></p>	

1.	Ganesh Prasad Kumble, “Practical Artificial Intelligence and Blockchain”, First Edition. Packt Publishing Ltd, July 2020.
2.	Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained”, 2 <sup>nd</sup> Edition, Packt Publishing Ltd, March 2018.
<b>REFERENCE BOOKS</b>	
1.	Andreas M. Antonopoulos , “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly Media Inc, 2015
2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.
<b>E BOOKS</b>	
1.	<a href="https://www.velmie.com/practical-blockchain-study">https://www.velmie.com/practical-blockchain-study</a>
<b>MOOC</b>	
1.	<a href="https://www.udemy.com/course/build-your-blockchain-az/">https://www.udemy.com/course/build-your-blockchain-az/</a>

### NON-DEPARTMENTAL ELECTIVES OFFERED BY CSE DEPARTMENT

COURSE TITLE	INTERNET OF THINGS			CREDITS	2
COURSE CODE	CSD4281	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
<b>ASSESSMENT SCHEME</b>					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.				

<b>Course Objective</b>	1. To understand the various sensors, actuators and IoT architectures. 2. To recognize the suitable connectivity protocols. 3. To apply appropriate sensors at various use cases. 4. To demonstrate the functionalities of Arduino. 5. To make use of the IoT enabled hardware setup to execute any IoT application.														
<b>Course Outcome</b>	Upon completion of this course, the students will be able to  1. Explain various sensors, actuators and IoT architectures. 2. Identify suitable connectivity protocols. 3. Apply appropriate sensors at various use cases. 4. Demonstrate the functionalities of Arduino. 5. Make use of the IoT enabled hardware setup to execute any IoT application.														
<b>Prerequisites:</b> Introduction to Embedded Systems, C Programming															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO-1	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
CO-2	3	3	3	3	3	2	2	2	2	2	2	3	3	2	3
CO-3	3	3	3	3	2	1	2	1	1	2	1	3	3	2	3
CO-4	3	3	3	3	1	1	2	1	2	2	1	3	3	2	3
CO-5	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
<b>MODULE 1: FUNDAMENTALS OF IOT (3L+3L=6)</b>															
Introduction-Applications -Sensors- Actuators- Basics of IoT: Components in internet of things – IoT service-oriented architecture – IoT Category – IoT Challenges  <b>Practical component:</b> Explore simulation tools for deployment of IoT using sensors.  <b>Suggested Readings:</b> Collect environmental data using sensors.													<b>CO-1</b>  <b>BTL-3</b>		
<b>MODULE 2: IOT CONNECTIVITY TECHNOLOGIES (3L+3L=6)</b>															
6LoWPAN, RFID, MQTT, CoAP, XMAP, AMQP, IEEE 802.15.4, Zigbee, Bluetooth, NFC, Piconets.  <b>Practical component:</b> Working with IoT Connectivity Technologies  <b>Suggested Readings:</b> Apply appropriate IoT protocols to connect sensors and actuators.													<b>CO-2</b>  <b>BTL-3</b>		
<b>MODULE 3: SENSOR NETWORKS(3L+3L=6)</b>															

Wireless Sensor Networks: Application of WSN in IoT, WSN in Agriculture, wireless multimedia sensor networks, WSN challenges, Machine-to-Machine communication. <b>Practical component:</b>  WSN in Agriculture  <b>Suggested Readings:</b>  Establish virtual sensor network.		<b>CO-3</b>  <b>BTL-3</b>
<b>MODULE 4: INTEROPERABILITY IN IOT &amp; INTRODUCTION TO ARDUINO &amp; SMART HOMES (3L+3L=6)</b>		
Interoperability: Examples and Different types, Arduino Programming: Features, Types, Board details, IDE. Setup, Function Libraries, Examples programs. Smart Home: Introduction, Aspects, Home Area Networks (HAN).  <b>Practical component:</b>  Working with Arduino.  <b>Suggested Readings:</b>  Interface Arduino with sensors and actuators.		<b>CO-4</b>  <b>BTL-3</b>
<b>MODULE 5: HANDS ON EXPERIMENTS USING ARDUINO INTERFACE</b>		<b>(3L+3L=6)</b>
1. LED Blinking  2. Display room temperature using temperature sensor  3. Traffic Light Control Self-experiment (Core Department based)		<b>CO-5</b>  <b>BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.	
2.	Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014.	
<b>REFERENCE BOOKS</b>		
1.	Introduction to IoT, NPTEL course by Dr. Sudip Misra Associate Professor, Department of Computer Science and Engineering IIT KHARAGPUR.	
<b>E BOOKS</b>		
1.	<a href="http://ptgmedia.pearsoncmg.com/images/9781587144561/samplepages/9781587144561_CH08.pdf">http://ptgmedia.pearsoncmg.com/images/9781587144561/samplepages/9781587144561_CH08.p</a>	
<b>MOOC</b>		
1.	<a href="https://nptel.ac.in/courses/106105166/">https://nptel.ac.in/courses/106105166/</a>	

COURSE TITLE	PYTHON PROGRAMMING			CREDITS	2
COURSE CODE	CSD4282	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0



Version	1.0	Approval Details		LEARNING LEVEL	BTL-3										
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE										
15%	15%	10%	5%	5%	50%										
Course Description	Python is an interpreted high-level general-purpose programming language. Python's design philosophy emphasizes code readability with its notable use of significant indentation. Python is a powerful general-purpose programming language. It is used in web development, data science, creating software prototypes, and so on. Fortunately for beginners, Python has simple easy-to-use syntax. This makes Python an excellent language to learn to program for beginners.														
Course Objective	<div>1. To identify and execute basic syntax and programs in Python.</div> <div>2. To solve problems using Python built-in data types and their methods.</div> <div>3. To create user-defined functions, modules and packages.</div> <div>4. To implement exception and file handling operations.</div> <div>5. To design an application using OOP concept in Python.</div>														
Course Outcome	<div>Upon completion of this course, the students will be able to</div> <div>1. Identify and execute basic syntax and programs in Python.</div> <div>2. Solve problems using Python built-in data types and their methods.</div> <div>3. Create user-defined functions, modules and packages.</div> <div>4. Implement exception and file handling operations.</div> <div>5. Design an application using OOP concept in Python.</div>														
Prerequisites: Basic Programming															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
CO-2	3	3	3	3	3	2	2	2	2	2	2	3	3	2	3
CO-3	3	3	3	3	2	1	2	1	1	2	1	3	3	2	3
CO-4	3	3	3	3	1	1	2	1	2	2	1	3	3	2	3
CO-5	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION (3L+3L=6)															

<p>Python Introduction- History and features of Python, Python Installation- Running Simple Programs, Python Identifiers, Reserved words, Indentation, Comments, assigning values to the variables, Standard data types, Type Conversion, Operators, Decision Making, Looping, Loop Control statement, Mathematical functions and constants- Random number function.</p> <p><b>Practical component:</b></p> <p>Python programming – Standard operations</p> <p><b>Suggested Readings:</b></p> <p>Apply decision and looping statements to solve any given problem.</p>	<p><b>CO-1</b></p> <p><b>BTL-3</b></p>
<b>MODULE 2: SEQUENCES &amp; DICTIONARY(3L+3L=6)</b>	
<p>Strings- Introduction, String operations, Built-in-String methods, Lists- Introduction, List Operations-Indexing, slicing, Built -in List methods and Functions, Matrices, Tuples- introduction, Tuple Operations, Built -in Tuple methods and functions, Dictionary-Introduction, Dictionary Operations, Built -in Dictionary methods and functions.</p> <p><b>Practical component:</b></p> <p>Working with python sequences and dictionary</p> <p><b>Suggested Readings:</b></p> <p>Use suitable data type and its built-in methods for handling any problem.</p>	<p><b>CO-2</b></p> <p><b>BTL-3</b></p>
<b>MODULE 3: FUNCTIONS, MODULES AND PACKAGES (3L+3L=6)</b>	
<p>Functions - User defined functions, function arguments &amp; its types - Time and Calendar module functions –Import statements - User defined Modules and Packages in Python.</p> <p><b>Practical component:</b></p> <p>Working with python functions, modules and packages</p> <p><b>Suggested Readings:</b></p> <p>Create user-defined functions, modules and packages.</p>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: FILE AND EXCEPTION HANDLING (3L+3L=6)</b>	
<p>Files- Opening and closing files, file manipulations, Directories in Python, File and Directory related methods. Exception - Handling Exceptions, try-finally, Raising an Exception.</p> <p><b>Practical component:</b></p> <p>Working with python files and exception handling</p> <p><b>Suggested Readings:</b></p> <p>Copy the contents from one file to another and handle exceptions simultaneously.</p>	<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<b>MODULE 5: OBJECT ORIENTED PROGRAMMING (3L+3L=6)</b>	
<p>OOPs Concepts -Class and Objects, Constructors and Inheritance.</p>	<p><b>CO-5</b></p>

<b>Practical component:</b>  Working with python OOPs concepts  <b>Suggested Readings:</b>  Apply the concept of inheritance for any given application.		<b>BTL-3</b>
<b>TEXT BOOKS</b>		
1.	Y. Daniel Liang, “Introduction to Programming using Python”, Pearson,2012.	
2.	Wesley J. Chun, “Core Python Programming”, Prentice Hall,2006.	
<b>REFERENCE BOOKS</b>		
1.	Mark Lutz, “Learning Python”, O’Reilly, 4 <sup>th</sup> Edition, 2009.	
<b>E BOOKS</b>		
1.	<a href="https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf">https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf</a>	
<b>MOOC</b>		
1.	<a href="https://www.edx.org/learn/python">https://www.edx.org/learn/python</a>	
2.	<a href="https://www.coursera.org/learn/python">https://www.coursera.org/learn/python</a>	

COURSE TITLE	JAVA PROGRAMMING			CREDITS	2
COURSE CODE	CSD4293	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	Java is a powerful general-purpose programming language. It is used to develop desktop and mobile applications, big data processing, embedded systems, and so on. Java is a High Level, class-based, object-oriented programming language that is designed to have as few implementation dependencies as possible.				

Course Objective	1. To understand OOP concepts and develop simple Java programs. 2. To inherit classes and implement interfaces. 3. To create files, read and write on console and files. 4. To implement exception handling operations. 5. To understand and use data structures in Java.														
Course Outcome	Upon completion of this course, the students will be able to  1. Understand OOP concepts and develop simple Java programs. 2. Inherit classes and implement interfaces. 3. Create files, read and write on console and files. 4. Implement exception handling operations. 5. Understand and use data structures in Java.														
Prerequisites: NIL															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
CO-2	3	3	3	3	3	2	2	2	2	2	2	3	3	2	3
CO-3	3	3	3	3	2	1	2	1	1	2	1	3	3	2	3
CO-4	3	3	3	3	1	1	2	1	2	2	1	3	3	2	3
CO-5	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: WEB DESIGN TOOLS AND UI DESIGN TOOLS (3L+3L=6)															
Bootstrap-Less-Atom-Notepad++; HTML Documents-Basic Structure of HTML Document-Creating HTML Documents- Basic HTML tags Introduction to elements of HTML-working with text-list-tables and frames-working with images-hyperlinks and multimedia-working with forms and controls. <b>Cascading Style Sheet (CSS):</b> The need for CSS, Introduction to CSS – Basic syntax and structure - InlineStyles – Embedding Style Sheets - Linking External Style Sheets – Backgrounds - Manipulating text.  <b>Practical component:</b>  CSS and HTML  <b>Suggested Readings:</b>  Design a sample web page for the department using HTML and CSS.													CO-1  BTL-3		
MODULE 2: INTRODUCTION TO JAVASCRIPT (3L+3L=6)															

<p>Introduction - Core features - Data types and Variables - Operators, Expressions, and Statements - Functions - Objects - Array, Date and Math related Objects, Event Handling - Controlling Windows &amp; Frames and Documents - Form handling and validations</p> <p><b>Practical component:</b></p> <p>Working with Java Script</p> <p><b>Suggested Readings:</b></p> <p>Create a Student registration form and validate.</p>	<p><b>CO-2</b></p> <p><b>BTL-3</b></p>
<b>MODULE 3: ADVANCED JAVASCRIPT (3L+3L=6)</b>	
<p>Introduction-Classes – Constructors – Object-Oriented Techniques in JavaScript – Object constructor and Prototyping - Sub classes and Super classes – JSON - jQuery and AJAX.</p> <p><b>Practical component:</b></p> <p>Working with advanced Java Script</p> <p><b>Suggested Readings:</b></p> <p>Create user-defined functions using advanced Java Script.</p>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: PHP (3L+3L=6)</b>	
<p>Introduction - How web works - Setting up the environment (LAMP server) - Programming basics - Print/echo - Variables and constants – Strings and Arrays – Operators, Control structures and looping structures – Functions – Reading Data in Web Pages - Embedding PHP within HTML.</p> <p><b>Practical component:</b></p> <p>Working with PHP</p> <p><b>Suggested Readings:</b></p> <p>Setting up the environment (LAMP server).</p>	<p><b>CO-4</b></p> <p><b>BTL-3</b></p>
<b>MODULE 5: PHP&amp; MYSQL AND WEB PUBLISHING (3L+3L=6)</b>	
<p><b>PHP&amp;Mysql:</b> Establishing connectivity with MySQL database, MySql query, SQL injection</p> <p><b>Web Publishing:</b> Creating website-saving the site- working on the site-creating website structure-creating tiles for webpages-themes publishing websites.</p> <p><b>Practical component:</b></p> <p>Working with PHP &amp; MySQL</p> <p><b>Suggested Readings:</b> Establish the database connection in a web page.</p>	<p><b>CO-5</b></p> <p><b>BTL-3</b></p>
<b>TEXT BOOKS</b>	

1.	Achyut S Godbole and Atul Kahate, “Web Technologies”, Second Edition, Tata McGraw Hill, 2012.
2.	Jenniffer Robins, “Learning Web Design”, 4 <sup>th</sup> Edition-O’Reilly Media,2012.
<b>REFERENCE BOOKS</b>	
1.	David Flanagan, “JavaScript: The Definitive Guide, Sixth Edition”, O'Reilly Media, 2011.
2.	James Lee, Brent Ware , “Open Source Development with LAMP: Using Linux, Apache, MySQL, Perl, and PHP” Addison Wesley, Pearson 2009.
<b>E BOOKS</b>	
1.	<a href="http://wtf.tw/ref/robbins.pdf">http://wtf.tw/ref/robbins.pdf</a>
2.	<a href="https://eloquentjavascript.net/Eloquent_Javascript.pdf">https://eloquentjavascript.net/Eloquent_Javascript.pdf</a>
<b>MOOC</b>	
1.	<a href="https://www.edx.org/course/html5-and-css-fundamentals-2">https://www.edx.org/course/html5-and-css-fundamentals-2</a>
2.	<a href="https://www.coursera.org/courses?query=php">https://www.coursera.org/courses?query=php</a>

COURSE TITLE	ANDROID APPLICATION DEVELOPMENT			CREDITS	2
COURSE CODE	CSD4291	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	Android app development is a process in which mobile apps are developed for devices that run the Android operating system. Android software development is the process by which applications are created for devices running the Android operating system.				
Course Objective	<ol style="list-style-type: none"> <li>1. To understand the mobility landscape.</li> <li>2. To recognize the Mobile apps development aspects.</li> <li>3. To design mobile apps, using Android as development platform.</li> <li>4. To learn the functionalities of multimedia and graphics.</li> <li>5. To build a mobile application using Android studio and Phone Gap.</li> </ol>				

Course Outcome	Upon completion of this course, the students will be able to														
	<div>1. Appreciate the Mobility landscape.</div> <div>2. Familiarize with Mobile apps development aspects.</div> <div>3. Design and develop mobile apps, using Android as development platform.</div> <div>4. Appreciation of nuances such as native hardware play, location awareness, graphics, and multimedia</div> <div>5. Build a mobile application using Android studio and Phone Gap.</div>														
Prerequisites: Exposure to Java															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
CO-2	3	3	3	3	3	2	2	2	2	2	2	3	3	2	3
CO-3	3	3	3	3	2	1	2	1	1	2	1	3	3	2	3
CO-4	3	3	3	3	1	1	2	1	2	2	1	3	3	2	3
CO-5	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: GETTING STARTED WITH MOBILITY (3L+3L=6)															
Mobility landscape, Mobile platforms, Mobile apps development, Overview of Android platform, setting up the mobile app development environment along with an emulator, a case study on Mobile app development.  Practical component:  Explore the mobility landscape  Suggested Readings:  Mobile platform													CO-1  BTL-3		
MODULE 2: BUILDING BLOCKS OF MOBILE APPS (3L+3L=6)															
App user interface designing – mobile UI resources (Layout, UI elements, Draw-able, Menu), Activity-states and life cycle, interaction amongst activities. Activity Life Cycle, Notifications.  Practical component:  Working with Mobile apps development tools  Suggested Readings:  Mobile UI resources													CO-2  BTL-3		
MODULE 3: SPRUCING UP MOBILE APPS (3L+3L=6)															

Graphics and animation – custom views, canvas, animation APIs, multimedia – audio/video playback and record, location awareness.		CO-3  BTL-3
<b>Practical component:</b>  Working with Android Studio		
<b>Suggested Readings:</b>  Develop using Animation APIs.		
MODULE 4: TESTING MOBILE APPS (3L+3L=6)		
Debugging mobile apps, White box testing, Black box testing, and test automation of mobile apps, JUnit for Android.		CO-4  BTL-3
<b>Practical component:</b>  Debugging and Testing.		
<b>Suggested Readings:</b> Establish the test automation of mobile apps.		
MODULE 5: TAKING APPS TO MARKET (3L+3L=6)		
Versioning, signing and packaging mobile apps, distributing apps on mobile market place.		CO-5  BTL-3
<b>Practical component:</b>  Build a mobile application using Android studio and Phone Gap.		
<b>Suggested Readings:</b>  Develop real time app.		
REFERENCE BOOKS		
1.	Leigh Williamson, John Ponzo, Patrick Bohrer, “Swift in the Cloud”, Wiley Publications, 1 <sup>st</sup> edition, 2017.	
2.	Hazem Saleh, “JavaScript Mobile Application Development”, Packt Publishing, 2014.	
E BOOKS		
1.	<a href="http://martinfowler.com/agile.html">http://martinfowler.com/agile.html</a>	
2.	<a href="http://www.it-ebooks.info/tag/agile">www.it-ebooks.info/tag/agile</a>	
MOOC		
1.	<a href="https://www.coursera.org/browse/computer-science/mobile-and-web-development">https://www.coursera.org/browse/computer-science/mobile-and-web-development</a>	
2.	<a href="https://www.edx.org/course/introduction-mobile-application-hkustx-comp107x-2">https://www.edx.org/course/introduction-mobile-application-hkustx-comp107x-2</a>	

<b>COURSE TITLE</b>	<b>CLOUD COMPUTING</b>	<b>CREDITS</b>	<b>2</b>
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COURSE CODE	CSD4292	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0										
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3										
ASSESSMENT SCHEME															
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE										
15%	15%	10%	5%	5%	50%										
Course Description	Cloud computing is the on-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user. The term is generally used to describe data centers available to many users over the Internet.														
Course Objective	1. To understand the cloud computing paradigm. 2. To recognize the cloud technology. 3. To utilize the cloud file system for data storage. 4. To learn the functionalities of cloud security. 5. To use the intercloud environment to execute real-time applications.														
Course Outcome	Upon completion of this course, the students will be able to 1. Recognize the features of cloud computing paradigm 2. Identify the cloud technology. 3. Explain the relational database and cloud file system. 4. Demonstrate the functionalities of cloud security. 5. Make use of the intercloud environment to execute real-time cloud application.														
Prerequisites: Fundamentals of Distributed and Grid Computing															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
CO-2	3	3	3	3	3	2	2	2	2	2	2	3	3	2	3
CO-3	3	3	3	3	2	1	2	1	1	2	1	3	3	2	3
CO-4	3	3	3	3	1	1	2	1	2	2	1	3	3	2	3
CO-5	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: CLOUD COMPUTING PARADIGM (3L+3L=6)															

<p>Introduction to Cloud Computing, Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering &amp; Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison among SAAS, PAAS, IAAS.</p> <p><b>Practical component:</b></p> <p>Explore Cloud computing simulation tools for deployment</p> <p><b>Suggested Readings:</b></p> <p>Cloud computing paradigm</p>	<p><b>CO-1</b></p> <p><b>BTL-3</b></p>
<b>MODULE 2: CLOUD TECHNOLOGY (3L+3L=6)</b>	
<p>Introduction to Cloud Technologies, Study of Hypervisors, Web services: SOAP and REST with comparisons, AJAX and mashups technologies. Virtualization Technology and its pitfalls. Multitenant software: Multi-entity support, Multi-schema approach, Multi-tenance using cloud data stores, Data access control for enterprise applications</p> <p><b>Practical component:</b></p> <p>Working with CloudSim tool.</p> <p><b>Suggested Readings:</b></p> <p>Apply appropriate cloud technology with multi-tenancy approach.</p>	<p><b>CO-2</b></p> <p><b>BTL-3</b></p>
<b>MODULE 3: DATA IN CLOUD (3L+3L=6)</b>	
<p>Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, Features and comparisons between GFS and HDFS.</p> <p>Map-Reduce and extensions: Parallel computing, The Map-Reduce model, Parallel efficiency of Map-Reduce, Example/Application of Map reduce.</p> <p><b>Practical component:</b></p> <p>Virtual machine management with CloudSim tool.</p> <p><b>Suggested Readings:</b></p> <p>Apply the relational database concept in cloud environment.</p>	<p><b>CO-3</b></p> <p><b>BTL-3</b></p>
<b>MODULE 4: CLOUD SECURITY (3L+3L=6)</b>	
<p>Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud. Identity Management and Access control. Cloud computing security challenges: Virtualization security management- virtual threats, VM Security Recommendations, VM-Specific Security techniques, Secure Execution Environments and Communications in cloud.</p> <p><b>Practical component:</b></p> <p>Cloud security using vulnerability tool analyzer.</p> <p><b>Suggested Readings:</b></p> <p>Establish the cloud security framework.</p>	<p><b>CO-4</b></p> <p><b>BTL-3</b></p>

MODULE 5: INTERCLOUD ENVIRONMENTS (3L+3L=6)	
<p>Issues in cloud computing, Implementing real time application over cloud platform. Issues in Intercloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment. Future cloud paradigms: Mobile Cloud Computing, Sky computing, load balancing, resource optimization and dynamic reconfiguration.</p> <p><b>Practical component:</b></p> <p>CloudAnalyst simulation tool for real-time application.</p> <p><b>Suggested Readings:</b></p> <p>Implement Intercloud scenarios for real time applications.</p>	<p><b>CO-5</b></p> <p><b>BTL-3</b></p>
TEXT BOOKS	
1.	Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, "Cloud Computing for Dummies", Wiley, 2009.
REFERENCE BOOKS	
1.	Scott Granneman, "Google AppsDeciphered: Compute in the Cloud to Streamline Your Desktop", Pearson Education, 2008.
2.	Tim Malhar, S.Kumaraswammy, S.Latif, "Cloud Security & Privacy", O'Reilly, 2009.
E BOOKS	
1.	<a href="https://www.ibm.com/cloud-computing/files/cloud-for-dummies.pdf">https://www.ibm.com/cloud-computing/files/cloud-for-dummies.pdf</a>
MOOC	
1.	<a href="https://nptel.ac.in/courses/106105167/">https://nptel.ac.in/courses/106105167/</a>

COURSE TITLE	JAVA PROGRAMMING			CREDITS	2
COURSE CODE	CSD4293	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	<p>Java is a powerful general-purpose programming language. It is used to develop desktop and mobile applications, big data processing, embedded systems, and so on. Java is a High Level, class-based, object-oriented programming language that is designed to have as few implementation dependencies as possible.</p>				

<b>Course Objective</b>	1. To understand OOP concepts and develop simple Java programs. 2. To inherit classes and implement interfaces. 3. To create files, read and write on console and files. 4. To implement exception handling operations. 5. To understand and use data structures in Java.														
<b>Course Outcome</b>	Upon completion of this course, the students will be able to  1. Understand OOP concepts and develop simple Java programs. 2. Inherit classes and implement interfaces. 3. Create files, read and write on console and files. 4. Implement exception handling operations. 5. Understand and use data structures in Java.														
<b>Prerequisites:</b> Basic Programming															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO-1	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
CO-2	3	3	3	3	3	2	2	2	2	2	2	3	3	2	3
CO-3	3	3	3	3	2	1	2	1	1	2	1	3	3	2	3
CO-4	3	3	3	3	1	1	2	1	2	2	1	3	3	2	3
CO-5	3	3	2	2	2	1	2	1	1	2	2	3	3	2	3
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: INTRODUCTION (3L+3L=6)</b>															
OOP & JAVA-JVM & Byte Code-Java Program Structure and Java Class Library - Data Types - Variables and Operators - Operator Precedence - Selection Statements - Iterative Statement, Defining Classes & Methods – Constructors - Creating Objects of a Class.  <b>Practical component:</b> Working with Java programming  <b>Suggested Readings:</b>  Create objects using different types of constructors.													<b>CO-1</b>  <b>BTL-3</b>		
<b>MODULE 2: INHERITANCE &amp; POLYMORPHISM (3L+3L=6)</b>															
Inheritance - Inheriting Classes- Type of Inheritance, Access Modifiers: public, protected, default, Polymorphism - Overloading – Overriding. Interfaces - Declaring Interfaces - Implementing Interfaces - Using inbuilt interfaces, Abstract Classes.  <b>Practical component:</b>  Working with Java Inheritance and polymorphism  <b>Suggested Readings:</b>													<b>CO-2</b>  <b>BTL-3</b>		

Develop programs to illustrate inheritance and interfaces.		
MODULE 3: INPUT OUTPUT STREAMS (3L+3L=6)		
Input/ Output in Java - I/O Basic-Reading and writing to Console - Reading and Writing on Files-FileInputStream/FileOutputStream –BufferedReader  Practical component:  Working with Input/ Output in Java  Suggested Readings:  File Copy and End of File.		CO-3  BTL-3
MODULE 4: EXCEPTION HANDLING (3L+3L=6)		
Exception-Handling Overview- Exception Types, try-catch, try-catch-finally, throw-throws-rethrow-Built-in Exception, user defined exceptions.  Practical component:  Working with Java Exception Handling  Suggested Readings:  Illustrate exception handling with examples.		CO-4  BTL-3
MODULE 5: DATA STRUCTURES & COLLECTIONS (3L+3L=6)		
Need for Data Structures, Array-ArrayList, String, Collections, Iterators, Vectors and Stacks.  Practical component:  Working with data structures  Suggested Readings: Sort the array of objects.		CO-5  BTL-3
TEXT BOOKS		
1.	Herbert Schildt, “JAVA - The Complete Reference”, 10th Edition, McGraw Hill Education, 2017.	
2.	Cay S. Horstman and Gary Cornell, “Core Java Volume I—Fundamentals”, 11th Edition, Prentice Hall, 2018.	
REFERENCE BOOKS		
1.	Cay Horstman, “Big Java: Early Objects”, 6th Edition, Wiley Publications, 2016.	
E BOOKS		

1.	<a href="https://zimslifeintcs.files.wordpress.com/2011/12/java-2-the-complete-reference-5th-edherbert-schildt.pdf">https://zimslifeintcs.files.wordpress.com/2011/12/java-2-the-complete-reference-5th-edherbert-schildt.pdf</a>
<b>MOOC</b>	
1.	<a href="https://onlinecourses.nptel.ac.in/noc19_cs07/">https://onlinecourses.nptel.ac.in/noc19_cs07/</a>
2.	<a href="https://www.coursera.org/learn/java-programming">https://www.coursera.org/learn/java-programming</a>

COURSE TITLE	DIGITAL IMAGE PROCESSING USING MATLAB			CREDITS	2
COURSE CODE	CSD4381	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course serves as an introduction to the world of DIGITAL IMAGE PROCESSING, and Infer the basics and fundamentals of digital image processing such as digitization, sampling, quantization, and operations.				
Course Objective	1. To Infer the basics and fundamentals of digital image processing such as digitization, sampling, quantization, and operations. 2. To Apply the various techniques for intensity transformations functions and spatial filtering for modify or enhancement of an image.				
Course Outcome	Upon completion of this course, the students will be able to 1. Infer the basics and fundamentals of digital image processing such as digitization, sampling, quantization, and operations. 2. Apply the various techniques for intensity transformations functions and spatial filtering for modify or enhancement of an image. 3. Compute Discrete Fourier Transform and apply Frequency domain filters for image enhancement. 4. Understand and Apply Color Models in Digital Image Processing. 5. Illustrate Morphological operation and Apply image segmentation techniques for various applications.				
Prerequisites: Concept of Digital Signal Processing					
CO, PO AND PSO MAPPING					

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	2	-	-	-	-	-	-	-	3	1	1	-
CO-2	3	3	3	2	-	-	-	-	-	-	2	3	1	1	-
CO-3	3	3	3	2	-	-	-	-	-	-	2	3	1	1	-
CO-4	3	3	3	2	-	-	-	-	-	-	2	3	1	1	-
CO-5	3	3	3	2	-	-	-	-	-	-	2	3	1	1	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE1: DIGITAL IMAGE FUNDAMENTALS</b>													<b>(6L)</b>		
Introduction– Fundamental steps in Image Processing Systems– Image Acquisition – Sampling and Quantization– Pixel Relationships– Mathematical Tools Used in Digital Image Processing. <b>Suggested Activity:</b> Find the representation of image, Reading Images, Writing Images, displaying images, handling image types, and handling operators in images using MATLAB													<b>CO-1</b> <b>BTL-2</b>		
<b>MODULE2: INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING</b>													<b>(6L)</b>		
Background - Some Basic Intensity Transformation Functions: Image Negatives, Log Transformations, Power-Law Transformations- Histogram Processing. Fundamentals of Spatial Filtering- Smoothing Spatial Filters- Sharpening Spatial Filters. <b>Suggested Activity:</b> Apply various intensity transformation functions, Computing and plotting image histograms and use standard image processing toolbox Spatial filters in MATLAB													<b>CO-2</b> <b>BTL-2</b>		
<b>MODULE3: FREQUENCY DOMAIN FILTERS</b>													<b>(6L)</b>		
Background- Sampling and the Fourier Transform of sampled functions - Discrete Fourier Transform (DFT)- Some Properties of the 2-D Discrete Fourier Transform- The Basics of Filtering in the Frequency Domain- Image Smoothing and Sharpening using Frequency Domain Filters- Selective Filtering. <b>Suggested Activity:</b> Compute and visualize the 2-D DFT, implement smoothing and sharpening techniques using low pass and high pass filters in frequency domain in MATLAB.													<b>CO-3</b> <b>BTL-3</b>		
<b>MODULE4: COLOR IMAGE PROCESSING</b>													<b>(6L)</b>		
Color Fundamentals- Color Models: RGB, CMY, CMYK, and HSI Color Models- Pseudo color Image Processing- Color Transformations- Color Image Smoothing and Sharpening. <b>Suggested Activity:</b> Find the representation of color image, Convert to Other Color Spaces, implement color transformations, and implement color image Smoothing and Sharpening in MATLAB.													<b>CO-4</b> <b>BTL-2</b>		

MODULE5:MORPHOLOGICALIMAGEPROCESSINGANDIMAGESEGMENTATION (6L)	
MorphologicalImageProcessing:Fundamentals-ErosionandDilation-OpeningandClosing-SomeBasicMorphologicalAlgorithms.ImageSegmentation:Introduction-Point,Line,andEdgeDetection –SegmentationbyRegionGrowingandbyRegionSplittingandMerging. <b>SuggestedActivity:</b> ImplementMorphologicaloperations,imagesegmentationandregion-basedsegmentationin MATLAB.	<b>CO-5</b>  <b>BTL-2</b>
TEXT BOOKS	
1.	RafaelCGonzalez,RichardEWoods,“DigitalImageProcessing”,4thEdition,Pearson,2018.
REFERENCEBOOKS	
1.	RafaelC.Gonzalez,RichardE. Woods,StevenEddins,DigitalImageProcessingusingMATLAB PearsonEducation,Inc.,2011.
2.	KennethR.Castleman,DigitalImageProcessingPearson,2006.
3.	AnilK.Jain,“FundamentalsofDigitalImageProcessing”,PersonEducaiton,2003.
EBOOKS	
1.	<a href="https://www.academia.edu/19746149/Digital_Image_Processing_3rd_Edition_Instructors_Manual_Rafael_C._Gonzalez">https://www.academia.edu/19746149/Digital_Image_Processing_3rd_Edition_Instructors_Manual_Rafael_C._Gonzalez</a>
2.	<a href="https://www.academia.edu/18324189/Digital_image_processing_using_matlab_gonzalez">https://www.academia.edu/18324189/Digital_image_processing_using_matlab_gonzalez</a>
3.	<a href="https://pdfs.semanticscholar.org/15bd/427a1a5f9bc57a7f67fb1b1fc85c5bb39f46.pdf">https://pdfs.semanticscholar.org/15bd/427a1a5f9bc57a7f67fb1b1fc85c5bb39f46.pdf</a>
MOOC	
1.	<a href="https://www.coursera.org/learn/digital">https://www.coursera.org/learn/digital</a>
2.	<a href="https://www.udemy.com/topic/digital-image-processing/">https://www.udemy.com/topic/digital-image-processing/</a>

COURSE TITLE	ETHICAL HACKING			CREDITS	2
COURSE CODE	CSD4382	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%



Course Description	This course serves as an introduction to the world of ETHICAL HACKING. To Identify the DNS, IP address, range and Operating System etc., related to a remote system.														
Course Objective	1. To Understand the basics of Ethical Hacking and Cryptographic techniques. 2. To study and implement cyber security tools for real-time applications														
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the concept of Ethical Hacking and Cryptographic techniques 2. Identify the DNS, IP address, range and Operating System etc., related to a remote system. 3. Analyze the packets and able to find the intruders. 4. Discover Vulnerabilities in a web application and servers. 5. Implement Pentest tools.														
Prerequisites: Networks, Operating System															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	2	2	2	-	-	-	-	-	-	-	1	1	-
CO-2	3	3	2	2	2	-	-	-	-	-	-	-	1	1	-
CO-3	3	3	2	2	2	1	-	-	-	-	-	-	1	1	-
CO-4	3	3	2	2	2	-	-	-	-	-	-	-	1	1	-
CO-5	3	3	2	2	2	3	-	-	-	-	-	-	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE1: ETHICAL HACKING BASICS													(6L)		
Introduction to Ethical Hacking – Types of hacking – Phases of Ethical hacking. Cryptography: Cryptography and encryption – PKI, Digital certificates, and digital signature – Encrypted communication and Cryptography attacks. Suggested Activities: Sample problems in Encryption techniques Suggested Reading: <a href="https://www.udemy.com/course/ethical-hacking-basics-part-1-cryptography">https://www.udemy.com/course/ethical-hacking-basics-part-1-cryptography</a>													CO-1  BTL-2		
MODULE2: RECONNAISSANCE AND SCANNING													(6L)		

<p>Foot printing : Foot printing with DNS – Determining Network Range – Google Hacking.Scanning          PortScanning.Enumeration:WindowsSecuritybasics–Enumeration Techniques.  <b>Suggested Activities:</b>Gather complete information about a Computer System such as DNS, IPaddress, IPaddress rangeandfindingthe open ports.  <b>SuggestedReading:</b><a href="https://www.edureka.co/blog/footprinting-ethical-hacking-kali-linux">https://www.edureka.co/blog/footprinting-ethical-hacking-kali-linux</a></p>	<p><b>CO-2</b> <b>BTL-2</b></p>
<b>MODULE3: SYSTEMATTACK (6L)</b>	
<p>Sniffing: Communications basics – Sniffing techniques and tools – Network Roadblocks: IntrusionDetection – Session hijacking, Firewalls and Honeypots, Denial of Service attacks. System Attack:Windows system hacking – Password Cracking – Exploitingprivileges. Social Engineering: HumanBased attack –Computer basedattack.  <b>Suggested Activities:</b> Demonstration of Rainbow Crack, Cain &amp; Abel tools to crack passwords andKismet,Wiresharktointerceptthemessages.  <b>SuggestedReading:</b><a href="https://www.udemy.com/course/password">https://www.udemy.com/course/password</a></p>	<p><b>CO-3</b> <b>BTL-3</b></p>
<b>MODULE4: WEBBASEDANDWIRELESSHACKING (6L)</b>	
<p>PhysicalSecurity.WebServerHacking:Websevicearchitecture– Webattacks.WebApplications:Webapplicationsattack– Webresourcesprotection.WirelessAttacks–Bluetoothattacks.  <b>SuggestedActivities:</b>Cross-siteScripting,SQL–Injectiondemonstration.  <b>SuggestedReading:</b><a href="https://www.udemy.com/course/web-app-hacking">https://www.udemy.com/course/web-app-hacking</a></p>	<p><b>CO-4</b> <b>BTL-2</b></p>
<b>MODULE5: MALWARESANDPENETRATIONTESTING (6L)</b>	
<p>MalwareAttacks:Trojans,virusesandworms.PenetrationTesting:TypesofPenetrationtesting– Penetration testingmethodologies– Penetrationtest tools.  <b>SuggestedActivities:</b>Demonstrationofpentesttools–Nmap,Wireshark,etc.  <b>SuggestedReading:</b><a href="https://www.udemy.com/topic/penetration-testing/">https://www.udemy.com/topic/penetration-testing/</a></p>	<p><b>CO-5</b> <b>BTL-2</b></p>

**TEXTBOOKS**

- |    |   |
|----|---|
| 1. | MattWalker,“CEH-CertifiedEthicalHackersGuide“,4 <sup>th</sup> Edition,McGraHillEducation, 2019  |
| 2. | MichaelGregg,“CertifiedEthicalHacker(CEH)Version9CertGuide“,2 <sup>nd</sup> Edition,Pearson Education,2018  |
| 3. | PatrickEngelbreton,“TheBasicsofHackingandPenetrationTesting:EthicalHackingand PenetrationTestingMadeEasy“,2 <sup>nd</sup> Edition,Syngress,Elseveir,2013. |
| 4. | ParteekSharma,“HackingRevealed“,1 <sup>st</sup> Edition,WhiteFalconPublishing,2018.   |

**REFERENCEBOOKS**

- |    |  |
|----|--|
| 1. | ReginaldWong,“MasteringReverseEngineering:Re-engineeryourethicalhackingskills“, PacktPublishing,2018.                            |
| 2. | DafyddStuttard,MarcusPinto,“TheWebApplicationHacker'sHandbook:Findingand ExploitingSecurityFlaws“,2ndEdition,JohnWeily&Sons,2011 |

3.	MonnappaKA, "Learning Malware Analysis: Explore the concepts, tools, and techniques to analyze and investigate Windows malware", 1st Edition, Packt Publishing, 2018.
<b>EBOOKS</b>	
1.	<a href="https://www.mediafire.com/file/dyewn6f3r3olnuw/A_Beginners_Guide_To_Hacking_Computer_Systems.zip/file">https://www.mediafire.com/file/dyewn6f3r3olnuw/A_Beginners_Guide_To_Hacking_Computer_Systems.zip/file</a>
2.	<a href="https://www.mediafire.com/file/8derf9dueyq64i5/Computer_Viruses%252C_Hacking_and_Malware_attacks_for_Dummies.zip/file">https://www.mediafire.com/file/8derf9dueyq64i5/Computer_Viruses%252C_Hacking_and_Malware_attacks_for_Dummies.zip/file</a>
<b>MOOC</b>	
1.	<a href="https://www.udemy.com/Ethical-Hacking/Online-Course">https://www.udemy.com/Ethical-Hacking/Online-Course</a>
2.	<a href="https://www.nptel.ac.in/courses/106105217">https://www.nptel.ac.in/courses/106105217</a>

COURSE TITLE	ARTIFICIAL INTELLIGENCE			CREDITS	2
COURSE CODE	CSD4383	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course serves as an introduction to the world of ARTIFICIAL INTELLIGENCE. And to Understand the basics of the building blocks of Artificial Intelligence.				
Course Objective	1. To understand the concept of searching techniques in the form of informed, uninformed search algorithms, Game tree search and heuristics. 2. To distinguish different learning algorithms used in the design of an AI agent and apply it using scikit Learn				
Course Outcome	Upon completion of this course, the students will be able to  1. Understand the basics of the building blocks of Artificial Intelligence. 2. Develop an understanding in the searching techniques in the form of informed, uninformed search algorithms, Game tree search and heuristics. 3. Distinguish different learning algorithms used in the design of an AI agent and apply it using scikit Learn. 4. Understand the various explorations in Artificial Intelligence 5. Develop an expert system for an application with the knowledge on different applications and				

specializations in Artificial Intelligence.

**Prerequisites:** Basics in Problem Solving and Critical Thinking

#### CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	-	1	-	-	-	-	-	-	-	1	1	-
CO-2	3	3	-	3	-	-	-	-	-	-	-	2	1	1	-
CO-3	3	3	3	3	3	-	-	-	2	-	-	2	1	1	-
CO-4	3	3	3	3	3	-	-	-	2	-	-	2	1	1	-
CO-5	3	3	3	3	3	-	-	-	-	-	-	2	1	1	-

1: Weakly related, 2: Moderately related and 3: Strongly related

#### MODULE1:INTRODUCTIONTOARTIFICIALINTELLIGENCE

(6L)

AI from Human Life-Neurons and the Brain-Psychology and Cognitive Science-Philosophy and Logic-  
AI from Engineering-Automata, Sensing, and Feedback-Statistics and Probability-Finite-State Machines-  
The Turing Test-The Turing Machine.

**Suggested Activity:** Group Discussion: The current trends in Artificial Intelligence.

**CO-1**  
**BTL-2**

#### MODULE2:PROBLEMSOLVING

(6L)

Reasoning and Representations-First Order Predicate Calculus-Theorem Proving Techniques-  
Resolution-Heuristic Search Strategies-Reasoning by Analogy-Solving Problems by Theorem Provers-  
State Space-Predicate-Calculus Description of State-Space Problems-  
Path Finding, Example Generation, Constructive Proofs, Answer Extraction-  
Theorem Proving in Planning and Automatic Programming.

**Suggested Activity:** Solve by Examples: First Order Predicate Calculus Examples with resolution principle and Unifiers.

**CO-2**  
**BTL-2**

#### MODULE3:FORMSOFLEARNING

(6L)

Bayesian Networks-Machine Learning-Memory-Based Learning-Decision Trees-  
Supervised and Unsupervised Learning-Neural Networks-Reinforcement learning.

**Suggested Activity:** Practical: Distinguish different learning methods using Scikit Learn with Anaconda.

**CO-3**  
**BTL-3**

MODULE4:EXPLORATIONSINARTIFICIALINTELLIGENCE (6L)	
LearningMachines-PatternRecognition-HeuristicPrograms-SemanticRepresentations-NaturalLanguageProcessing-ComputerVision-GamePlaying-IntelligentSystemArchitectures-CognitiveArchitectures. <b>SuggestedActivity:</b> CaseStudy:MobileRobots.	<b>CO-4</b> <b>BTL-2</b>
MODULE5:APPLICATIONSANDSPECIALIZATIONS (6L)	
Speech Recognition and Understanding Systems- Speech Processing— Consulting Systems - The SRIComputer-Based Consultant-Expert Systems-Robot Systems- Ubiquitous Artificial Intelligence-Self-organizing,and EvolutionarySystems. <b>SuggestedActivity:</b> CaseStudy:SmartToolsofAI.	<b>CO-5</b> <b>BTL-2</b>
TEXT BOOKS	
1.	NilsJ.Nilsson“TheQuestforArtificialIntelligence:AHistoryofIdeasandAchievements”byCambridgeUniversity Press,2009.
2.	PhilipC. Jackson,Jr“IntroductiontoArtificialIntelligence”ThirdEdition,DoverPublications,Inc, NewYork,2019.
REFERENCE BOOKS	
1.	StuartRussell,PeterNorvig,“ArtificialIntelligence–AModernApproach”,2ndEdition,Pearson Education/PrenticeHallofIndia,2004.
2.	ElaineRichandKevinKnight,“ArtificialIntelligence”,2ndEdition,TataMcGraw-Hill,2003.
EBOOKS	
1.	<a href="http://ai.stanford.edu/~nilsson/QAI/qai.pdf">http://ai.stanford.edu/~nilsson/QAI/qai.pdf</a>
MOOC	
1.	<a href="https://swayam.gov.in/nd1_noc20_cs42/preview">https://swayam.gov.in/nd1_noc20_cs42/preview</a>
2.	<a href="https://www.coursera.org/learn/introduction-to-ai">https://www.coursera.org/learn/introduction-to-ai</a>

COURSE TITLE	BIG DATA ANALYTICS			CREDITS	2
COURSE CODE	CSD4391	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE

15%	15%	10%	5%	5%	50%										
Course Description	This course serves as an introduction to the world of BIGDATAANALYTICS. And Outline the importance of Big Data Analytics														
Course Objective	1. To Relate the Data Analytics Lifecycle, which is an approach to managing and executing analytical projects 2. To Apply the knowledge of problems associated with big data in various domains for Big data Analytics Using R.														
Course Outcome	Upon completion of this course, the students will be able to 1. Outline the importance of Big Data Analytics 2. Relate the Data Analytics Lifecycle, which is an approach to managing and executing analytical projects 3. Apply the knowledge of problems associated with big data in various domains for Big data Analytics Using R. 4. Apply tools and techniques to analyze big data using clustering & Association Rules techniques. 5. Categorize and summarize the applications using MapReduce also to Develop Big Data Solutions using Hadoop Eco System														
Prerequisites: Database basics															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	-	-	-	-	-	-	-	-	-	1	1	-
CO-2	3	3	3	3	3	-	-	-	-	-	-	2	1	1	-
CO-3	3	3	3	3	3	-	-	-	-	-	-	-	1	1	-
CO-4	3	3	3	3	3	-	-	-	-	-	-	-	1	1	-
CO-5	3	3	3	3	3	-	-	-	-	-	-	2	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE1:INTRODUCTION TO BIG DATA ANALYTICS (6L)															
Big Data Overview-Data Structures-Analyst Perspective on Data Repositories- State of the Practice in Analytics - BI Versus Data Science- Current Analytical Architecture- Drivers of Big Data- Emerging Big Data Ecosystem and a New Approach to Analytics- Key Roles for the New Big Data Ecosystem -Examples of Big Data Analytics. Suggested Activity: Group Discussion: The challenges of the current analytical architecture for data scientists.													CO-1 BTL-2		
MODULE2:DATA ANALYTICS LIFECYCLE (6L)															

DataAnalyticsLifecycleOverview-KeyRolesforaSuccessfulAnalyticsProject- BackgroundandOverviewofDataAnalyticsLifecycle- Phase1:DiscoveryLearningtheBusinessDomain,Resources, Framing the Problem, Identifying Key Stakeholders, Interviewing the Analytics Sponsor, DevelopingInitialHypotheses, Identifying PotentialData Sources-Phase 2:Data Preparation,PreparingtheAnalytic Sandbox, Performing ETLT, Learning About the Data, Data Conditioning, Survey and Visualize,CommonToolsfortheDataPreparationPhase- Phase3:ModelPlanning,DataExplorationandVariable Selection, Model Selection, Common Tools for the Model Planning Phase -Phase 4: ModelBuilding, Common Tools for the Model Building Phase -Phase5:Communicate Results-Phase 6:Operationalize <b>SuggestedActivity:</b> CaseStudy:GlobalInnovationNetworkandAnalysis(GINA)		<b>CO-2</b> <b>BTL-2</b>
<b>MODULE3:BASICDATAANALYTICSUSINGR</b> (6L)		
Introduction to R-R Graphical User Interfaces-Data Import and Export--Attribute and Data Types-Descriptive Statistics -Exploratory Data Analysis- Visualization Before Analysis -Dirty Data - StatisticalMethodsforEvaluation-HypothesisTesting. <b>Suggested Activity:</b> Apply Hypothesis statistical method and analyze: Suppose everyone who visits aretailwebsitegetsonepromotionalofferornopromotionatall.Wewanttoseeifmakinga promotionaloffer makesadifference.		<b>CO-3</b> <b>BTL-3</b>
<b>MODULE4:CLUSTERING&amp;ASSOCIATIONRULES</b> (6L)		
Advanced Analytical Theory and Methods:CLUSTERING - Overview of Clustering-K-means -Use Cases-OverviewoftheMethod-DeterminingtheNumberofClusters- AdvancedAnalyticalTheoryASSOCIATION RULES, Overview -Apriori Algorithm -Evaluation of Candidate Rules -Applications ofAssociation Rules <b>SuggestedActivity:</b> AssociationRules		<b>CO-4</b> <b>BTL-2</b>
<b>MODULE5:MAPREDUCEANDHADOOP</b> (6L)		
AdvancedAnalytics—TechnologyandTools:MapReduceandHadoop- AnalyticsforUnstructuredData -UseCases -MapReduce-Apache Hadoop- TheHadoopEcosystem-Pig <b>SuggestedActivity:</b> UseMapReduceinHadooptoperformawordcountonthespecifieddataset.		<b>CO-5</b> <b>BTL-2</b>
<b>TEXT BOOKS</b>		
1.	JohnWiley&Sons“DataScience&BigDataAnalytics:Discovering,Analyzing,Visualizingand PresentingData”byJohnWiley&Sons,Inc. Indianapolis,Indiana,2015.	
<b>REFERENCEBOOKS</b>		
1.	<b>VigneshPrajapati,"BigDataAnalyticswithRandHadoop",2013.</b>	
2.	KimH.PriesandRobertDunnigan,"BigDataAnalytics:APracticalGuideforManagers"CRC Press,2015	
<b>EBOOKS</b>		
1.	<a href="http://csis.pace.edu/ctappert/cs816-19fall/books/2015DataScience&amp;BigDataAnalytics.pdf">http://csis.pace.edu/ctappert/cs816-19fall/books/2015DataScience&amp;BigDataAnalytics.pdf</a>	
<b>MOOC</b>		
1.	<a href="https://www.mooc-list.com/course/introduction-big-data-analytics-coursera">https://www.mooc-list.com/course/introduction-big-data-analytics-coursera</a>	

2.	<a href="https://www.mooc-list.com/tags/big-data">https://www.mooc-list.com/tags/big-data</a>
3.	<a href="http://nptel.ac.in/courses/110106072/">http://nptel.ac.in/courses/110106072/</a>
4.	<a href="https://www.coursera.org/specializations/big-data">https://www.coursera.org/specializations/big-data</a>

COURSE TITLE		CYBER FORENSICS, INVESTIGATIONS AND LAWS						CREDITS			2				
COURSE CODE		CSD4392		COURSE CATEGORY			NE		L-T-P-S			2-0-0-0			
Version		1.0		Approval Details					LEARNING LEVEL			BTL-3			
ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment			Seminar/ Assignments/ Project			Surprise Test / Quiz		Attendance			ESE		
15%		15%			10%			5%		5%			50%		
Course Description		This course serves as an introduction to the world of CYBERSECURITY AND FORENSICS. To Interpret the Concepts and Mechanisms of Cyber Security													
Course Objective		1. To understand the different cybercrime activities. 2. To understand the relation between cyber laws and cyber crimes													
Course Outcome		Upon completion of this course, the students will be able to 1. Interpret the Concepts and Mechanisms of Cyber Security 2. Classify the various cybercrime activities 3. Relate cyber laws and cyber crimes 4. Solve various cybercrimes using tools and techniques 5. Examine various devices for digital evidences													
Prerequisites : Computer Network															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	2	2	2	-	-	-	-	-	2	1	1	-



CO-2	3	3	3	2	1	2	-	2	-	-	-	2	1	1	-
CO-3	3	3	3	2	1	2	-	2	-	-	-	2	1	1	-
CO-4	3	3	3	2	2	2	-	2	-	-	-	2	1	1	-
CO-5	3	3	3	2	2	2	-	2	-	-	-	2	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE1:INTRODUCTIONTOCYBERSECURITY (6L)															
OverviewofCyberSecurity-CyberSecurity-ProtectionMechanisms–Firewalls– IntrusionDetectionSystems–IntrusionPreventionSystems– EmailSecurity– WebSecurity <b>SuggestedActivity:</b> DemonstrateanyoneSecuritymechanismimplementedinthecampuservers														CO-1 BTL-2	
MODULE2:INTRODUCTIONTOCYBERCRIMES (6L)															
IntroductionandOverviewofCyberCrime-NatureandScopeofCyberCrime-Types ofCyberCrime:SocialEngineering-CategoriesofCyberCrime-PropertiesofCyberCrime. <b>SuggestedActivity:</b> Classifythegivennetworkactivityascriminalandnormalactivity														CO-2 BTL-2	
MODULE3:CYBERLAWSANDACTS (6L)															
LawsandEthics-DigitalEvidenceControls-EvidenceHandlingProcedures- BasicsofIndianEvidenceACTIPCanCrPC-ElectronicCommunicationPrivacyACT-LegalPolicies. <b>SuggestedActivity:</b> Identifytheappropriatelegalpolicyforanygivencybercrime.														CO-3 BTL-3	
MODULE4:CYBERINVESTIGATION (6L)															
IntroductiontoCyberCrimeInvestigation-InvestigationTools–Discovery- DigitalEvidenceCollection- Evidence Preservation - E-Mail Investigation – Tracking - IP Tracking - E-Mail Recovery-RecoveringDeletedEvidences-Password Cracking <b>SuggestedActivity:</b> AnalyzeanygivenPCAPfilesusingWiresharkandobtainforensicevidences.														CO-4 BTL-2	
MODULE5:FORENSICEXAMINATION OFDEVICES (6L)															
ForensicExaminationofWindowsSystem-ForensicExaminationofUnixSystem– ForensicExamination ofHandhelddevices. <b>SuggestedActivity:</b> Examineanyonedeviceforforensicevidence/dataandsubmitareport														CO-5 BTL-2	
TEXT BOOKS															

1.	BillNelson,AmeliaPhillips,FrankEnfinger,ChristopherSteuart,—ComputerForensicsand Investigations,CengageLearning,IndiaEdition,2016.
2.	KevinMandia,ChrisProsis,MattPepe,“IncidentResponseandComputerForensics“,Tata McGraw-Hill,NewDelhi,2006.
3.	Man, Young Rhee, “Internet Security: Protocols”,WileyPublications,2003.
<b>REFERENCEBOOKS</b>	
1.	RobertMSlade,“SoftwareForensics”,TataMcGrawHill,NewDelhi,2005.
2.	BernadetteHSchell,ClemensMartin,“Cybercrime”,ABC–CLIOInc,California,2004.
<b>E BOOKS</b>	
1.	<a href="https://doc.lagout.org/security/ceh-official-certified-ethical-hacker-review-guide-exam-312-50.9780782144376.27422.pdf">https://doc.lagout.org/security/ceh-official-certified-ethical-hacker-review-guide-exam-312-50.9780782144376.27422.pdf</a>
<b>MOOC</b>	
1.	<a href="https://www.mooc-list.com/tags/digital-forensics">https://www.mooc-list.com/tags/digital-forensics</a>
2.	<a href="https://www.mooc-list.com/course/cybersecurity-capstone-edx">https://www.mooc-list.com/course/cybersecurity-capstone-edx</a>

COURSE TITLE	MACHINE LEARNING			CREDITS	2
COURSE CODE	CSD4393	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course serves as an introduction to the world of MACHINE LEARNING and to Demonstrate the concepts of machine learning, its algorithms				
Course Objective	1. To understand the concept of Machine Learning and its algorithms 2. To know the real-time problem-solving methods using ANN and CNN				

Course Outcome	Upon completion of this course, the students will be able to														
	1. Demonstrate the concepts of machine learning, its algorithms														
	2. Analyze supervised learning algorithms for different applications														
	3. Analyze unsupervised learning algorithms for different applications														
	4. Solve problems using artificial neural networks artificial neural networks														
5. Identify probabilistic graphical models															
Prerequisites: ProbabilityandStatistics															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO - 10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	2	2	1	-	-	-	-	-	-	1	1	1	-
CO-2	3	3	2	2	1	-	-	-	-	2	-	2	1	1	-
CO-3	3	3	2	2	1	-	-	-	-	-	-	2	1	1	-
CO-4	3	3	2	2	1	-	-	-	-	-	-	2	1	1	-
CO-5	3	3	2	2	1	-	-	-	-	-	-	2	1	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE1:FUNDAMENTALSOFMACHINELEARNING (6L)															
Definitionoflearningsystems-Goalsandapplicationsofmachinelearning-TypesOfMachineLearning- MachineLearningProcess-Terminology-WeightSpace-TheCurseOfDimensionality- TestingMachineLearningAlgorithms SuggestedActivities:(UsingPythonLibraries/MATLABTool) InstallingPythonLibraries/MATLABtools SuggestedReading: Introduction: <a href="https://nptel.ac.in/courses/106105152/">https://nptel.ac.in/courses/106105152/</a>													CO-1 BTL-2		
MODULE2:SUPERVISEDLEARNING (6L)															
Regression:LinearRegression–ParametricModels-MultivariateRegression. Classification:BayesianDecisionTheory-parametricandnon-parametricmethods- MultivariateClassification-Logistic Regression-K-NearestNeighborclassifier. DecisionTreebasedmethodsforclassificationandRegression-Ensemblemethods. SuggestedActivities:(UsingPythonLibraries/MATLABTool) TodesignamodelforpredictingthehousingpricefromUCIdatasetusingMultivariateLinearRegression. SuggestedReading: <a href="https://nptel.ac.in/content/storage/MP4/106106139/mod01lec02.mp4">https://nptel.ac.in/content/storage/MP4/106106139/mod01lec02.mp4</a>													CO-2 BTL-2		
MODULE3:UNSUPERVISEDLEARNING															
Introduction-Clustering-K-means Clustering, EM algorithm, Hierarchical Clustering- PrincipalComponentAnalysis-ProbabilisticPCA. SuggestedActivities:(UsingPythonLibraries/MATLABTool)													CO-3 BTL-3		

To segment a customer dataset based on the buying behavior of customers using K-means/Hierarchical clustering. <b>Suggested Reading:</b> <a href="https://nptel.ac.in/content/storage/MP4/106106139/mod01lec03.mp4">https://nptel.ac.in/content/storage/MP4/106106139/mod01lec03.mp4</a>		
<b>MODULE 4: NEURONS &amp; NEURAL NETWORKS (6L)</b>		
The Brain And The Neuron-Neural Networks-Perceptron-Training the perceptron-Perceptron Learning Algorithm-Multilayer Perceptron- Back Propagation-Dimensionality Reduction. <b>Suggested Activities: (Using Python Libraries/MATLAB Tool)</b> Recognition of MNIST handwritten digits using Artificial Neural Network. <b>Suggested Reading:</b> <a href="https://nptel.ac.in/content/storage/MP4/106106139/mod10lec32.mp4">https://nptel.ac.in/content/storage/MP4/106106139/mod10lec32.mp4</a> <a href="https://nptel.ac.in/content/storage/MP4/106106139/mod10lec33.mp4">https://nptel.ac.in/content/storage/MP4/106106139/mod10lec33.mp4</a>		
<b>MODULE 5: GRAPHICAL MODELS (6L)</b>		
Introduction-Graphical Models-Naive Bayes Classifier-Hidden Markov Model (HMM)-Linear Regression-Undirected Graphs: Markov Random Fields-Learning the Structure of a Graphical Model. <b>Suggested Activities: (Using Python Libraries/MATLAB Tool)</b> Text classification using Naïve Bayes Classifier. <b>Suggested Reading:</b> Naïve Bayes: <a href="https://nptel.ac.in/content/storage/MP4/106106139/mod16lec63.mp4">https://nptel.ac.in/content/storage/MP4/106106139/mod16lec63.mp4</a> HMM: <a href="https://nptel.ac.in/content/storage/MP4/106106139/mod16lec67.mp4">https://nptel.ac.in/content/storage/MP4/106106139/mod16lec67.mp4</a> Undirected Graph Models: <a href="https://nptel.ac.in/content/storage/MP4/106106139/mod16lec65.mp4">https://nptel.ac.in/content/storage/MP4/106106139/mod16lec65.mp4</a>		<b>CO-5</b> <b>BTL-2</b>
<b>TEXT BOOKS</b>		
1.	Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.	
2.	Tom Mitchell, "Machine Learning", McGraw-Hill, 1997. (latest edition)	
3.	Ethem Alpaydin, “Introduction to Machine Learning”, 4 <sup>th</sup> edition, MIT Press, March 2020.	
4.	Richert and Coelho, “Building Machine Learning System with Python”, 2013.	
<b>REFERENCE BOOKS</b>		
1.	Stephen Marsland, “Machine Learning—An Algorithmic Perspective”, CRC Press, 2009.	
2.	Andreas C. Muller, “Introduction to Machine Learning with Python: A Guide for Data Scientists”, O'Reilly, 2016.	
3.	Sebastian Raschka, “Python Machine Learning”, Packt Publishing, 2015.	
4.	Hastie, Tibshirani, Friedman, “The Elements of Statistical Learning: Data Mining, Inference, and Prediction”, 2 <sup>nd</sup> Edition, Springer, 2017.	
<b>E BOOKS</b>		

1.	<a href="https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html">https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html</a>
2.	<a href="http://web4.cs.ucl.ac.uk/staff/D.Barber/textbook/091117.pdf">http://web4.cs.ucl.ac.uk/staff/D.Barber/textbook/091117.pdf</a>
3.	<a href="http://www.dkriesel.com/media/science/neuronale-netze-en-zeta2-2col-dkrieselcom.pdf">http://www.dkriesel.com/media/science/neuronale-netze-en-zeta2-2col-dkrieselcom.pdf</a>
<b>MOOC</b>	
1.	<a href="https://www.coursera.org/learn/machine-learning">https://www.coursera.org/learn/machine-learning</a>

COURSE TITLE		BUSINESS INTELLIGENCE								CREDITS		2			
COURSE CODE		CSD4481		COURSE CATEGORY		NE		L-T-P-S		2-0-0-0					
Version		1.0		Approval Details				LEARNING LEVEL		BTL-4					
ASSESSMENT SCHEME															
First Periodical Assessment		Second Periodical Assessment		Seminar/ Assignments/ Project		Surprise Test / Quiz		Attendance		ESE					
15%		15%		10%		5%		5%		50%					
Course Description		This is a course suitable for all B.Tech students. It deals basics of Data Information and Knowledge. This course helps to learn Data Validation, Data Transformation. Also, from this course students are able to understand the concepts of operational intelligence.													
Course Objective		1. To understand data information and knowledge. 2. To learn the concept of Decision Support Systems (DSS). 3. To learn Functionalities & Classifications of Data Mining. 4. To understand data validation and data transformation. 5. To learn the concept of operational intelligence.													
Course Outcome		Upon completion of this course, the students will be able to 1. Explain the essentials of BI & data analytics and the corresponding terminologies. 2. Summarize the Mathematical Model and their support Systems. 3. Analyze the steps involved in the BI - Analytics process. 4. Illustrate competently on the topic of Data analytics. 5. Demonstrate the real time scenario using BI & Data analytics techniques.													
Prerequisites: Weka Tool															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3

CO-1	2	2	-	-	1	3	-	-	-	-	-	-	-	-
CO-2	1	2	-	-	2	1	-	-	-	-	-	-	-	-
CO-3	2	-	-	2	3	1	-	-	-	-	-	-	-	-
CO-4	2	3	-	-	-	-	-	-	2	-	-	1	-	-
CO-5	1	2	-	-	3	-	-	-	2	1	2	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: BUSINESS INTELLIGENCE – INTRODUCTION (6L)														
Introduction - History and Evolution: Effective and Timely decisions, Data Information and Knowledge, Architectural Representation, Role of mathematical Models, Real Time Business Intelligent System.  Suggested Activity:  Import the legacy data from different sources such as (Excel, Sql Server, Oracle etc.) and load in the target system.													CO-1  BTL-2	
MODULE 2: BI – DSS & MATHEMATICAL MODEL FOR DECISION MAKING(6L)														
Decision Support Systems (DSS) – Representation of Decision-making Process, Evolution of Information systems, Development of DSS, Structure of Mathematical Models, Development of Models, Model Classes.  Suggested Activity:  Create the Data staging area for the selected database.													CO-2  BTL-2	
MODULE 3: BI – DATA MINING & WAREHOUSING(6L)														
Data Mining - Introduction to Data Mining, Architecture of Data Mining and How Data mining works(Process) , Functionalities & Classifications of Data Mining, Representation of Input Data, Analysis Methodologies.  Data Warehousing - Introduction to Data Warehousing, Data Mart, Online Analytical Processing (OLAP) – Tools, Data Modeling, Difference between OLAP and OLTP, Schema – Star and Snowflake Schemas, ETL Process – Role of ETL..  Suggested Activity:  Create the cube with suitable dimension and fact tables based on ROLAP, MOLAP and HOLAP model.													CO-3  BTL-3	
MODULE 4: BI – DATA PREPARATION (6L)														
Data Validation - Introduction to Data Validation, Data Transformation – Standardization and Feature Extraction, Data Reduction – Sampling, Selection, PCA, Data.  Suggested Activity:  Import the data warehouse data in Microsoft Excel and create the Pivot table and Pivot Chart Create the Data staging area for the selected database.													CO-4  BTL-2	
MODULE 5: IMPLEMENTATION OF BI (6L)														

Operational Intelligence: Technological – Business Activity Monitoring, Complex Event Processing, Business Process Management, Metadata, Root Cause Analysis		CO-5  BTL-2
<b>Suggested Activity:</b>  Create the ETL map and setup the schedule for execution.		
TEXT BOOKS		
1.	Drew Bentely. <i>Business Intelligence and Analytics</i> , Library Pres., (2017). ISBN: 978-1-9789-2136-8	
2.	Larissa T. Moss & Shaku Atre, <i>Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications</i> , First Edition, Addison-Wesley Professional, 2003.	
3.	Kimball, R., Ross, M., Thornthwaite, W., Mundy, J., and Becker, B. John, <i>The Data Warehouse Lifecycle Toolkit: Practical Techniques for Building Data Warehouse and Business Intelligence Systems</i> , Second Edition, Wiley & Sons, 2008.	
REFERENCE BOOKS		
1.	Cindi Howson, <i>Successful Business Intelligence</i> , Second Edition, McGraw-Hill Education, 2013.	
E BOOKS		
1.	Ramesh Sharda, Dursun Delen, Efraim Turban. <i>Business Intelligence A Managerial Perspective on Analytics</i> , Third Edition, Pearson Publications. Link: <a href="https://bit.ly/2YcuLHK">https://bit.ly/2YcuLHK</a>	
2	Carlo-Vercellis, <i>Business Intelligence Data Mining and Optimization for Decision-Making</i> , First Edition, 2009. Link : <a href="https://bit.ly/3d6XxOr">https://bit.ly/3d6XxOr</a>	
MOOC		
1.	<a href="https://www.coursera.org/learn/business-intelligence-data-analytics">https://www.coursera.org/learn/business-intelligence-data-analytics</a>	

COURSE TITLE	COMPUTER VISION			CREDITS	2
COURSE CODE	CSD4482	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This is a course suitable for B.Tech students. It deals basics of computer vision and images. This course helps to learn thresholding and morphology. Also, from this course				

	students are able to understand the concepts edges, template matching and moving object detection.														
Course Objective	1. To understand the basics of computer vision and images. 2. To understand the concepts of thresholding and Multispectral – morphology. 3. To learn the concepts of edges and Hough transform. 4. To identify the techniques and performance metrics. 5. To understand the Moving Object Detection.														
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the basics of computer vision techniques. 2. Apply the thresholding, morphology and transformation techniques to images. 3. Employ various edge and feature detection techniques. 4. Implement object recognition techniques. 5. Detect and track moving objects in the video sequence.														
Prerequisites: - Basic knowledge in Matrices and Linear Algebra															
CO, PO AND PSO MAPPING															
CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO - 10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	2	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO-2	-	3	3	2	-	-	-	-	-	-	-	1	-	-	-
CO-3	1	2	2	-	3	-	-	-	-	-	-	3	-	-	-
CO-4	2	1	-	-	-	-	-	-	-	-	-	2	-	-	-
CO-5	-	3	3	-	1	-	-	-	-	-	-	-	-	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION (6L)															
Introduction to computer vision- Practical Applications - Images: Cameras, Images - Sampling, Quantization - Color images - Noise: Types, Generation, Evaluation – Smoothing: Image Averaging, Local Averaging and Gaussian Smoothing, Median Filter- Histograms.  Suggested Activity: (Using Open CV/MATLAB)  1. Reduce image noise using Smoothing algorithms. 2. Draw Histogram for a given image.													CO-1  BTL-2		
MODULE 2: THRESHOLDING, MORPHOLOGY AND TRANSFORMATIONS(6L)															
Thresholding - Threshold Detection Methods- Variations on thresholding – Adaptive, Band, Semi, Multispectral- Morphology: Dilation, Erosion, Opening & Closing.													CO-2  BTL-2		



Geometric Transformations: Affine, Perspective- Interpolation: Nearest Neighbor, Bilinear and Bi-Cubic Interpolation.		
<b>Geometric Transformations:</b> Affine, Perspective- Interpolation: Nearest Neighbor, Bilinear, Bi-Cubic- Camera distortions.		
<b>Suggested Activity: (Using Open CV/MATLAB)</b>  1. Implementation of Thresholding and Morphological operations on the given image. 2. Do image augmentation using various transformation techniques.		
<b>MODULE 3: DETECTION TECHNIQUES(6L)</b>		
Edges: Edge detection -First and Second directive, Image sharpening - Contour segmentation- Basic representation, border detection, Line segment representation- Hough transform.  Features: Moravec Corner Detection, Harris Corner Detection, FAST and SIFT. <b>Suggested Activity: (Using Open CV/MATLAB)</b>  1. Implement edge detection algorithm on the given image. 2. Find key points in the given image using feature detection algorithms.		<b>CO-3</b> <b>BTL-3</b>
<b>MODULE 4: RECOGNITION</b>		<b>(6L)</b>
Template Matching: Applications, Algorithm, Matching Metrics, Finding Local Maxima or Minima- Statistical Pattern Recognition -Cascade of Haar Classifiers- SVM- HoG – Performance: Ground Truth -Classification Performance Metrics. <b>Suggested Activity: (Using Open CV/MATLAB)</b>  1. Implement Face recognition using cascade of Haar classifiers.		<b>CO-4</b> <b>BTL-2</b>
<b>MODULE 5: MOVING OBJECT DETECTION AND TRACKING (6L)</b>		
Video: Moving Object Detection: Object of Interest - Common Problems -Difference Images -  Background Models. Tracking: Exhaustive search- Mean Shift- Dense and Feature Based Optical Flow - Metrics for Assessing Video Tracking Performance. <b>Suggested Activity: (Using Open CV/MATLAB)</b>  1. Detect and Track moving object in a video sequence		<b>CO-5</b> <b>BTL-2</b>
<b>TEXT BOOKS</b>		
1.	Kenneth Dawson-Howe. (2014). <i>A Practical Introduction to Computer Vision with OpenCV</i> , Wiley.	
2.	Richard Szeliski. (2011). <i>Computer Vision: Algorithms and Applications</i> , Springer International.	
<b>REFERENCE BOOKS</b>		
1.	Gary Bradski and Adrian Kaehler. (2008). <i>Learning OpenCV</i> , 1st Edition, O’Reilly.	
2.	<a href="#">Joe Minichino.</a> , <a href="#">Joseph Howse. (2015).</a> <i>Learning OpenCV 3 Computer Vision with Python</i> , Packt Publishing Limited, 2nd Revised edition.	

3.	Neeraj Bhargava, Ritu Bhargava, Abhishek Pandey. (2016). <i>A Practical Approach for Image Processing &amp; Computer Vision In MATLAB</i> , Create Space Independent Publishing Platform.
4.	<a href="#">David A. Forsyth, Jean Ponce. (2011). <i>Computer Vision: A Modern Approach</i>, Prentice Hall.</a>
5.	<a href="#">Reinhard Klette. (2014). <i>Concise Computer Vision: An introduction into theory and Algorithms</i>, Springer-Verlag London.</a>
<b>E BOOKS</b>	
1.	<a href="http://freecomputerbooks.com/Computer-Vision-Xiong-Zhihui.html">http://freecomputerbooks.com/Computer-Vision-Xiong-Zhihui.html</a>
2.	<a href="https://docs.opencv.org/2.4/opencv_tutorials.pdf">https://docs.opencv.org/2.4/opencv_tutorials.pdf</a>
<b>MOOC</b>	
1.	<a href="https://in.udacity.com/course/introduction-to-computer-vision--ud810">https://in.udacity.com/course/introduction-to-computer-vision--ud810</a>
2.	<a href="https://www.edx.org/course/computer-vision-and-image-analysis">https://www.edx.org/course/computer-vision-and-image-analysis</a>

COURSE TITLE	DEEP LEARNING			CREDITS	2
COURSE CODE	CSD4483	COURSE CATEGORY	NE	L-T-P-S	2-0-0-0
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This is a course suitable for B.Tech. students. It deals basics of machine learning algorithms. This course helps to learn and design the simple feed forward neural network model. Also, from this course students are able to the demonstrate deep learning-based experiments using real-world data.				
Course Objective	<ol style="list-style-type: none"> <li>1. To learn the machine Learning Basics.</li> <li>2. To understand the concepts of Back propagation.</li> <li>3. To learn the concepts of Complete Convolutional Network.</li> <li>4. To learn the different auto encoder architectures.</li> <li>5. To understand the Acoustic modeling for speech recognition.</li> </ol>				

<b>Course Outcome</b>	Upon completion of this course, the students will be able to 1. Explain Machine Learning concepts, classifications of Machine Learning. 2. Design the simple feed forward neural network model. 3. Illustrate the principles of convolutional neural networks and recurrent neural networks. 4. Describe the concepts of Auto Encoding Techniques. 5. Demonstrate the Deep Learning based experiments using real-world data.														
<b>Prerequisites: - Linear Algebra and Calculus</b>															
<b>CO, PO AND PSO MAPPING</b>															
<b>CO</b>	<b>PO -1</b>	<b>PO- 2</b>	<b>PO- 3</b>	<b>PO- 4</b>	<b>PO- 5</b>	<b>PO- 6</b>	<b>PO- 7</b>	<b>PO- 8</b>	<b>PO- 9</b>	<b>PO - 10</b>	<b>PO- 11</b>	<b>PO- 12</b>	<b>PSO- 1</b>	<b>PSO- 2</b>	<b>PSO- 3</b>
CO-1	1	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO-2	1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO-3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO-4	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-
CO-5	1	3	-	-	1	-	-	-	-	-	-	3	-	-	-
<b>1: Weakly related, 2: Moderately related and 3: Strongly related</b>															
<b>MODULE 1: INTRODUCTION (6L)</b>															
Machine Learning Basics: Elementary Classification Problem- Evaluating Classification Results- Naïve Bayes Classifier-Simple Neural Network: Logistic Regression-MNIST Dataset-K-Means –Learning  Different Representations: PCA - Learning Language: The Bag of Words Representation  <b>Suggested Activity:</b>  3. Demonstration of Simple Machine learning Model for classification problem.													<b>CO-1</b>  <b>BTL-2</b>		
<b>MODULE 2: FEEDFORWARD NEURAL NETWORKS(6L)</b>															
Feed forward Neural Networks – Back propagation- Complete Feed forward Neural Network- Regularization- Learning Rate, Momentum and Dropout- Stochastic Gradient Descent and Online Learning.  <b>Suggested Activity: (Using Open CV/MATLAB)</b>  3. Image Classification using Feed forward Neural Network.													<b>CO-2</b>  <b>BTL-2</b>		
<b>MODULE 3: CNN AND RNN(6L)</b>															
CNN with Logistic Regression- Feature Maps and Pooling- Complete Convolutional Network-CNN to Classify Text- Recurrent Neural Networks: Settings of Learning with RNN- Adding Feedback Loops and Unfolding a Neural Network- Elman Networks- Long Short-Term Memory  <b>Suggested Activity: (Using Open CV/MATLAB)</b>  1. Implement CNN to Classify Text 2. Apply Long Short-Term Memory for Video Classification													<b>CO-3</b>  <b>BTL-3</b>		

MODULE 4: AUTOENCODERS (6L)	
<p>Learning Representations- Different Auto encoder Architectures- Stacking Auto encoders- Overview of Different Neural Network Architecture- Energy-Based Models- Memory-Based Models</p> <p><b>Suggested Activity: (Using Open CV/MATLAB)</b></p> <p>Apply the auto encoding technique for Image Compression.</p>	<p><b>CO-4</b></p> <p><b>BTL-2</b></p>
MODULE 5: APPLICATIONS (6L)	
<p>Acoustic modeling for speech recognition-DNN–HMM architecture-Output representations in the DNN-Adaptation of the DNN-based speech recognizers-Better architectures and nonlinear units- Better optimization and regularization-Speech synthesis-Audio and music processing-Applications in Object Recognition and Computer Vision.</p> <p><b>Suggested Activity: (Using Open CV/MATLAB)</b></p> <p>Demonstration of DNN application for speech recognition.</p>	<p><b>CO-5</b></p> <p><b>BTL-2</b></p>
TEXT BOOKS	
1.	Kenneth Dawson-Howe. (2014). <i>A Practical Introduction to Computer Vision with OpenCV</i> , Wiley.
2.	Richard Szeliski. (2011). <i>Computer Vision: Algorithms and Applications</i> , Springer International.
REFERENCE BOOKS	
1.	Gary Bradski and Adrian Kaehler. (2008). <i>Learning OpenCV</i> , 1st Edition, O'Reilly.
2.	<a href="#">Joe Minichino.</a> , <a href="#">Joseph Howse. (2015).</a> <i>Learning OpenCV 3 Computer Vision with Python</i> , Packt Publishing Limited, 2nd Revised edition.
3.	Neeraj Bhargava, Ritu Bhargava, Abhishek Pandey. (2016). <i>A Practical Approach for Image Processing &amp; Computer Vision In MATLAB</i> , Create Space Independent Publishing Platform.
4.	<a href="#">David A. Forsyth, Jean Ponce. (2011).</a> <i>Computer Vision: A Modern Approach</i> , Prentice Hall.
5.	<a href="#">Reinhard Klette. (2014).</a> <i>Concise Computer Vision: An introduction into theory and Algorithms</i> , Springer-Verlag London.
E BOOKS	
1.	<a href="http://freecomputerbooks.com/Computer-Vision-Xiong-Zhihui.html">http://freecomputerbooks.com/Computer-Vision-Xiong-Zhihui.html</a>
2.	<a href="https://docs.opencv.org/2.4/opencv_tutorials.pdf">https://docs.opencv.org/2.4/opencv_tutorials.pdf</a>
MOOC	
1.	<a href="https://in.udacity.com/course/introduction-to-computer-vision--ud810">https://in.udacity.com/course/introduction-to-computer-vision--ud810</a>
2.	<a href="https://www.edx.org/course/computer-vision-and-image-analysis">https://www.edx.org/course/computer-vision-and-image-analysis</a>

