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

B. TECH. ELECTRONICS AND COMMUNICATION
(Duration: 4 Years)
CURRICULUM and SYLLABUS

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

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHOOL OF ELECTRICAL 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 ELECTRONICS AND COMMUNICATION ENGINEERING

VISION AND MISSION

VISION

To be a premier academic centre for quality education to meet the industrial standards and research in diverse areas of Electronics and Communication Engineering with social commitment.

MISSION

- *To impart adequate engineering knowledge to transform students into highly professional engineers as well as good researchers.*
- *To develop their interdisciplinary skills as per the need of the industry and society.*
- *To inculcate Entrepreneurship and life long learning skills among the students with ethics and social commitment.*

B. Tech. Electronics and Communication Engineering
PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO I *Graduates will be nurtured to become successful professionals suitable for cutting - edge communication technologies to meet the societal needs.*

PEO II *Graduates will exhibit creative multidisciplinary skills to cater the needs of digital revolution through industry enhanced training and design projects.*

PEO III *Graduates will focus towards sustainable electronic product development with entrepreneurship skills through ethical attitude and effective collaborative learning practices.*

PEO IV *Graduates will conduct problem-solving investigations on issues and concerns in the emerging areas of electronics and communication engineering.*

PROGRAM OUTCOMES (ALIGNED WITH GRADUATE ATTRIBUTES) (PO)

PROGRAMME OUTCOMES (PO)

PO 1: ***Engineering knowledge:*** *Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.*

PO 2: ***Problem analysis:*** *Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.*

PO 3: ***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.*

PO 4: ***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.*

PO 5: ***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.*

PO 6: ***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.*

PO 7: ***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.*

PO 8: ***Ethics:*** *Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice**.***

PO 9: ***Individual and team work:*** *Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.*

PO 10: ***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**.***

PO 11: ***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.*

PO 12: ***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.*

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO 1 *Able to analyze and design the advanced Communication and Digital Systems.*

PSO 2 *Able to analyze, design and validate the systems using hardware and software tools pertaining to VLSI and Signal Processing.*

B.TECH – ELECTRONICS AND COMMUNICATION ENGINEERING									
(165 CREDIT STRUCTURE)									
SEMESTER - I									
SL. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	BS	MEA4101/ ELA4101	Engineering Graphics And Computer Aided Design / Professional English and Soft Skills	1	1	2	3	2	4
2	BS	MAA4101	Matrices and Calculus	3	0	2	4	2	5
3	BS	PHA4102/ CYA4101	Engineering Physics / Engineering Materials	3	0	0	3	2	3
4	BS	CSA4101	Problem Solving Using C	2	0	2	3	2	4
5	PC	EEB4101	Introduction to Digital Systems	3	0	0	3	1	3
6	BS	GEA4131	Engineering Immersion Lab	0	0	2	0.5	1	2
7	BS	PHA4131/ CYA4131	Engineering Physics Lab / Materials Chemistry Lab	0	0	2	1	2	2
Total				**12**	**1**	**10**	**17.5**	**12**	**23**
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	0	5
2	BS	PHA4102/ CYA4101	Engineering Physics / Engineering Materials	3	0	0	3	1	3
3	BS	MEA4101/E LA4101	Engineering Graphics And Computer Aided Design / Professional English and Soft skills	1	1	2	3	1	4
4	PC	ECB4101	Engineering and Design	2	0	2	3	0	4
5	PC	ECB4116	Digital System Design	3	1	0	4	0	4
6	PC	ECB4117	Network Theory	3	1	0	4	0	4
7	BS	GEA4102	Sustainable Engineering Systems	2	0	0	2	1	2
8	PC	ECB4141	Digital System Design Lab	0	0	2	1	0	2
9	BS	GEA4131	Engineering Immersion Lab	0	0	2	0.5	0	2
10	BS	PHA4131/ CYA4131	Engineering Physics Lab/ Materials Chemistry Lab	0	0	2	1	0	2
Total				**17**	**3**	**12**	**25.5**	**3**	**32**

SEMESTER - III									
SL. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	BS	MAA4201	Partial Differential Equations and Transforms	3	0	2	4	1	5
2	PC	ECB4201	Analog Electronics	3	1	0	4	1	4
3	PC	ECB4202	Electromagnetic Fields and Waves	3	1	0	4	2	4
4	BS	GEA4216	Professional Ethics and Life Skills	2	0	0	2	1	2
5	DE	***	Department Elective-I	3	0	0	3	1	3
6	NE	***	Non Department Elective- I	2	0	0	2	1	2
7	PC	ECB4231	Analog Electronics Lab	0	0	3	1	0	3
8	PC	ECB4232	Circuits Simulation Lab	0	0	2	1	0	2
9	PC	ECB4233	Design Project - I	0	0	2	1	1	2
Total				**16**	**2**	**9**	**22**	**8**	**27**
SEMESTER - IV									
SL. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	BS	MAA4218	Random Process	3	0	2	4	1	5
2	PC	ECB4216	Transmission Lines and Networks	3	1	0	4	1	4
3	PC	ECB4217	Signals and Systems	3	1	0	4	1	4
4	PC	ECB4218	Microcontrollers and Embedded Systems	3	0	0	3	1	3
5	DE	***	Department Elective-II	3	0	0	3	1	3
6	NE	***	Non Department Elective–II	2	0	0	2	1	2
7	PC	ECB4241	MATLAB and Simulink Lab	0	0	2	1	0	2
8	PC	ECB4242	Microcontrollers and Embedded Systems Lab	0	0	3	1	0	3
9	PC	ECB4243	Design Project - II	0	0	2	1	1	2
Total				**17**	**2**	**9**	**23**	**7**	**28**
SEMESTER - V									
SL. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	BS	MAA4301	Optimization Techniques	3	1	0	4	1	4
2	PC	ECB4301	Control Systems	3	1	0	4	1	4
3	PC	ECB4302	Communication Systems	3	0	0	3	1	3
4	PC	ECB4303	Digital Signal Processing	3	1	0	4	1	4
5	DE	***	Department Elective-III	3	0	0	3	1	3
6	NE	***	Non Department Elective–III	2	0	0	2	1	2
7	PC	ECB4331	Communication Systems Lab	0	0	3	1	0	3

8	PC	ECB4332	Digital Signal Processing lab	0	0	3	1	0	3
9	PC	ECB4333	Design Project -III	0	0	2	1	1	2
Total				**17**	**3**	**8**	**23**	**7**	**28**
SEMESTER - VI									
SL. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	PC	ECB4316	Computer Networks	3	0	0	3	1	3
2	PC	ECB4317	Optical Communication	3	0	0	3	1	3
3	PC	ECB4318	Antenna and Wave Propagation	3	1	0	4	1	4
4	PC	ECB4319	Wireless Communication systems	3	0	0	3	1	3
5	BS	GEA4304	Business Economics	2	0	0	2	1	2
6	DE	***	Department Elective-IV	3	0	0	3	1	3
7	NE	***	Non Department Elective–IV	2	0	0	2	1	2
8	PC	ECB4341	Computer Networks Lab	0	0	3	1	0	3
9	PC	ECB4342	Design Project -IV	0	0	2	1	1	2
10	PC	ECB4343	Comprehension	1	0	0	1	1	1
Total				**20**	**1**	**5**	**23**	**9**	**26**
SEMESTER – VII									
SL. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	PC	ECB4401	VLSI Design Techniques	3	1	0	4	1	4
2	PC	ECB4402	RF and Microwave Engineering	3	1	0	4	1	4
3	PC	ECB4403	Internet of Things	3	0	0	3	1	3
4	PC	ECB4404	Machine Learning and Artificial Intelligence	3	1	0	4	1	4
5	DE	***	Department Elective –V	3	0	0	3	1	3
6	NE	***	Non Department Elective-V	2	0	0	2	1	2
7	PC	ECB4431	VLSI Design Lab	0	0	3	1	0	3
8	PC	ECB4432	Microwave and Optical Lab	0	0	3	1	0	3
9	PC	ECB4433	Design Project - V	0	0	2	1	1	2
Total				**17**	**3**	**8**	**23**	**7**	**28**
SEMESTER – VIII									
SL. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	PC	ECB4441	Project and Viva – voce	0	0	24	8	11	24
Total				**0**	**0**	**24**	**8**	**11**	**24**
Total							**165**		

LIST OF DEPARTMENTAL ELECTIVES WITH GROUPING - SEMESTER WISE									
SEM	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
3	DE	ECC4251	Logic system design with VHDL	3	0	0	3	1	3
3	DE	ECC4252	Basic Electrical Engineering	3	0	0	3	1	3
3	DE	ECC4253	Instrumentation Engineering	3	0	0	3	1	3
3	DE	ECC4254	Microprocessor and Applications	3	0	0	3	1	3
3	DE	ECC4255	An Introduction to Programming the Internet of Things (IOT)	3	0	0	3	1	3
3	DE	ECC4256	Data Structures and Algorithms using C	3	0	0	3	1	3
3	DE	ECC4257	Circuit Simulation Using Pspice	3	0	0	3	1	3
4	DE	ECC4266	Digital Image Processing	3	0	0	3	1	3
4	DE	ECC4267	Biomedical Instrumentation	3	0	0	3	1	3
4	DE	ECC4268	Nano Electronic and Devices	3	0	0	3	1	3
4	DE	ECC4269	Robotics and Control	3	0	0	3	1	3
4	DE	ECC4270	Programming with LabView	3	0	0	3	1	3
4	DE	ECC4271	Object Oriented Programming Using C++	3	0	0	3	1	3
4	DE	ECC4272	Digital Design Using Basys3 and Nexsys4 DDR FPGA Board	3	0	0	3	1	3
5	DE	ECC4351	Virtual and Augmented Reality	3	0	0	3	1	3
5	DE	ECC4352	Embedded Automotive Systems	3	0	0	3	1	3
5	DE	ECC4353	Advanced Microprocessors	3	0	0	3	1	3
5	DE	ECC4354	Pattern recognition	3	0	0	3	1	3
5	DE	ECC4355	System Design Using Raspberry Pi Processor	3	0	0	3	1	3
5	DE	ECC4356	Image Signal Processing Using MATLAB	3	0	0	3	1	3
6	DE	ECC4366	Mobile Communication	3	0	0	3	1	3
6	DE	ECC4367	Information Coding Techniques	3	0	0	3	1	3
6	DE	ECC4368	Wireless Adhoc Sensor Networks	3	0	0	3	1	3
6	DE	ECC4369	Digital Telephone Systems	3	0	0	3	1	3
6	DE	ECC4370	Speech Signal Processing	3	0	0	3	1	3
6	DE	ECC4371	Radar Systems	3	0	0	3	1	3
6	DE	ECC4372	Satellite Communication	3	0	0	3	1	3
6	DE	ECC4373	Neural Networks and Fuzzy Logic	3	0	0	3	1	3
6	DE	ECC4374	Python Programming for Real-World Task	3	0	0	3	1	3
7	DE	ECC4451	Wireless Networks	3	0	0	3	1	3

7	DE	ECC4452	Software Defined Radio	3	0	0	3	1	3
7	DE	ECC4453	High Speed Networks	3	0	0	3	1	3
7	DE	ECC4454	Remote Sensing	3	0	0	3	1	3
7	DE	ECC4455	Opto Electronic Devices	3	0	0	3	1	3
7	DE	ECC4456	Industrial Electronics	3	0	0	3	1	3
7	DE	ECC4457	Advanced Mobile Communication Technology	3	0	0	3	1	3
7	DE	ECC4458	Embedded C For 8051 and ARM Using Keil Microversion	3	0	0	3	1	3

LIST OF NON DEPARTMENTAL ELECTIVES OFFERED BY ELECTRONICS AND COMMUNICATION DEPARTMENT WITH GROUPING - SEMESTER WISE									
SEM	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
3	NE	ECD4281	Basics Of Communication Systems	2	0	0	2	1	2
3	NE	ECD4282	Fundamentals Of Matlab Programming	2	0	0	2	1	2
3	NE	ECD4283	Fundamentals Of Bluetooth Technology	2	0	0	2	1	2
3	NE	ECD4284	Basics Of Neural Networks and Fuzzy Logic	2	0	0	2	1	2
4	NE	ECD4291	Neural Networks and Fuzzy Logic	2	0	0	2	1	2
4	NE	ECD4292	Fundamentals Of Microprocessors and Microcontrollers	2	0	0	2	1	2
4	NE	ECD4293	IOT Based Health Care Systems	2	0	0	2	1	2
5	NE	ECD4381	Mobile Communication Engineering	2	0	0	2	1	2
5	NE	ECD4382	Introduction to Data Communication	2	0	0	2	1	2
5	NE	ECD4383	Introduction to Arduino and Its Applications	2	0	0	2	1	2
5	NE	ECD4384	Machine Learning	2	0	0	2	1	2
5	NE	ECD4387	Matlab Programming for Engineers	2	0	0	2	1	2
6	NE	ECD4391	Image Processing and Pattern Recognition	2	0	0	2	1	2
6	NE	ECD4392	Radar and Optical Communication	2	0	0	2	1	2
6	NE	ECD4393	Fundamentals of Wireless Sensor Networks	2	0	0	2	1	2
6	NE	ECD4397	Project Planning and Organization for Engineers	2	0	0	2	1	2
7	NE	ECD4481	Fundamentals of SDR	2	0	0	2	1	2
7	NE	ECD4482	Radio-Frequency Identification (RFID) and Its Applications	2	0	0	2	1	2
7	NE	ECD4483	Modern Wireless Communication Systems	2	0	0	2	1	2
7	NE	ECD4484	Introduction to Sensor Technology	2	0	0	2	1	2

SEMESTER I

COURSE TITLE	PROFESSIONAL ENGLISH AND SOFT SKILLS			CREDITS	3
COURSE CODE	ELA4101	COURSE CATEGORY	HS	L-T-P-S	2-0-2-1
Version	1.0	Approval Details	24 ACM 30th May 2018	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 has been designed to meet students' current and future language and communication needs. It attempts to develop their proficiency in the four language skills and knowledge of grammar and vocabulary. This course teaches students how to communicate accurately, appropriately and fluently in professional and social situations.
Course Objective	1. To acquire self-confidence by which the learner can improve upon their informative listening skills by an enhanced acquisition of the English language. 2. To provide an environment to Speak in English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate. 3. To equip the students to Read, comprehend and answer questions based on literary, scientific and technological texts. 4. To enhance the writing skills of the students via training in instructions, recommendations, checklists, process-description, letter-writing and report writing. 5. To equip the learners in analysing and applying creative thinking skills and participate in brainstorming, mind-mapping, audiovisual activities and excel in employability skills.
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate the ability to construct the grammatically correct sentences with accuracy and syntax structures. 2. Integrate various components of English Language and determining it through reading and listening. 3. Analyze and transcode data, construct different types of written essays, read complex passages and summarize ideas, create personal profiles in the form of a resume. 4. Organize and articulate ideas, concepts, and perceptions in a comprehensive manner in written business correspondence, and speaking in formal and informal situations.

	5. Infer details about presentation skills and implementing it in various professional situations.

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

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

MODULE 1: FUNCTIONAL GRAMMAR AND VOCABULARY	**(6L + 6P=12)**
Introduction to communication skills –Self Introduction - Basic grammar (tenses, subject verb agreement) - Basic vocabulary (prefixes , suffixes, synonyms & antonyms, phrasal verbs and idioms)- Topic sentences , paragraph writing **Suggested Activities:** Short conversations-Situational Communication-Dialogue Writing - Writing short paragraph based on environment protection, societal issues, health, cultural contexts etc., identifying topic sentences, linking pairs of sentences**.** **Suggested Reading:** 1. Dr. Bikram K. Das et al.(2009) *An Introduction to Professional English and Soft Skills* with audio CD, Cambridge University Press. 2. John, Dolly(2014), *English for Life and the Workplace Through LSRW&T Skills*, Pearson Publications.	**CO-1** **BTL-2**
MODULE 2 – LISTENING AND SPEAKING SKILLS	**(6L + 6P=12)**
Academic listening (listening to lectures different topics, audio excerpts and answering question) - General listening (conversations, speeches: formal and informal) - Giving instructions and suggestions- Active and Passive Voice **Suggested activities:** Listen and repeat, Listening to audio excerpts- Listening to native speakers - TED Talks, short prepared speeches, Table topics – Speaking in different situations- MCQ's - Cloze exercises- Complete the Dialogue **Suggested sources:** 1. Bommelje, R. (2011). *LISTEN, LISTEN, LISTEN. In The top 10 ways to strengthen your self- leadership.* International Listening Leadership Institute. Retrieved from http://www.listening leaders.com/Articles.html 2. Hoppe, M. H. (2006). *Active listening: Improve your ability to listen and lead* [ebook]. Greensboro, NC: Center for Creative Leadership. 3. Barnes, D. (2008) *Exploratory talk for learning in Mercer*, N. and Hodgkinson, S. (eds) Exploring Talk in School. London: Sage Publications	**CO-2** **BTL-3**

MODULE – 3 : FUNCTIONAL READING AND WRITING	(6L+ 6P=12)
Reading comprehension (academic texts and general texts)-Reading and Interpreting visual data, charts, tables and graphs-- Report writing- accident, industrial, survey, general reports –Direct and Indirect speech **Suggested Activities:** Identify the errors in sentences, grammar exercise, reading passage for identifying the contextual meaning, interpreting charts, tables and graphs, choose the right meaning of the word given Assignment on suggested reading activity – Book review **Suggested sources:** 1. Murphy, Raymond (2016) *Essential English Grammar,* Cambridge University Press.	**CO-3** **BTL-3**
MODULE – 4 : BUSINESS CORRESPONDENCE	**(6L + 6P=12)**
Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing-Connectives - Cause and effect **Suggested activities:** Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect exercises - Presentation in the language lab (Technical or Non-technical topic) **Suggested sources:** 1. Bailey, E. (2008). Writing and speaking. New York, NY: McGraw-Hill. 2. Maynard-Smith, Julian. (2021), *Ultimate Guide to Business Writing, All the Secrets of Creating and Managing Business Documents,* Routledge.	**CO-4** **BTL-4**
MODULE 5 – PRESENTATION SKILLS AND INTERVIEW SKILLS	**(6L + 6P=12)**
Presentation Skills - Reading and Interpreting Advertisements—Job Application-Covering Letter -Curriculum Vitae –E-mail - Project proposal –Interview skills (HR questions) – Group Discussion **Suggested Activities:** Presentation in the language lab (Technical or Non-technical topic) Group Discussion (Technical or Non-technical topic) **Suggested Sources:** 1. Manoharan. K(2016), *Education and Personality Development,* APH Publishing Home.	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Professional Skills and Soft Skills(2020), Study Material, Hindustan Institute of Technology and Science.
REFERENCE BOOKS	
1.	Pillai, Sabina and Fernandez, Agna,(2018) *Soft Skills & Employability Skills,* Cambridge University Press.
2.	Steve Hart et al,(2016) *Embark, English for Undergraduates*, Cambridge University Press.
3.	Butterfield, Jeff(2010) *Soft Skills for Everyone*, Cengage Learning.
4.	Koneru, Aruna(2015) *Professional Speaking Skills,* Oxford University Publishers.
E BOOKS	

1	https://www.britishcouncil.in/english/courses-business
2	http://www.bbc.co.uk/learningenglish/english/features/pronunciation
3	http://www.bbc.co.uk/learningenglish/english/
4	http://www.cambridgeenglish.org/learning-english/free-resources/write-and-improve/
MOOC	
1	https://www.mooc-list.com/tags/english
2	https://www.mooc-list.com/course/adventures-writing-stanford-online
3	http://www.cambridgeenglish.org/learning-english/free-resources/mooc/

COURSE TITLE	**ENGINEERING GRAPHICS AND COMPUTER AIDED DESIGN**			**CREDITS**	**3**
COURSE CODE	**MEA4101**	**COURSE CATEGORY**	**BS**	**L-T-P-S**	**1-1-2-2**
Version	**1.0**	**Approval Details**	**24 ACM 30th May 2018**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

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

Course Description	This course broadly introduces the mechanical design using computer aided design tools and fundamentals of free hand sketching. It prepares the students to learn the basic concepts involved in technical drawing skills and computer graphics. It also emphasis on the principles and basic understanding of projections and visualizations aspects of component designing.
Course Objective	1. To understand the basics of Engineering graphics and plane curvatures using AutoCAD tool 2. To visualize the free hand sketch and orthographic projections and to solve simple problems 3. To comprehend the various geometrical models and its developments 4. To understand the transformation of 2D drafting to 3D models using CAD tools 5. To generate associated views of 3D models and related geometric dimensioning and tolerencing.
Course Outcome	Upon completion of this course, the students will be able to 1. Use the AutoCAD commands to generate simple drawings and understand drafting techniques. 2. Apply the acquired knowledge to solve simple problems involving straight planes and solids. 3. Visualize solid objects and apply AutoCAD commands to generate the models. 4. Recognize and use 3D model commands in AutoCAD tool to generate solid objects.

	Generate the various views of the geometrical solid model manually and using AutoCAD as well.

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	PS O1	PS O2
CO-1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO-2	-	-	2	-	3	-	-	-	-	-	-	-	1	-
CO-3	-	-	-	-	-	1	-	-	-	-	-	-	1	1
CO-4	-	-	-	-	3	-	-	-	-	-	1	-	1	1
CO-5	-	-	3	-	-	-	-	-	-	-	-	1	1	-

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

MODULE 1: BASICS OF ENGINEERING GRAPHICS AND PLANE CURVES (6L+6P=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. **Practical component:** AutoCAD – Solid modelling tool - Basics. **Suggested Readings:** Basics of drafting and dimensioning	**CO-1 BTL-2**

MODULE 2: VISUALIZATION, ORTHOGRAPHIC PROJECTIONS AND FREE HAND SKETCHING (6L+6P=12)

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. **Practical component:** 2D drafting, Orthographic projections **Suggested Readings:** AutoCAD tool – Commands for sketching , Projections	**CO-2 BTL-2**

MODULE 3: GEOMETRICAL MODELLING, ISOMETRIC AND DEVELOPMENT OF SURFACES (6L+6P=12)

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	**CO-3 BTL-3**

of modelling - Wire frame model, Surface Model and Solid Model – Introduction to graphic software for solid modelling. Development of Surfaces **Practical component:** 3D modelling and surface development **Suggested Readings:** Surface modelling and solid modelling	
MODULE 4: COMPUTER AIDED DESIGN AND DRAFTING (6L+6P=12)	
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. **Practical component:** 2D to 3D transformation, plotting of drawings **Suggested Readings:** 3D modelling – view generations and commands	**CO-4** **BTL-2**
MODULE 5: SIMPLE DESIGN PROJECTS – COMPUTER AIDED DESIGN (6L+6P=12)	
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 tolerencing. 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 color coding according to drawing practice. **Practical component:** 3D solid meshed topology, geometrical dimensioning, simple components **Suggested Readings:** AutoCAD dimensioning, assembly of solid components	**CO-5** **BTL-3**
TEXT BOOKS	
1.	Jeyapoovan, T. (2016). Engineering Drawing and Graphics Using AutoCAD, 7th Edition, Vikas Publishing House Pvt Ltd., New Delhi, 2016.
REFERENCE BOOKS	
1.	Warren J. Luzadder and Jon. M. Duff. (2016). Fundamentals of Engineering Drawing, Prentice Hall of India Pvt. Ltd., Eleventh Edition.
2.	Jensen, J.D. Helsel, D.R. Short. (2012). Engineering Drawing and Design, McGraw-Hill, Sixth Edition.
E BOOKS	

1.	http://keralatechnologicaluniversity.blogspot.in/2015/06/engineering-graphics-i-benjamin-pentex-freeebook-pdf-download.html
2.	http://keralatechnologicaluniversity.blogspot.in/2015/06/engineering-graphics-p-i-varghese.html
MOOC	
1.	http://nptel.ac.in/courses/112103019/
2.	http://nptel.ac.in/courses/105104148/

COURSE TITLE	**MATRICES AND CALCULUS**			**CREDITS**	**4**
COURSE CODE	**MAA 4101**	**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	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

Course Description	**To make the student understand the basic concepts of matrices and calculus using MATLAB**
Course Objective	1. To Know how to perform some simple operations on matrices 2. To understand effectively the basic concepts of differentiation and partial differentiation and their applications. 3. To perform integration and other operations for certain types of functions and carry out the computation fluently. 4. To classify ordinary differential equations.
Course Outcome	Upon completion of this course, the students will be able to 1. calculate the inverse of the matrix using Cayley Hamilton theorem and diagonalise the matrix 2. determine the derivative and higher derivatives of a given function explicitly using differentiation formulas 3. evaluate of area and volume using line integral. 4. classify the differential equations and solve them.
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
CO-1	3	3	2	-	-	-	-	-	-	-	-	-	1	1
CO-2	3	3	2	-	-	-	-	-	-	-	-	-	1	1
CO-3	3	3	2	2	-	-	-	-	-	-	-	-	1	1
CO-4	3	3	-	-	2	2	2	-	-	-	-	-	1	1

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

MODULE 1:MATRICES (13L+2P=15)

Characteristic equation – Eigen values and Eigenvectors – Properties – Cayley Hamilton theorem (Statement only) – Verification and inverse of the matrix using Cayley Hamilton theorem- Diagonalization of matrices using similarity transformation Suggested Reading: Basics of Matrices **Lab1: Eigen values and Eigenvectors, Verification and inverse using Cayley Hamilton theorem- Diagonalization**	**CO-1** **BTL-3**
MODULE 2: DIFFERENTIAL CALCULUS **(13L+2P=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 Suggested Reading: Basics of Differentiation **Lab2: Taylor's series – Maxima and minima of functions of two variables**	**CO-2** **BTL-3**
MODULE 3:INTEGRAL CALCULUS **(13L+2P=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. Suggested Reading: Basics of Integrations **Lab3: Applications of Integral Calculus: Area, Surface area and Volume.**	**CO-3** **BTL-3**
MODULE 4: ORDINARY DIFFERENTIAL EQUATIONS	**(13L+2P=15)**
Second order differential equations with constant coefficients – Particular integrals – e^{ax}, $Sinax, Cosax, x^m$, e ^{ax} Cos bx, e^{ax} Sin bx. Solutions of homogeneous differential equations with variable coefficients – Variation of parameters.. Suggested Reading: Basics of Differential Equations. **Lab 4**: Solution of Second order differential equations.	**CO-4** **BTL-3**

TEXT BOOKS	
1.	Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd 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, 2010
REFERENCE BOOKS	
1.	Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
2.	Weir, M.D and Joel Hass, Thomas' Calculus, 12th Edition, Pearson India, 2016.
3.	Advanced Engineering Mathematics With Matlab, Third Edition,2011 by CRC Press.
E BOOKS	
1.	http://nptel.ac.in/courses/111105035/ https://www.edx.org/.../introduction-engineering-mathematics-utarlingtonx-engr3
MOOC	
1.	https://www.mooc-list.com/tags/engineering-mathematics

COURSE TITLE	ENGINEERING PHYSICS (Common to ECE,EEE,CSE & IT)			CREDITS	3
COURSE CODE	PHA4102	COURSE CATEGORY	BS	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	24th ACM - 30.5.2018	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 will facilitate students to understand the concepts of properties of matter, heat, acoustics, ultrasonics, quantum physics, semiconducting materials and photonics to solve engineering problems
Course Objective	1. To impart knowledge on types of stress, elastic moduli, heat conduction and determination of thermal conductivity. 2. To provide a strong foundation on the concepts and applications of acoustics and ultrasonics. 3. To illustrate theoretically and experimentally the particle nature of light and wave nature of particle. 4. To distinguish the materials based on band theory and make the students understand the basic functions of electronic devices 5. To make the students understand the production of lasers and propagation of light through an optical fiber.
Course Outcome	Upon completion of this course, the students will be able to 1. distinguish the types of stress and relate the concept of elastic moduli with the properties of materials and also explain the concept of heat conduction and thermal conductivity. 2. explain the concept of reverberation time and outline the generation and applications of ultrasonics. 3. explain the black body radiation, Compton Effect and also solve the Schrodinger's wave equations. 4. classify the materials based on band gap and also illustrate the functioning of discrete devices. 5. outline the principle, working and application of lasers and optical fibers.

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	PSO1	PSO2
CO-1	3	2	-	-	-	-	-	-	-	-	-	3	-	1
CO-2	3	2	-	-	3	-	-	-	-	-	-	3	-	1
CO-3	3	2	-	-	3	-	-	-	-	-	-	3	-	1
CO-4	3	2	-	-	2	-	-	-	-	-	-	3	1	1
CO-5	3	2	-	-	3	-	-	-	-	-	-	3	1	1

1: Weakly related, 2: Moderately related and 3: Strongly related	
MODULE 1 – PROPERTIES OF MATTER & HEAT	
Elasticity - Hooke's law– Elastic Moduli – Young's modulus of elasticity - Rigidity modulus - Bulk modulus - Twisting couple on a wire - Torsional pendulum - determination 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 conductivities of good and bad conductors – Forbe's method – theory and experiment – Lee's disc method for bad conductors.	**CO-1** **BTL-3**
MODULE 2 – ACOUSTICS AND ULTRASONICS **(9L)**	
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	**CO-2** **BTL-3**
MODULE 3 – QUANTUM PHYSICS **(9L)**	
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)	**CO-3** **BTL-3**
MODULE 4 – SEMICONDUCTING MATERIALS **(9L)**	
Band theory of solids - Classification of metals, semiconductors & insulators – Intrinsic & Extrinsic Semiconductors (Qualitative Treatment) – Direct & Indirect band gap – semiconductor Hall Effect – Determination of Hall Coefficient. PN junction diode – Construction, working & VI characteristics, Zener diode - Construction, working & VI characteristics – Zener diode as voltage regulator – Transistors - Construction & working – CE & CB Configuration characteristics curves.	**CO-4** **BTL-3**
MODULE 5 – PHOTONICS AND FIBRE OPTICS **(9L)**	
Principle of lasers - Stimulated absorption - Spontaneous emission, stimulated emission - population inversion - pumping action - active medium - laser characteristics – Nd-Yag laser -CO_2 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.	**CO-5** **BTL-3**
TEXT BOOKS	
1.	Mani, P. (2011). *Engineering Physics*, Vol I & II, Dhanam Publications, Chennai.
REFERENCE BOOKS	
1.	Gaur, R. K. and Gupta S.L. (2010). Engineering Physics, 8th edition, Dhanpat Rai publications (P) Ltd., New Delhi.
2.	Arthur Beiser, (2007). Concepts of Modern Physics, Tata McGraw – Hill Publications.

3.	Rajendran, V. Marikani , A. (2009). Applied Physics for engineers, 3rd edition, Tata McGraw –Hill publishing company Ltd., New Delhi.
4.	Avadhanulu, M. N. and Kshirsagar, P. G. (2018). A textbook of Engineering Physics, S. Chand & Company Pvt. Ltd, New Delhi.
E BOOKS	
1.	Aithal, P. S. and Ravindra, H. J. (2011). Textbook of Engineering Physics, 1st edition, ACME Learning Pvt. Ltd., New Delhi https://zenodo.org/record/243407#.Ye_V3-pBxPY
2.	John R. Gordon, Ralph V. McGrew and Raymond A. Serway. (2010). *Physics for Scientists and Engineers* 8th edition, Brooks/Cole Cengage learning, USA https://www.academia.edu/33716022/Physics_for_Scientists_and_Engineers_8th_Edition_Ebook
3.	Avadhanulu, M. N. and Kshirsagar, P. G. (2018). A textbook of Engineering Physics, S. Chand & Company Pvt. Ltd, New Delhi https://www.quickstudyhelper.com/textbook-engineering-physics.html
4.	Akma Binti Che Ishak et al (2021) Introduction to semiconductor https://anyflip.com/zflmv/ntnu/basic
MOOC	
1.	http://nptel.ac.in/courses/115106061/
2.	http://nptel.ac.in/courses/117101054/12
3.	https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/index.htm
4.	https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/

COURSE TITLE	**ENGINEERING MATERIALS (Common to ALL Branches of Engineering)**			**CREDITS**	**3**
COURSE CODE	**CYA4101**	**COURSE CATEGORY**	**BS**	**L-T-P-S**	**3-0-0-2**
Version	**1.0**	**Approval Details**	**24th ACM 30.5.2018**	**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	To make the students understand the basic concepts of Engineering Materials and their applications.				

Course Objective	1. To make the students understand the basics of crystal structure and phase rule. 2. To provide an exposure on the fundamentals of powder metallurgy and applications of inorganic materials and composites. 3. To give a strong foundation on the basic concepts of nanomaterials, the general synthetic methods with emphasis on their applications. 4. To illustrate the applications of conducting polymers and liquid- crystals, with a good exposure on their basic terminologies. 5. To provide a knowledge on the theoretical basis of the chemical composition, properties and applications of lubricants, adhesives and explosives.
Course Outcome	Upon completion of this course, the students will be able to 1. Propose and justify suitable metals/materials for alloying. 2. State and select a suitable high-temperature material for industrial applications. 3. Suggest an appropriate technique for nanomaterial synthesis and also select a property-guided molecular material for a given application. 4. Identify the materials which can be employed as organic conductors and liquid- crystals in electronic devices. 5. Distinguish and select a suitable organic / inorganic material as lubricant / adhesive / explosive based on 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
CO-1	3	2	1	-	-	-	1	-	-	-	-	1	1	-
CO-2	3	2	1	-	-	-	2	-	-	-	-	2	1	-
CO-3	3	2	1	1	-	-	2	-	-	-	-	2	1	-
CO-4	3	2	1	1	-	-	2	-	-	-	-	2	2	-
CO-5	3	2	1	-	-	-	2	-	-	-	-	2	2	-

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

MODULE 1: CRYSTAL STRUCTURE AND PHASE RULE	**(9L)**
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.	**CO-1 BTL-3**

MODULE 2: POWDER METALLURGY, INORGANIC MATERIALS AND COMPOSITES. (9L)

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. **Powder Metallurgy** – Preparation of metal/alloy– Advantages and limitations.	**CO-2** **BTL-3**
MODULE 3: NANOMATERIALSAND MOLECULAR SIEVES (9L)	
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). **Zeolite Molecular sieves** – composition, structure, classification - applications – ion exchange, adsorption, separation, laundry, catalysis.	**CO-3** **BTL-2**
MODULE 4: MATERIALS FOR ELECTRONIC APPLICATONS (9L)	
Liquid Crystals- Introduction – Characteristics – Classification- Thermotropic crystals- - Polymorphism in Thermotropic Liquid Crystals – Molecular arrangement in various stsres 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.	**CO-4** **BTL-2**
MODULE 5: LUBRICANTS, ADHESIVES AND EXPLOSIVES (9L)	
Lubricants – Mechanism of Lubrication, Classification and Properties, Semi Solid Lubricants, Solid Lubricants, MoS_2 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.	**CO-5** **BTL-2**

TEXT BOOKS	
1.	P.S. Raghavan (2018), *Engineering Materials*, Dhanam Publications
2.	P.C. Jain and Monicka Jain (2012), *Engineering Chemistry*, Dhanpat Raj Publication (P) Ltd, New Delhi
REFERENCE BOOKS	
1.	Puri, Sharma and Pathania (2020), *Principles of Physical Chemistry*, Vishal Publishing Co. Jalandar.
E BOOKS	
1.	http://www.erforum.net/2016/01/engineering-chemistry-by-jain-and-jain-pdf-free-ebook.html
MOOC	
1.	https://www.edx.org/course/materials-science-engineering-misisx-mse1x

COURSE TITLE	**PROBLEM SOLVING USING C**			**CREDITS**	**3**
COURSE CODE	**CSA4101**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**2-0-2-2**

Version	1.0	Approval Details	24th ACM, 30.05.2018	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
CO-1	2	2	2	-	-	2	-	2	-	-	1	2	2	-
CO-2	3	3	3	2	2	1	-	2	2	1	-	1	2	3
CO-3	3	3	3	2	2	2	-	1	3	3	2	1	2	3
CO-4	3	3	3	2	-	-	-	-	-	-	1	-	1	2
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+6P=12)

Introduction – Fundamentals of digital computers - Programming languages -Programming Paradigms – Types of Programming Languages – Language Translators – Problem Solving Techniques: Algorithm – Flow Chart - Pseudo code. **Practical Component:** 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+6P=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. **Practical Component:** (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+6P=12)**
Functions – Storage Class – Arrays – Strings and standard functions - Pre-processor Statements. **Practical Component:** (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 (vii) Program to concatenate and compare two strings (viii) Program using pre-processor statements	**CO-3** **BTL-4**
MODULE 4: POINTERS, STRUCTURES AND UNION	**(6L+6P=12)**
Pointers – Dynamic Memory allocation – Structure and Union – Files. **Practical Component:** (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+6P=12)**

Structure of embedded C program - Data Types - Operators - Statements - Functions - Keil C Compiler. **Practical component:** 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, 7th 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.
E BOOKS	
1.	https://en.wikibooks.org/wiki/C_Programming
MOOC	
1.	http://nptel.ac.in/courses/106105085/2
2.	https://www.udemy.com/c-programming-for-beginners/
3.	https://www.coursera.org/specializations/c-programming

COURSE TITLE	**INTRODUCTION TO DIGITAL SYSTEMS**			**CREDITS**	**3**
COURSE CODE	**EEB4101**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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 provides an introduction to digital system using microprocessors, sensors and actuators. Within this context, it introduces the fundamentals of Boolean algebra, digital arithmetic, Sensors and Displays, Signal Conditioning Circuits, microprocessor architecture and I/O, and Consumer Electronics and Communication System. Learning opportunities include: active-learning lectures; tutorials in which small teams work together to explore, discuss, apply and explain digital electronic circuits. The course is designed to be one of the first undertaken by new students in electrical and electronic engineering such that its successful completion will provide the necessary foundation for more specialist learning in core engineering

Course Objective	1. To gain knowledge on basic operation in digital systems 2. To study about sensors and display units 3. To have knowledge on the concepts of signal processing and converting elements 4. To study about microcontroller and its interfacing 5. To gain knowledge about different types of communication
Course Outcome	Upon completion of this course, the students will be able to 1. Summarize basic operation in digital systems and instruments 2. Express knowledge on basic functioning of sensors and display units. 3. Familiarize the concepts of signal processing and converting elements 4. Choose industrial controllers, microcontrollers with interfacing for specific applications 5. Explain the principles and operation of satellite communication, mobile communication and home electric appliances

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

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

MODULE 1: INTRODUCTION TO DIGITAL SYSTEMS	**(9L)**
Analog & 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). **Suggested Readings:** Basics of number systems	CO-1 BTL-3
MODULE 2: SENSORS AND DISPLAYS	**(9L)**
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. **Suggested Readings:** Primary sensing elements, introduction to displays	CO-2 BTL-3
MODULE 3: SIGNAL CONDITIONING CIRCUITS	**(9L)**

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 **Suggested Readings:** Basic network theorems	CO-3 BTL-3
MODULE 4: INTRODUCTION TO MICRO CONTROLLERS	**(9L)**
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 **Suggested Readings:** Electronics with Microcontroller interface	CO-4 BTL-3
MODULE 5: CONSUMER ELECTRONICS AND COMMUNICATION SYSTEM	**(9L)**
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.) **Suggested Reading:** Consumer Electronics User Manuals	CO-5 BTL-2

TEXT BOOKS	
1.	Digital Fundamentals, Thomas l. 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, SepehrNaimi, SarmadNaimi, Muhammad Ali Mazidi, Second edition, 2017.
5.	Programmable Logic Controllers, Frank D. Petruzella, McGraw-Hill Education, 2016.
REFERENCE BOOKS	
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, 4th 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), 2nd edition, Springer, 2018
E BOOKS	

1.	http://www.ee.iitm.ac.in/~giri/pdfs/EE4140/textbook.pdf
2.	https://electronics.howstuffworks.com/home-audio-video-channel.htm
MOOC	
1.	http://nptel.ac.in/courses/106108099/Digital%20Systems.pdf
2.	http://nptel.ac.in/courses/112103174/pdf/mod2.pdf
3.	http://nptel.ac.in/courses/108105063/pdf/L-09(SS)(IA&C)%20((EE)NPTEL).pdf

COURSE TITLE	**ENGINEERING IMMERSION LAB**			**CREDITS**	**0.5**
COURSE CODE	**GEA4131**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					
CIA					**ESE**
80%					**20%**
Course Description	Engineering Immersion Lab helps the students to understand and familiarize the basic knowledge on Computer, Electrical, Electronic and Mechanical Engineering domains				
Course Objective	To make students trained on basic engineering experiments in Computer, Electrical, Electronic and Mechanical Engineering fields.				
Course Outcome	1. Identify and use of tools, accessories, trouble shooting, software installations, Assembling and fabrication techniques in basic Engineering domains. 2. Have hands on experience on designing circuits for various 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**
CO-1	2	1	1	-	1	1	-	-	1	1	-	1	1	1
CO-2	2	1	1	-	1	1	-	-	1	1	-	1	1	1

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

GROUP A - LIST OF EXPERIMENTS

I. MECHANICAL ENGINEERING

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.

GROUP B - LIST OF EXPERIMENTS

V. ELECTRICAL ENGINEERING

1. Studyoftools and accessories
2. Study ofcables.
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 LogicCircuits.
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

COURSE TITLE	**ENGINEERING PHYSICS LAB (Common to ALL branches of Engineering)**			**CREDITS**	**1**
COURSE CODE	**PHA4131**	**COURSE CATEGORY**	**BS**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	24th ACM - 30.5.2018	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

Experimental	Calculation	Result	Viva	Record	ESE
30	**10**	**10**	**20**	**10**	**20%**

Course Description	This course imparts practical knowledge on experimental methods to determine mechanical and optical properties of materials.
Course Objective	1. To train students to determine elastic properties of materials 2. To provide a practical exposure to measure viscosity of liquids. 3. To train students to estimate the thermal conductivity of a bad conductor. 4. To equip students to utilize light beam to analyse materials. 5. To impart hands-on training in plotting the V-I characteristics of p-n junction diode
Course Outcome	Upon completion of this course, the students will be able to 1. determine the Young's modulus and rigidity modulus of materials 2. measure viscosity of liquids by Poiseuille's flow 3. determine thermal conductivity of a bad conductor by Lee's disc method 4. apply phenomena of light to determine the thickness of a thin wire and refractive index of a material 5. analyse V-I characteristics of a p-n junction diode.

Prerequisites: Knowledge in Physics 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
CO-1	3	3	-	-	-	-	-	-	3	-	-	3	1	-
CO-2	3	3	-	-	-	-	-	-	3	-	-	3	1	-
CO-3	3	3	-	-	-	-	-	-	3	-	-	3	1	-
CO-4	3	3	-	-	3	-	-	-	3	-	-	3	1	-

CO-5	3	3	-	-	-	-	-	-	3	-	-	3	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related														

MODULE 1: PROPERTIES OF MATTER- SOLID	**. (9 P)**
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.	**CO-1 BTL-3**
MODULE 2: PROPERTIES OF MATTER- LIQUID	**(3 P)**
4. Viscosity – Determination of co-efficient of viscosity of a liquid by Poiseuille's flow.	**CO-2 BTL-3**
MODULE 3: THERMAL CONDUCTIVITY	**(3 P)**
5. Lee's Disc – Determination of thermal conductivity of a bad conductor. Preparation of urea-formaldehyde resin.	**CO-3 BTL-3**
MODULE 4: OPTICS	**(9 P)**
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	**CO-4 BTL-3**
MODULE 5: SEMICONDUCTOR DEVICES	**(3 P)**
9. Semiconductor diode – VI characteristics	**CO-5 BTL-3**

TEXT BOOKS	
1.	Mani, P. (2005). Engineering Physics Practicals, Dhanam Publications, Chennai.
REFERENCE BOOKS	
1	Ayachit, N. H. and Mittal P. K. (2013), Engineering Physics: With laboratory Manual, I K International Publishing House Pvt. Ltd.
2.	Kulkarni, P. (2015). Experiments in Engineering Physics Bachelor of Engineering and Technology, Edition 2015
E BOOKS	
1.	http://www.aurora.ac.in/images/pdf/departments/humanities-and-sciences/engg-phy-lab-manual.pdf
MOOC	
1.	https://www.vlab.co.in/broad-area-physical-sciences
2.	https://nptel.ac.in/courses/115/105/115105110/#

COURSE TITLE	**MATERIALS CHEMISTRY LABORATORY (Common to ALL branches of Engineering)**			**CREDITS**	**1**
COURSE CODE	**CYA4131**	**COURSE CATEGORY**	**BS**	**L-T-P-S**	**0-0-2-2**
Version	**1.0**	**Approval Details**	**24th ACM - 30.5.2018**	**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					
Experimental	**Calculation**	**Result**	**Viva**	**Record**	**ESE**
30	**10**	**10**	**20**	**10**	**20%**

Course Description	This course imparts practical exposure on basic techniques employed for the analyses of lubricants, refractories & other engineering materials and spectrophotometric analyses for metal ions.
Course Objective	1. To train the students in characterization of lubricants by viscosity measurement. 2. To give a practical exposure for the construction of phase diagram, for partially-miscible liquids (phenol-water system) 3. To provide the students practical knowledge in preparation of polymers (urea-formaldehyde resin) 4. To impart hands-on training in characterization of refractories. 5. To equip the students with practical skill in estimation of metal ions by spectrophotometry.
Course Outcome	Upon completion of this course, the students will be able to 1. grade the lubricants based on viscosity 2. analyze the phase diagram and interpret the critical solution temperature. 3. apply the practical knowledge gained on the preparation of polymers, for the preparation of other similar macromolecules. 4. analyze the strength of refractories. 5. apply the spectrophotometric method for the determination of metal ions in different environment.

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

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

MODULE 1: PROPERTIES OF LUBRICANTS	**(6 P)**
1. Determination of viscosity of polymer using Ostwald Viscometer. 2. Determination of Viscosity Index of lubricants. 3. Determination of viscosity of oil using Red-Wood Viscometer.	**CO-1** **BTL-3**
MODULE 2: PHASE DIAGRAM IN LIQUID SYSTEM	**(6 P)**
4. Construction of phenol-water phase diagram. 5. Determination of adsorption isotherm for acetic acid on activated charcoal.	**CO-2** **BTL-3**
MODULE 3: PREPARATION POLYMER RESIN.	**(6 P)**
6. Preparation of urea-formaldehyde resin.	**CO-3** **BTL-3**
MODULE 4: BASIC PROPERTIES OF REFRACTORIES	**(6 P)**

7. Determination of porosity of a refractory. 8. Determination of apparent density of porous solids.	**CO-4** **BTL-3**
MODULE 5: ESTIMATION METAL ION CONTENTS IN THE SAMPLE	**(6 P)**
9. Estimation of dye content in the effluent by UV-Visible spectrophotometry. 10. Determination of copper / iron content in the alloy by colorimetry. 11. Estimation of sodium and potassium ions by flame photometry. 12. Verification of Beer-Lambert's law using gold nanoparticles.	**CO-5** **BTL-3**
TEXT BOOKS	
1.	P.S. Raghavan (2018), *Materials Chemicals Laboratory Manual*, Dhanam Publications.
REFERENCE BOOKS	
1.	J. Mendham, R.C. Denney, J.D. Barnes and N.J.K. Thomas (2009), *Vogel's Textbook of Quantitative Chemical Analysis,* 6th Edition, Pearson Education.
E BOOKS	
1.	http://www.erforum.net/2016/01/engineering-chemistry-by-jain-and-jain-pdf-free-ebook.html
MOOC	
1.	https://www.coursetalk.com/providers/coursera/courses/introduction-to-chemistry-1

SEMESTER II

COURSE TITLE	**ANALYTICAL MATHEMATICS**			**CREDITS**	**4**
COURSE CODE	**MAA 4117**	**COURSE CATEGORY**	**BS**	**L-T-P-S**	**3-0-2-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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	To make the student understand the basic analytical mathematical skills that is imperative for effective understanding of engineering subject using MATLAB.				
Course Objective	1. To demonstrate the fundamental understanding of integrals 2. To apply problem solving skills vectors 3. To understand the concepts of Laplace Transforms 4. To understand the concept of Fourier series 5. To understand the concepts of complex variables				

Course Outcome	Upon completion of this course, the students will be able to 1. evaluate surface and volume integrals 2. perform vector operations and interpret the results geometrically 3. solve the system of ordinary differential equations using Laplace Transform 4. develop any periodic function satisfying Dirichlet's conditions as a Fourier series 5. construct the analytic function and finding the harmonic function.

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

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

MODULE 1:MULTIPLE INTEGRALS	**(10L+2P=12)**
Double integration – Cartesian and polar co-ordinates – Change of order of integration. Area as a double integral – Triple integration in Cartesian coordinates – Volume as a triple integral – Change of variables between Cartesian and polar coordinates. Suggested Reading: Line Integrals **Lab: Area and Volume using double and triple integration.**	**CO-1** **BTL-3**
MODULE 2:VECTOR CALCULUS	**(10L+2P=12)**
Gradient, Divergence and Curl – Unit normal vector, Directional derivative – angle between surfaces–Solenoidal and Irrotationalvector 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 parallelopipeds. Suggested Reading: Basics of Vectors **Lab: Area using Green's theorem and Volume using Gauss divergence theorem.**	**CO-2** **BTL-3**
MODULE 3:LAPLACE TRANSFORMS	**(10L+2P=12)**
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. Suggested Reading: Basics of Transform **Lab: Finding Laplace and Inverse Laplace Transform of Elementary Functions, Solutions of Ordinary differential equations using Laplace transform**	**CO-3** **BTL-3**

MODULE 4: FOURIER SERIES	(10L+2P=12)
Dirichlet's Conditions – General Fourier Series – Odd and even functions – Half range sine and cosine series –Harmonic Analysis. Suggested Reading: Basics of series **Lab: Fourier series Expansion of simple functions, Harmonic Analysis**	**CO-3** **BTL-3**
MODULE 5: COMPLEX VARIABLES	**(10L+2P=12)**
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. Suggested Reading: Complex Numbers **Lab: Complex Numbers**	**CO-4** **BTL-3**

TEXT BOOKS	
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.
REFERENCE BOOKS	
1.	Sastry, S.S, —Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4thEdition, New Delhi, 2014
2.	Wylie, R.C. and Barrett, L.C., —Advanced Engineering Mathematics —Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
3.	Dean G. Duffy., "Advanced Engineering Mathematics with MATLAB", CRC Press, Third Edition 2013.
E BOOKS	
1.	nptel.ac.in/courses/111105035/22
MOOC	
1.	https://www.edx.org/course/introduction-engineering-mathematics-utarlingtonx-engr3-0x

COURSE TITLE	ENGINEERING PHYSICS (Common to ECE,EEE,CSE & IT)			CREDITS	3
COURSE CODE	PHA4102	COURSE CATEGORY	BS	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	24th ACM - 30.5.2018	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 will facilitate students to understand the concepts of properties of matter, heat, acoustics, ultrasonics, quantum physics, semiconducting materials and photonics to solve engineering problems
Course Objective	6. To impart knowledge on types of stress, elastic moduli, heat conduction and determination of thermal conductivity. 7. To provide a strong foundation on the concepts and applications of acoustics and ultrasonics. 8. To illustrate theoretically and experimentally the particle nature of light and wave nature of particle. 9. To distinguish the materials based on band theory and make the students understand the basic functions of electronic devices 10. To make the students understand the production of lasers and propagation of light through an optical fiber.
Course Outcome	Upon completion of this course, the students will be able to 6. distinguish the types of stress and relate the concept of elastic moduli with the properties of materials and also explain the concept of heat conduction and thermal conductivity. 7. explain the concept of reverberation time and outline the generation and applications of ultrasonics. 8. explain the black body radiation, Compton Effect and also solve the Schrodinger's wave equations. 9. classify the materials based on band gap and also illustrate the functioning of discrete devices. 10. outline the principle, working and application of lasers and optical fibers.

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	PSO1	PSO2
CO-1	3	2	-	-	-	-	-	-	-	-	-	3	-	1
CO-2	3	2	-	-	3	-	-	-	-	-	-	3	-	1
CO-3	3	2	-	-	3	-	-	-	-	-	-	3	-	1
CO-4	3	2	-	-	2	-	-	-	-	-	-	3	1	1
CO-5	3	2	-	-	3	-	-	-	-	-	-	3	1	1

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

MODULE 1 – PROPERTIES OF MATTER & HEAT

Elasticity - Hooke's law– Elastic Moduli – Young's modulus of elasticity - Rigidity modulus - Bulk modulus - Twisting couple on a wire - Torsional pendulum - determination of rigidity modulus of a wire - Depression of a cantilever - Young's modulus by cantilever - uniform and non-uniform bending.	**CO-1 BTL-3**

Thermal conductivity – experimental determination of thermal conductivities of good and bad conductors – Forbe's method – theory and experiment – Lee's disc method for bad conductors.	
MODULE 2 – ACOUSTICS AND ULTRASONICS	**(9L)**
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	**CO-2** **BTL-3**
MODULE 3 – QUANTUM PHYSICS	**(9L)**
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)	**CO-3** **BTL-3**
MODULE 4 – SEMICONDUCTING MATERIALS	**(9L)**
Band theory of solids - Classification of metals, semiconductors & insulators – Intrinsic & Extrinsic Semiconductors (Qualitative Treatment) – Direct & Indirect band gap – semiconductor Hall Effect – Determination of Hall Coefficient. PN junction diode – Construction, working & VI characteristics, Zener diode - Construction, working & VI characteristics – Zener diode as voltage regulator – Transistors - Construction & working – CE & CB Configuration characteristics curves.	**CO-4** **BTL-3**
MODULE 5 – PHOTONICS AND FIBRE OPTICS	**(9L)**
Principle of lasers - Stimulated absorption - Spontaneous emission, stimulated emission - population inversion - pumping action - active medium - laser characteristics – Nd-Yag laser -CO_2 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.	**CO-5** **BTL-3**

TEXT BOOKS

1.	Mani, P. (2011). *Engineering Physics*, Vol I & II, Dhanam Publications, Chennai.

REFERENCE BOOKS

1.	Gaur, R. K. and Gupta S.L. (2010). Engineering Physics, 8th edition, Dhanpat Rai publications (P) Ltd., New Delhi.
2.	Arthur Beiser, (2007). Concepts of Modern Physics, Tata McGraw – Hill Publications.
3.	Rajendran, V. Marikani , A. (2009). Applied Physics for engineers, 3rd edition, Tata McGraw –Hill publishing company Ltd., New Delhi.
4.	Avadhanulu, M. N. and Kshirsagar, P. G. (2018). A textbook of Engineering Physics, S. Chand & Company Pvt. Ltd, New Delhi.

E BOOKS	
1.	Aithal, P. S. and Ravindra, H. J. (2011). Textbook of Engineering Physics, 1st edition, ACME Learning Pvt. Ltd., New Delhi https://zenodo.org/record/243407#.Ye_V3-pBxPY
2.	John R. Gordon, Ralph V. McGrew and Raymond A. Serway. (2010). *Physics for Scientists and Engineers* 8th edition, Brooks/Cole Cengage learning, USA https://www.academia.edu/33716022/Physics_for_Scientists_and_Engineers_8th_Edition_Ebook
3.	Avadhanulu, M. N. and Kshirsagar, P. G. (2018). A textbook of Engineering Physics, S. Chand & Company Pvt. Ltd, New Delhi https://www.quickstudyhelper.com/textbook-engineering-physics.html
4.	Akma Binti Che Ishak et al (2021) Introduction to semiconductor https://anyflip.com/zflmv/ntnu/basic
MOOC	
1.	http://nptel.ac.in/courses/115106061/
2.	http://nptel.ac.in/courses/117101054/12
3.	https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/index.htm
4.	https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/

COURSE TITLE	ENGINEERING MATERIALS (Common to ALL Branches of Engineering)			CREDITS	3
COURSE CODE	CYA4101	COURSE CATEGORY	BS	L-T-P-S	3-0-0-2
Version	1.0	Approval Details	24th ACM 30.5.2018	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	To make the students understand the basic concepts of Engineering Materials and their applications.
Course Objective	1. To make the students understand the basics of crystal structure and phase rule. 2. To provide an exposure on the fundamentals of powder metallurgy and applications of inorganic materials and composites. 3. To give a strong foundation on the basic concepts of nanomaterials, the general synthetic methods with emphasis on their applications. 4. To illustrate the applications of conducting polymers and liquid- crystals, with a good exposure on their basic terminologies. 5. To provide a knowledge on the theoretical basis of the chemical composition, properties and applications of lubricants, adhesives and explosives.

Course Outcome	Upon completion of this course, the students will be able to 1. Propose and justify suitable metals/materials for alloying. 2. State and select a suitable high-temperature material for industrial applications. 3. Suggest an appropriate technique for nanomaterial synthesis and also select a property-guided molecular material for a given application. 4. Identify the materials which can be employed as organic conductors and liquid- crystals in electronic devices. 5. Distinguish and select a suitable organic / inorganic material as lubricant / adhesive / explosive based on 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
CO-1	3	2	1	-	-	-	1	-	-	-	-	1	1	-
CO-2	3	2	1	-	-	-	2	-	-	-	-	2	1	-
CO-3	3	2	1	1	-	-	2	-	-	-	-	2	1	-
CO-4	3	2	1	1	-	-	2	-	-	-	-	2	2	-
CO-5	3	2	1	-	-	-	2	-	-	-	-	2	2	-

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

MODULE 1: CRYSTAL STRUCTURE AND PHASE RULE (9L)	
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.	**CO-1 BTL-3**
MODULE 2: POWDER METALLURGY, INORGANIC MATERIALS AND COMPOSITES. (9L)	
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. **Powder Metallurgy** – Preparation of metal/alloy– Advantages and limitations.	**CO-2 BTL-3**
MODULE 3: NANOMATERIALSAND MOLECULAR SIEVES (9L)	
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). **Zeolite Molecular sieves** – composition, structure, classification - applications – ion exchange, adsorption, separation, laundry, catalysis.	**CO-3 BTL-2**

MODULE 4: MATERIALS FOR ELECTRONIC APPLICATONS (9L)	
Liquid Crystals- Introduction – Characteristics – Classification- Thermotropic crystals- - Polymorphism in Thermotropic Liquid Crystals – Molecular arrangement in various stsres 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.	**CO-4 BTL-2**
MODULE 5: LUBRICANTS, ADHESIVES AND EXPLOSIVES (9L)	
Lubricants – Mechanism of Lubrication, Classification and Properties, Semi Solid Lubricants, Solid Lubricants, MoS_2 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.	**CO-5 BTL-2**

TEXT BOOKS	
1.	P.S. Raghavan (2018), *Engineering Materials*, Dhanam Publications
2.	P.C. Jain and Monicka Jain (2012), *Engineering Chemistry*, Dhanpat Raj Publication (P) Ltd, New Delhi
REFERENCE BOOKS	
1.	Puri, Sharma and Pathania (2020), *Principles of Physical Chemistry*, Vishal Publishing Co. Jalandar.
E BOOKS	
1.	http://www.erforum.net/2016/01/engineering-chemistry-by-jain-and-jain-pdf-free-ebook.html
MOOC	
1.	https://www.edx.org/course/materials-science-engineering-misisx-mse1x

COURSE TITLE	**PROFESSIONAL ENGLISH AND SOFT SKILLS**			**CREDITS**	**3**
COURSE CODE	**ELA4101**	**COURSE CATEGORY**	**HS**	**L-T-P-S**	**2-0-2-1**
Version	**1.0**	**Approval Details**	**24 ACM 30th May 2018**	**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 has been designed to meet students' current and future language and communication needs. It attempts to develop their proficiency in the four language skills and knowledge of grammar and vocabulary. This course teaches students how to communicate accurately, appropriately and fluently in professional and social situations.
Course Objective	1. To acquire self-confidence by which the learner can improve upon their informative listening skills by an enhanced acquisition of the English language. 2. To provide an environment to Speak in English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate. 3. To equip the students to Read, comprehend and answer questions based on literary, scientific and technological texts. 4. To enhance the writing skills of the students via training in instructions, recommendations, checklists, process-description, letter-writing and report writing. 5. To equip the learners in analysing and applying creative thinking skills and participate in brainstorming, mind-mapping, audiovisual activities and excel in employability skills.
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate the ability to construct the grammatically correct sentences with accuracy and syntax structures. 2. Integrate various components of English Language and determining it through reading and listening. 3. Analyze and transcode data, construct different types of written essays, read complex passages and summarize ideas, create personal profiles in the form of a resume. 4. Organize and articulate ideas, concepts, and perceptions in a comprehensive manner in written business correspondence, and speaking in formal and informal situations. 5. Infer details about presentation skills and implementing it in various professional situations.
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
CO-1	-	-	-	-	-	-	-	-	-	3	-	-	1	1
CO-2	-	-	-	-	-	-	-	2	2	3	-	-	1	1
CO-3	-	-	-	-	-	-	-	-	-	3	-	-	1	1
CO-4	-	-	-	-	-	-	2	-	-	3	2	-	1	1
CO-5	-	-	-	-	-	-	-	-	2	3	2	3	1	1

1: Weakly related, 2: Moderately related and 3: Strongly related	
MODULE 1: FUNCTIONAL GRAMMAR AND VOCABULARY	**(6L + 6P=12)**
Introduction to communication skills –Self Introduction - Basic grammar (tenses, subject verb agreement) - Basic vocabulary (prefixes , suffixes, synonyms & antonyms, phrasal verbs and idioms)- Topic sentences , paragraph writing **Suggested Activities:** Short conversations-Situational Communication-Dialogue Writing - Writing short paragraph based on environment protection, societal issues, health, cultural contexts etc., identifying topic sentences, linking pairs of sentences. **Suggested Reading:** 1. Dr. Bikram K. Das et al.(2009) *An Introduction to Professional English and Soft Skills* with audio CD, Cambridge University Press. 2. John, Dolly(2014), *English for Life and the Workplace Through LSRW&T Skills*, Pearson Publications.	**CO-1** **BTL-2**
MODULE 2 – LISTENING AND SPEAKING SKILLS	**(6L + 6P=12)**
Academic listening (listening to lectures different topics, audio excerpts and answering question) - General listening (conversations, speeches: formal and informal) - Giving instructions and suggestions- Active and Passive Voice **Suggested activities:** Listen and repeat, Listening to audio excerpts- Listening to native speakers - TED Talks, short prepared speeches, Table topics – Speaking in different situations- MCQ's - Cloze exercises- Complete the Dialogue **Suggested sources:** 1. Bommelje, R. (2011). *LISTEN, LISTEN, LISTEN. In The top 10 ways to strengthen your self- leadership.* International Listening Leadership Institute. Retrieved from http://www.listening leaders.com/Articles.html 2. Hoppe, M. H. (2006). *Active listening: Improve your ability to listen and lead* [ebook]. Greensboro, NC: Center for Creative Leadership. 3. Barnes, D. (2008) *Exploratory talk for learning in Mercer*, N. and Hodgkinson, S. (eds) Exploring Talk in School. London: Sage Publications	**CO-2** **BTL-3**
MODULE – 3 : FUNCTIONAL READING AND WRITING	**(6L+ 6P=12)**
Reading comprehension (academic texts and general texts)-Reading and Interpreting visual data, charts, tables and graphs-- Report writing- accident, industrial, survey, general reports –Direct and Indirect speech **Suggested Activities:** Identify the errors in sentences, grammar exercise, reading passage for identifying the contextual meaning, interpreting charts, tables and graphs, choose the right meaning of the word given Assignment on suggested reading activity – Book review **Suggested sources:** 1. Murphy, Raymond (2016) *Essential English Grammar,* Cambridge University Press.	**CO-3** **BTL-3**

MODULE – 4 : BUSINESS CORRESPONDENCE	(6L + 6P=12)
Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect **Suggested activities:** Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect exercises - Presentation in the language lab (Technical or Non-technical topic) **Suggested sources:** 1. Bailey, E. (2008). Writing and speaking. New York, NY: McGraw-Hill. 2. Maynard-Smith, Julian. (2021), *Ultimate Guide to Business Writing, All the Secrets of Creating and Managing Business Documents,* Routledge.	**CO-4** **BTL-4**
MODULE 5 – PRESENTATION SKILLS AND INTERVIEW SKILLS	**(6L + 6P=12)**
Presentation Skills - Reading and Interpreting Advertisements—Job Application- Covering Letter -Curriculum Vitae –E-mail - Project proposal –Interview skills (HR questions) – Group Discussion **Suggested Activities:** Presentation in the language lab (Technical or Non-technical topic) Group Discussion (Technical or Non-technical topic) **Suggested Sources:** 1. Manoharan. K(2016), *Education and Personality Development,* APH Publishing Home.	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Professional Skills and Soft Skills(2020), Study Material, Hindustan Institute of Technology and Science.
REFERENCE BOOKS	
1.	Pillai, Sabina and Fernandez, Agna,(2018) *Soft Skills & Employability Skills,* Cambridge University Press.
2.	Steve Hart et al,(2016) *Embark, English for Undergraduates*, Cambridge University Press.
3.	Butterfield, Jeff(2010) *Soft Skills for Everyone*, Cengage Learning.
4.	Koneru, Aruna(2015) *Professional Speaking Skills,* Oxford University Publishers.
E BOOKS	
1	https://www.britishcouncil.in/english/courses-business
2	http://www.bbc.co.uk/learningenglish/english/features/pronunciation
3	http://www.bbc.co.uk/learningenglish/english/
4	http://www.cambridgeenglish.org/learning-english/free-resources/write-and-improve/
MOOC	
1	https://www.mooc-list.com/tags/english
2	https://www.mooc-list.com/course/adventures-writing-stanford-online
3	http://www.cambridgeenglish.org/learning-english/free-resources/mooc/

COURSE TITLE	ENGINEERING GRAPHICS AND COMPUTER AIDED DESIGN			CREDITS	3
COURSE CODE	MEA4101	COURSE CATEGORY	BS	L-T-P-S	1-1-2-1
Version	1.0	Approval Details	24th ACM 30.05.2018	LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

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

Course Description	This course broadly introduces the mechanical design using computer aided design tools and fundamentals of free hand sketching. It prepares the students to learn the basic concepts involved in technical drawing skills and computer graphics. It also emphasis on the principles and basic understanding of projections and visualizations aspects of component designing.
Course Objective	1. To understand the basics of Engineering graphics and plane curvatures using AutoCAD tool 2. To visualize the free hand sketch and orthographic projections and to solve simple problems 3. To comprehend the various geometrical models and its developments 4. To understand the transformation of 2D drafting to 3D models using CAD tools 5. To generate associated views of 3D models and related geometric dimensioning and tolerencing.
Course Outcome	Upon completion of this course, the students will be able to 1. Use the AutoCAD commands to generate simple drawings and understand drafting techniques. 2. Apply the acquired knowledge to solve simple problems involving straight planes and solids. 3. Visualize solid objects and apply AutoCAD commands to generate the models. 4. Recognize and use 3D model commands in AutoCAD tool to generate solid objects. 5. Generate the various views of the geometrical solid model manually and using AutoCAD as well.

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
CO-1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO-2	-	-	2	-	3	-	-	-	-	-	-	-	1	-

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

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

MODULE 1: BASICS OF ENGINEERING GRAPHICS AND PLANE CURVES	**(6L+6P=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. **Practical component:** AutoCAD – Solid modelling tool - Basics. **Suggested Readings:** Basics of drafting and dimensioning	**CO-1** **BTL-2**
MODULE 2: VISUALIZATION, ORTHOGRAPHIC PROJECTIONS AND FREE HAND SKETCHING	**(6L+6P=12)**
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. **Practical component:** 2D drafting, Orthographic projections **Suggested Readings:** AutoCAD tool – Commands for sketching , Projections	**CO-2** **BTL-2**
MODULE 3: GEOMETRICAL MODELLING, ISOMETRIC AND DEVELOPMENT OF SURFACES	**(6L+6P=12)**
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 **Practical component:** 3D modelling and surface development **Suggested Readings:** Surface modelling and solid modelling	**CO-3** **BTL-3**
MODULE 4: COMPUTER AIDED DESIGN AND DRAFTING	**(6L+6P=12)**

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. **Practical component:** 2D to 3D transformation, plotting of drawings **Suggested Readings:** 3D modelling – view generations and commands	**CO-4** **BTL-2**
MODULE 5: SIMPLE DESIGN PROJECTS – COMPUTER AIDED DESIGN	**(6L+6P=12)**
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 tolerencing. 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 color coding according to drawing practice. **Practical component:** 3D solid meshed topology, geometrical dimensioning, simple components **Suggested Readings:** AutoCAD dimensioning, assembly of solid components	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Jeyapoovan, T. (2016). Engineering Drawing and Graphics Using AutoCAD, 7th Edition, Vikas Publishing House Pvt Ltd., New Delhi, 2016.
REFERENCE BOOKS	
1.	Warren J. Luzadder and Jon. M. Duff. (2016). Fundamentals of Engineering Drawing, Prentice Hall of India Pvt. Ltd., Eleventh Edition.
2.	Jensen, J.D. Helsel, D.R. Short. (2012). Engineering Drawing and Design, McGraw-Hill, Sixth Edition.
E BOOKS	
1.	http://keralatechnologicaluniversity.blogspot.in/2015/06/engineering-graphics-j-benjamin-pentex-freeebook-pdf-download.html
2.	http://keralatechnologicaluniversity.blogspot.in/2015/06/engineering-graphics-p-i-varghese.html
MOOC	
1.	http://nptel.ac.in/courses/112103019/
2.	http://nptel.ac.in/courses/105104148/

COURSE TITLE	ENGINEERING AND DESIGN			CREDITS	3
COURSE CODE	ECB4101	COURSE CATEGORY	PC	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	24TH ACM, 30.05.2018	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	Engineering design is the process of devising a system, component, or process to meet desired needs. This purpose of this course is to excite the student on creative design and its significance, to make the student aware of the processes involved in design, to make the student understand the interesting interaction of various segments of humanities, sciences and engineering in the evolution of a design and also to get an exposure as to how to engineer a design.
Course Objective	1. Understand the broad scope of design engineering 2. Recognise the main drivers for design engineering 3. Describe how human variation impacts on design engineering 4. Apply some basic concepts and methods from design engineering to explore creative solutions to clearly defined real world problems 5. Demonstrate skills in communication, presentation, information handling and numeracy through the completion of activities.
Course Outcome	Upon completion of this course, the students will be able to 1. Identify different elements involved in good designs and to apply them in practice when called for. 2. Interpolate the product oriented and user oriented aspects that make the design a success. 3. Select innovative designs incorporating different segments of knowledge gained in the course 4. Interpret broader perspective of design covering function, cost, environmental sensitivity, safety and other factors other than engineering analysis. 5. Summarize the 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
CO-1	2	2	3	-	-	2	2	1	2	1	-	2	-	1

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

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

Module 1:Introduction to Electronic System Design	**(7L + 2P)**
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. **Project:** 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-3**
Module 2: Electronic System Design Processes	**(7L + 2P)**
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. 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. **Project:**An exercise in the detailed design of any two products	**CO-2** **BTL-4**
Module 3: Prototyping in Electronics Engineering	**(4L + 5P)**
Prototyping- rapid prototyping; testing and evaluation of design; Design modifications; Freezing the design; Cost analysis. Engineering the design – From prototype to product. Planning; Scheduling; Supply chains; inventory; handling; manufacturing/construction operations; storage; packaging; shipping; marketing; feed-back on design **Project:** 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	**CO-3** **BTL-4**
Module 4: Quality Aspects for Electronic System Design	**(4L+ 5P)**
Design for "X"; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc.	**CO-4** **BTL-4**

Project: Example: 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.	
Module 5: User Centered Designs for Electronic System	**(4L + 5P)**
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. **Project:** Examine the possibility of value addition for an existing product.	**CO-5** **BTL-4**

TEXT BOOKS	
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
REFERENCE BOOKS	
1	Eastman, C. M. (Ed.), Design for X Concurrent engineering imperatives, 1996, XI, 489 p. ISBN 978-94-011-3985-4 Springer
2	Haik, Y. And Shahin, M. T., Engineering Design Process, Cengage Learning, ISBN-13: 978-0-495-66816-9
3	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
4	Voland, G., Engineering by Design, ISBN 978-93-325-3505-3, Pearson India
E BOOKS	
1	https://www.kobo.com/us/en/ebook/engineering-design-3
MOOC	
1	https://www.mooc-list.com/course/principles-engineering-futurelearn
2	https://www.mooc-list.com/course/decision-making-engineering-design-edx

COURSE TITLE	**DIGITAL SYSTEM DESIGN**			**CREDITS**	**4**
COURSE CODE	**ECB4116**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-0**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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 module describes the reduction of the given logical expressions using Boolean algebra also by algorithmic methods. It covers the combinational logic circuit problems, sequential circuit analysis and synthesis, Semiconductor memories, programmable devices and logic Families and their characteristics. Last module focusses completely on the applications and gives an introduction about the Verilog software and design the basic and complex circuits using HDL language.
Course Objective	1. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits. 2. To prepare students to perform the analysis and design of various digital electronic circuits.
Course Outcome	Students will be able to 1. Analyze and reduce the given logical expressions using Boolean algebra also by algorithmic methods 2. Design the combinational logic circuits of basic and specified problem statement 3. Design and analyze the function of specified sequential logic circuits 4. Implement the logic functions using Programmable devices 5. Use VHDL for digital logic design and simulation

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

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

MODULE 1 – BOOLEAN ALGEBRA & ITS SIMPLIFICATION TECHNIQUES (9L+3T)

Binary arithmetic – Logic Gates – Minimization of POS and SOP Reduction of switching equations using Boolean algebra, Realization of switching function. DE Morgan's Theorem. Karnaugh map simplification method (up to 4 variables) – Advantages and Limitations – Quine McClusky's method. **Suggested Readings:** Computational efficiency and cost requirement of circuits using various codes.	**CO-1** **BTL-3**
MODULE 2 – DESIGN OF BASIC COMBINATIONAL CIRCUITS	**(9L+3T)**
Adders – Subtractors – Binary parallel adders, Parallel subtractors, Parallel adder/ subtractors, Binary decoders and encoders – Priority encoders – Multiplexers – MUX as universal combinational modules – De-multiplexers. **Suggested Readings:** Advanced arithmetic (data manipulation) circuit to reduce delay and cost	**CO-2** **BTL-3**
MODULE 3 – FUNCTIONAL AND DESIGN ANALYSIS OF SEQUENTIAL CIRCUITS	**(9L+3T)**
Flip flops – SR, JK, D and T flip flops, Master – Slave flip flops, Characteristic and excitation table – Shift registers – Counters – Synchronous and Asynchronous counters – Modulus counters, Up/Down counters – State diagram, State table, State minimization techniques- Design of synchronous sequential circuits **Suggested Readings:** Asynchronous digital circuit design methods and its challenges	**CO-3** **BTL-4**
MODULE 4 – SEMICONDUCTOR MEMORY AND PROGRAMMABLE DEVICES	**(9L+3T)**
Semiconductor memories- Classification of memories –Programmable Logic Devices –Logic Implementation with Programmable Logic Array (PLA), Programmable Array Logic (PAL) – concept of Field Programmable Gate Arrays (FPGA). TTL, ECL and CMOS logic family concepts and their characteristics **Suggested Readings:** Advanced materials and their characteristics used for memory construction	**CO-4** **BTL-4**
MODULE 5 –DESIGN TECHNIQUES USING VHDL LANGUAGE	**(9L+3T)**
Introduction to Hardware description languages- Data types and objects- operators- type of delays Entity and Architectural declaration- VHDL Modelling styles – Dataflow, Structural and Behavioral models for basic combinational circuits. **Suggested Readings:** VHDL tools like Xiinx	**CO-5** **BTL-4**
TEXT BOOKS	
1.	Morris Mano, "Digital design", 5 th Edition, Prentice Hall of India, 2012
2.	Anil K. Maini, "Digital Electronics: Principles, Devices and Applications", Willey, 2007
3.	Charles Roth, " Digital System Design using VHDL" ,Tata McGraw Hill 2nd edition, 2012
REFERENCE BOOKS	

1.	Milos Ercegovac, Jomas Lang, "Introduction to Digital Systems", Wiley publications, 2009.
2.	John M. Yarbrough, "Digital logic: Applications and Design", Thomas – Vikas Publishing House, 2002.
3.	R.P.Jain, "Modern digital Electronics",4th Edition, TMH, 2010.
4.	William H. Gothmann, " Digital Electronics- An introduction to theory and practice" , PHI, 2 nd edition ,2006
E BOOKS	
1	https://www.researchgate.net/publication/264005171_Digital_Electronics 2
2	http://free-ebook-download-links.blogspot.in/2008/08/free-books-on-digital-electronics.html
MOOC	
1	http://nptel.ac.in/courses/117106086/1
2	https://www.openlearning.com/courses/SKEE1223x

COURSE TITLE	**NETWORK THEORY**			**CREDITS**	**4**
COURSE CODE	**ECB4117**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-0**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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	Fundamental laws and theorems governing electrical circuits at dc and low frequencies are discussed in this course using which the students can analyze a wide range of complex circuits. Transient and steady state response of circuits are studied in this course can help the students to design better circuits for the desired function. Concept of two port networks, which we learn here, helps us understand and analyze different two-port devices such as TV receiver, Transformers and other devices we use in everyday life.				
Course Objective	1. To learn techniques of solving circuits involving different active and passive elements. 2. To analyze the behavior of the circuit's frequency response. 3. To predict the transient response of first and second order circuits 4. To understand the significance of network functions. 5. To make the students learn how to synthesize an electrical network from a given impedance/admittance function.				

Course Outcome	Upon completion of this course, the students will be able to 1. Identify the main circuit elements and apply Kirchhoff's Laws to calculate currents, voltages using a variety of analytical methods and reduce more complicated circuits into the Thevenin's and Norton's equivalent circuits. 2. Obtain the maximum power transfer to the load and able to Analyze the series resonant and parallel resonant circuits. 3. Evaluate the time response of basic circuits with one energy storage element to the sudden application of DC voltage or current as well as to the sudden change in the circuit configuration. 4. Analyze the two port network with various network parameter techniques and able to understand the relation between all the network parameters 5. Synthesis the network parameters (such as , h & ABCD) and able understand the various active filters.

Prerequisites: Trigonometric formulae, Methods of differentiation, Methods of integration, Partial Fractions, Matrices, Laplace Transforms.

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

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

MODULE 1: CIRCUIT ANALYSIS & THEOREMS	**(9L+3T=12)**
Kirchoff's current and voltage laws – Nodal and Mesh analysis - series and parallel connection of independent sources – R, L and C – Network Theorems – Thevenin, Superposition, Norton, Maximum power transfer and duality – Star-delta conversion **Suggested Readings:** Evolution of cyber security	**CO-1** **BTL-4**
MODULE 2: RESONANCE AND COUPLED CIRCUITS	**(9L+3T=12)**
Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits. **Suggested Readings:** Advances in Cyber Security: Principles, Techniques, and Applications	**CO-2** **BTL-4**
MODULE 3: TRANSIENT RESPONSE FOR DC & AC CIRCUITS	**(9L+3T=12)**
Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input	**CO-3** **BTL-4**

Suggested Readings: Best practices for Cyber security standards	
MODULE 4: TWO PORT NETWORKS	**(9L+3T=12)**
One port networks – Two port admittance Parameters (Y parameters) – Admittance parameters analysis of terminated Two Port networks - Two port impedance Parameters (z-parameters) – Impedance and Gain calculations of terminated Two Port networks modelled by z-parameters **Suggested Readings:** Cyber-attacks, counter measures and protection schemes	**CO-4** **BTL-3**
MODULE 5: NETWORK PARAMETERS AND FILTERS	**(9L+3T=12)**
Hybrid parameters (h- para)– Inverse Hybrid Parameters (g-para)- Transmission parameters (ABCD parameters) - Various Combinations of Two port N/W.- Introduction and functions of active filters- band pass, low pass, high pass and band reject filters. **Suggested Readings:** Next-generation digital forensics	**CO-5** **BTL-3**

TEXT BOOKS	
1	Network Analysis & Synthesis By Franklin S. KUO, Wiley Publication, 2006.
2	Network Analysis: - By M.E Van Valkenburg PHI Publication, 2016.
3	Engineering Circuit Analysis: - By W H Hayt, J E Kemmerly, S M Durbin 6th Edition TMH Publication, 2002.
REFERENCE BOOKS	
1	Electric Circuits and Networks: - By K. S. Suresh Kumar – Pearson Education, 2009.
2	Linear Circuits Analysis 2nd edition:-By DeCarlo/ Lin – Oxford University Press (Indian edition), 2001.
3	Electric Circuit Analysis By S N Sivanandam, Vikas Publishing House Introductory Circuit Analysis by Robert Boylestad, Pearson, 2004.
E BOOKS	
1	http://engineeronadisk.com/
2	Text book companion http://www.scilab.in/Completed_Books#2
MOOC	
1	https://nptel.ac.in/courses/108/105/108105159/
2	www.allaboutcircuits.com

COURSE TITLE	**SUSTAINABLE ENGINEERING SYSTEMS (Common to ALL Branches of Engineering)**	**CREDITS**	**2**

COURSE CODE	GEA4102	COURSE CATEGORY	BS	L-T-P-S	2-0-0-1
Version	1.0	Approval Details	24TH ACM, 30.05.2018	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 the interactions of engineering, society and ecological systems. Specifically, the program studies the relationship of engineering to economic development, environmental impact, social structure, and the sustainability of natural resources. This course examines how engineering activities influence human well-being as a whole complex system and will provide students with knowledge and methods to analyze and solve sustainable development problems. The module description of the Sustainable Engineering Systems applies a holistic and systemic approach to solving problems and move beyond the tradition of breaking designs down into disconnected parts.
Course Objective	Students will be able to 1. Outline the strategy of sustainability and apply for simple system design 2. Formulate and analyze the Technology readiness level and Life cycle assessment of a product / process 3. Study and analyze the impact of green engineering 4. Conceptualize the waste management purpose and strategies 5. Apply suitable water management solutions for societal needs
Course Outcome	Upon completion of this course, the students will be able to 1. Identify the strategies for retaining principles of sustainability and apply the approach for simple system design with examples. 2. Interpolate the assessing technologies and their impact on environment. 3. Predict the impact of Green Engineering. 4. Use LCA approach for Management of natural resources and waste management from various types of industries. 5. Select Sustainable Water technologies for assessment of waste water treatment 6. Interpret the Behavioral aspects of humans and feedback

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
CO-1	2	2	-	-	-	-	3	1	2	2	-	2	1	1

CO-2	2	3	-	-	3	-	3	1	2	2	-	2	-	-
CO-3	2	3	-	-	-	1	3	1	2	2	-	2	-	-
CO-4	2	3	-	-	-	1	3	1	2	2	-	2	1	1
CO-5	2	3	-	-	2	2	3	1	2	2	-	2	-	-
CO-6	1	1	-	-	1	1	2	1	2	2	-	-	-	-

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

MODULE 1: PRINCIPLES OF SUSTAINABLE SYSTEMS	**(5L)**
Sustainability Definitions - Principles of Sustainable Design, Sustainable Engineering - Frameworks for Applying Sustainability Principles - Summary & Activities. **Suggested Readings:** Biomimicry in Infrastructure, Technology and Design	**CO-1** **BTL-2**
MODULE 2: TECHNOLOGY DEVELOPMENT AND LIFECYCLE ASSESSMENT	**(5L)**
Technology as a part of anthropogenic environment - Technology readiness levels (TRL) – technical metrics - Emerging, converging, disruptive technologies - Life Cycle Assessment (LCA) methodology - Summary & Activities **Suggested Readings:** Open LCA tools and Case study on non-sustainable products	**CO-2** **BTL-2**
MODULE 3: GREEN ENGINEERING	**(5L)**
Principles of Green Engineering - Frameworks for assessment of alternatives - Green Engineering examples - Multifunctional Materials and Their Impact on Sustainability - Summary & Activities. **Suggested Readings:** Best practices for green buildings	**CO-3** **BTL-3**
MODULE 4: RESOURCE MANAGEMENT TECHNOLOGIES	**(5L)**
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. **Suggested Readings:** E waste schemes	**CO-4** **BTL-2**
MODULE 5: SUSTAINABLE WATER AND WASTEWATER SYSTEMS	**(5L)**
Water cycle - Water conservation and protection technologies - Water treatment systems Metrics for assessment of water management technologies - Summary & Activities. **Suggested Readings:** Water Conservation Strategies	**CO-5** **BTL-2**
MODULE 6: BEHAVIORAL ASPECTS AND FEEDBACKS	**(5L)**
Collaborative Decision Making - Role of Community and Social Networking - Human Factor in Sustainability Paradigm - Summary & Activities.	**CO-6** **BTL-2**

TEXT BOOKS	
1	Vanek, F.M., and L.D. Albright, *Energy Systems Engineering. Evaluation and Implementation*, McGraw Hill, 2008.
2	C.U. Becker, Sustainability Ethics and Sustainability Research, Springer 2012.
3	J.B. Guinee et al., Life Cycle Assessment: Past, Present, and Future, *Environ. Sci. Technol.*, 2011, 45, 90-96.
4	Anastas, P.T., Zimmerman, J.B., *Innovations in Green Chemistry and Green Engineering*, Springer 2013.
5	*Solid Waste Technology & Management*, Volume 1 & 2, Christensen, T., Ed., Wiley and Sons., 2010.
6	Sterman, J.D., in Sustainability Science: The Emerging Paradigm, Weinstein, M.P. and Turner, R.E. (Eds.), Springer Science+Business Media, LLC 2012.
REFERENCE BOOKS	
1	David T. Allen, David R. Shonnard, Sustainable Engineering Concepts, Design and Case Studies, Pearson Education, December 2011. (ISBN: 9780132756587)
2	Gerald Jonker Jan Harmsen, Engineering for Sustainability 1st Edition, A Practical Guide for Sustainable Design, Elsvier 2012**. (**ISBN**:** 9780444538475).
E BOOKS	
1.	https://www.oreilly.com/library/view/sustainable-engineering-concepts/9780132756563/
MOOC	
1	https://www.coursera.org/learn/sustainability
2	https://www.academiccourses.com/Certificate/Sustainability-Studies/India/
3	https://onlinecourses.nptel.ac.in/noc18_ce08/preview
4	https://www.coursera.org/learn/ecosystem-services

COURSE TITLE	**DIGITAL SYSTEM DESIGN LAB**			**CREDITS**	**1**
COURSE CODE	**ECB4141**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-5**
ASSESSMENT SCHEME					
CIA					**ESE**
80%					**20%**
Course Description	To provide hand-on experience in designing and implementing digital/logic circuits. The laboratory exercises are designed to give students ability to design, build, and implement digital circuits and systems. The first half of the course uses standard TTL chips, wires and a proto board. The second half of the course uses VHDL programming tool for				

	simulation. Laboratory assignments progress from investigation of the properties of basic logic gates and flip-flops to the design of combinational and sequential circuits.
Course Objective	1. To enable students to design and verify the operations of digital logic circuits practically 2. To impart the practical approach through simulation program on the design and operations of digital circuits.
Course Outcome	Upon completion of this course, the students will be able to 1. Design and implement basic and other stated combinational logic circuits. 2. Design and implement basic and other stated sequential logic circuits. 3. Design and Simulate basic Combinational logic circuits using VHDL language.

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
CO-1	3	2	-	-	1	-	-	-	-	-	-	-	2	1
CO-2	3	2	-	-	1	-	-	-	-	-	-	-	2	1
CO-3	3	2	-	-	1	-	-	-	-	-	-	-	2	1

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

LIST OF EXPERIMENTS

LIST OF EXPERIMENTS USING DIGITAL GATES AND ICS

1. Design and implementation of Adders and Subtractors using logic gates.
2. Design and implementation of 4 bit binary Adder/ subtractor and BCD adder using IC 7483
3. Design and implementation of code converters using logic gates
   (i) BCD to excess-3 code and vice versa
   (ii) Binary to gray and vice-versa
4. Design and implementation of 2Bit Magnitude Comparator using logic gates and 8 Bit Magnitude Comparator using IC 7485
5. Design and implementation of Multiplexer and De-multiplexer using logic Gates
6. Design and implementation of encoder and decoder using logic gates
7. Construction and verification of 4 bit ripple counter and Mod-10 counters
8. Design and implementation of 3-bit synchronous up/down counter
9. Design and Verification of truth table of Master slave JK flip flop.
10. Design of Asynchronous up Counter.(MOD-6)

LIST OF EXPERIMENTS USING VHDL LANGUAGE

1. Design of Adders and Subtractors using VHDL
2. Design of Multiplexers and De-Multiplexers using VHDL

3. Design of 4 bit Ripple Counter and MOD 10 Counter using VHDL.	
REFERENCE BOOKS	
1.	L K Maheswari and M M S Anand, "Laboratory Manual for Introductory Electronic Experiments", New Age, 2010
2.	S Poornachandra Rao and B Sasikala, "Handbook of Experiments in Electronics and Communication Engineering",Vikas publishers, 2003.
MOOC	
1.	https://epd.sutd.edu.sg/undergraduate-courses/30110-digital-systems-laboratory/
2.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-111-introductory-digital-systems-laboratory-spring-2006/

COURSE TITLE	**ENGINEERING IMMERSION LAB**			**CREDITS**	**0.5**
COURSE CODE	**GEA4131**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

CIA	**ESE**
80%	**20%**

Course Description	Engineering Immersion Lab helps the students to understand and familiarize the basic knowledge on Computer, Electrical, Electronic and Mechanical Engineering domains
Course Objective	To make students trained on basic engineering experiments in Computer, Electrical, Electronic and Mechanical Engineering fields.
Course Outcome	1. Identify and use of tools, accessories, trouble shooting, software installations, Assembling and fabrication techniques in basic Engineering domains. 2. Have hands on experience on designing circuits for various 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
CO-1	2	1	1	-	1	1	-	-	1	1	-	1	1	1
CO-2	2	1	1	-	1	1	-	-	1	1	-	1	1	1

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

GROUP A - LIST OF EXPERIMENTS

I. MECHANICAL ENGINEERING

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.

GROUP B - LIST OF EXPERIMENTS

V. ELECTRICAL ENGINEERING

1. Studyoftoolsandaccessories
2. Study ofcables.
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 LogicCircuits.
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

COURSE TITLE	**ENGINEERING PHYSICS LAB (Common to ALL branches of Engineering)**			**CREDITS**	**1**
COURSE CODE	**PHA4131**	**COURSE CATEGORY**	**BS**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	**24th ACM - 30.5.2018**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

Experimental	**Calculation**	**Result**	**Viva**	**Record**	**ESE**
30	**10**	**10**	**20**	**10**	**20%**

Course Description	This course imparts practical knowledge on experimental methods to determine mechanical and optical properties of materials.
Course Objective	1. To train students to determine elastic properties of materials 2. To provide a practical exposure to measure viscosity of liquids. 3. To train students to estimate the thermal conductivity of a bad conductor. 4. To equip students to utilize light beam to analyse materials. 5. To impart hands-on training in plotting the V-I characteristics of p-n junction diode
Course Outcome	Upon completion of this course, the students will be able to 1. determine the Young's modulus and rigidity modulus of materials 2. measure viscosity of liquids by Poiseuille's flow 3. determine thermal conductivity of a bad conductor by Lee's disc method 4. apply phenomena of light to determine the thickness of a thin wire and refractive index of a material 5. analyse V-I characteristics of a p-n junction diode.

Prerequisites: Knowledge in Physics 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
CO-1	3	3	-	-	-	-	-	-	3	-	-	3	1	-
CO-2	3	3	-	-	-	-	-	-	3	-	-	3	1	-
CO-3	3	3	-	-	-	-	-	-	3	-	-	3	1	-
CO-4	3	3	-	-	3	-	-	-	3	-	-	3	1	-
CO-5	3	3	-	-	-	-	-	-	3	-	-	3	1	-

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

MODULE 1: PROPERTIES OF MATTER- SOLID	**(9P)**
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.	**CO-1** **BTL-3**
MODULE 2: PROPERTIES OF MATTER- LIQUID	**(3P)**
4. Viscosity – Determination of co-efficient of viscosity of a liquid by Poiseuille's flow.	**CO-2** **BTL-3**
MODULE 3: THERMAL CONDUCTIVITY	**(3P)**
5. Lee's Disc – Determination of thermal conductivity of a bad conductor.Preparation of urea-formaldehyde resin.	**CO-3** **BTL-3**
MODULE 4: OPTICS	**(6P)**
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	**CO-4** **BTL-3**
MODULE 5: ESTIMATION METAL ION CONTENTS IN THE SAMPLE	**(6P)**
9. Semiconductor diode – VI characteristics	**CO-5** **BTL-3**

TEXT BOOKS	
1.	P. Mani, engineering Physics Practicals, Dhanam Publications, Chennai, 2005
REFERENCE BOOKS	
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
E BOOKS	
1.	http://www.aurora.ac.in/images/pdf/departments/humanities-and-sciences/engg-phy-lab-manual.pdf
MOOC	
1.	https://www.vlab.co.in/broad-area-physical-sciences
2.	https://nptel.ac.in/courses/115/105/115105110/#

COURSE TITLE	MATERIALS CHEMISTRY LABORATORY (Common to ALL branches of Engineering)			CREDITS	1
COURSE CODE	CYA4131	COURSE CATEGORY	BS	L-T-P-S	0-0-2-2
Version	1.0	Approval Details	24th ACM - 30.5.2018	LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

Experimental	Calculation	Result	Viva	Record	ESE
30	10	10	20	10	20%

Course Description	This course imparts practical exposure on basic techniques employed for the analyses of lubricants, refractories & other engineering materials and spectrophotometric analyses for metal ions.
Course Objective	1. To train the students in characterization of lubricants by viscosity measurement. 2. To give a practical exposure for the construction of phase diagram, for partially-miscible liquids (phenol-water system) 3. To provide the students practical knowledge in preparation of polymers (urea-formaldehyde resin) 4. To impart hands-on training in characterization of refractories. 5. To equip the students with practical skill in estimation of metal ions by spectrophotometry.
Course Outcome	Upon completion of this course, the students will be able to 1. grade the lubricants based on viscosity 2. analyze the phase diagram and interpret the critical solution temperature. 3. apply the practical knowledge gained on the preparation of polymers, for the preparation of other similar macromolecules. 4. analyze the strength of refractories. 5. apply the spectrophotometric method for the determination of metal ions in different environment.

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

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

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

MODULE 1: PROPERTIES OF LUBRICANTS	**(6 P)**
1. Determination of viscosity of polymer using Ostwald Viscometer. 2. Determination of Viscosity Index of lubricants. 3. Determination of viscosity of oil using Red-Wood Viscometer.	**CO-1** **BTL-3**
MODULE 2: PHASE DIAGRAM IN LIQUID SYSTEM	**(6 P)**
4. Construction of phenol-water phase diagram. 5. Determination of adsorption isotherm for acetic acid on activated charcoal.	**CO-2** **BTL-3**
MODULE 3: PREPARATION POLYMER RESIN.	**(6 P)**
6. Preparation of urea-formaldehyde resin.	**CO-3** **BTL-3**
MODULE 4: BASIC PROPERTIES OF REFRACTORIES	**(6 P)**
7. Determination of porosity of a refractory. 8. Determination of apparent density of porous solids.	**CO-4** **BTL-3**
MODULE 5: ESTIMATION METAL ION CONTENTS IN THE SAMPLE	**(6 P)**
9. Estimation of dye content in the effluent by UV-Visible spectrophotometry. 10. Determination of copper / iron content in the alloy by colorimetry. 11. Estimation of sodium and potassium ions by flame photometry. 12. Verification of Beer-Lambert's law using gold nanoparticles.	**CO-5** **BTL-3**

TEXT BOOKS	
1.	P.S. Raghavan (2018), *Materials Chemicals Laboratory Manual*, Dhanam Publications.
REFERENCE BOOKS	
1.	J. Mendham, R.C. Denney, J.D. Barnes and N.J.K. Thomas (2009), *Vogel's Textbook of Quantitative Chemical Analysis,* 6th Edition, Pearson Education.
E BOOKS	
1.	http://www.erforum.net/2016/01/engineering-chemistry-by-jain-and-jain-pdf-free-ebook.html
MOOC	
1.	https://www.coursetalk.com/providers/coursera/courses/introduction-to-chemistry-1

SEMESTER III

COURSE TITLE	**PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS**			**CREDITS**	**4**
COURSE CODE	**MAA4201**	**COURSE CATEGORY**	**BS**	**L-T-P-S**	**3-0-2-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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	To make the student understand the basic concepts of partial differential equations and transforms and its applications
Course Objective	1. To present the main results in the context of partial differential equations and to study numerical methods for the approximation of their solution 2. To introduce the wave equation including time and position dependence 3. To mathematically model the way thermal energy moves through the plate 4. To understand the concept of Fourier transform 5. To understand the concept of Z-transform and its properties
Course Outcome	Upon completion of this course, the students will be able to 1. formulate and solve standard types of partial differential equations 2. solve the Wave and Heat equations 3. obtain the solution of two dimensional heat equations 4. evaluate the definite integrals using Fourier transform 5. compute the solution of difference equation using Z-Transform.

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

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

MODULE 1: PARTIAL DIFFERENTIAL EQUATIONS (9L+3T=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	**CO-1** **BTL-4**

MODULE 2: ONE DIMENSIONAL WAVE AND HEAT FLOW EQUATION (9L+3T=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.	**CO-2** **BTL-4**
MODULE 3: TWO DIMENSIONAL HEAT FLOW EQUATION	**(9L+3T=12)**
Steady state solution of two dimensional heat equations and applications in finite plates and infinite plates problems. **Suggested Reading:** Partial Differential Equations, Half range sine series.	**CO-3** **BTL-4**
MODULE 4: FOURIER TRANSFORM	**(9L+3T=12)**
Fourier Integral Theorem (without proof) - Fourier transform pair - Sine and Cosine transforms - Properties - Transforms of Simple functions - Convolution theorem - Parseval's identity. **Suggested Reading:** Basic integration.	**CO-3** **BTL-3**
MODULE 5: Z-TRANSFORM AND DIFFERENCE EQUATIONS	**(9L+3T=12)**
Z-Transform - Elementary Properties - Inverse Z-Transform - Convolution theorem - Formation of Difference equations - Solution of difference equations using Z-Transform **Suggested Reading:** Basic calculus	**CO-4** **BTL-4**

TEXT BOOKS	
1.	P. Sivarama Krishna Das, C. VijayakumarL, "Transforms and partial differential equations", 1 Pearson Publication, 2011
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
REFERENCE BOOKS	
1.	BaILN.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.
E BOOKS	
1.	nptel.ac.in/courses/122107037/
2.	nptel.ac.in/courses/122107037/22
MOOC	
1.	https://www.edx.o rg/course/introduction-differential-equations-bux-math226-1x-1

COURSE TITLE	**ANALOG ELECTRONICS**			**CREDITS**	**4**
COURSE CODE	**ECB4201**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-1**

Version	1.0	Approval Details	24TH ACM, 30.05.2018	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	Analog Electronics deals with electronic systems that has a continuous variable signal. In this course, the foundation of various analog electronic circuits that can be used to design amplifiers, oscillators, filters, analog converters, waveform generators and other analog circuits as required for the application is learned by the student.
Course Objective	1. To develop the principles behind the design of an amplifier. 2. To build tuned amplifier and feedback Amplifiers 3. To design an operational-amplifier independently well before the end of the course 4. To select appropriate wave shaping circuits to solve problems 5. To familiarize the basic concepts of converters and ICs.
Course Outcome	Upon completion of this course, the students will be able to 1. Apply different biasing, classify the types and solve problems on different amplifier circuits. 2. Analyse the characteristics of tuned amplifier and feedback Amplifiers 3. Describe the linear Op-Amps, its applications and special ICs 4. Identify appropriate wave shaping circuits to solve problems. 5. Discuss the applications of analog electronic circuits.

Prerequisites: PHA4102-Engineering Physics

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
CO-1	3	3	2	1	1	1	-	-	-	-	2	1	-	1
CO-2	3	3	2	2	1	-	-	-	-	-	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	3	2	1	-	-	-	-	-	2	1	-	1

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

MODULE 1: SMALL SIGNAL AND LARGE SIGNAL AMPLIFIERS (9L+3T=12)

Fixed and self-biasing of BJT & FET – Small signal analysis of CE, CC & Common source amplifiers – Cascade and Darlington connections, transformer coupled class A, B & AB amplifiers – Push-pull amplifiers.	**CO-1 BTL-4**

Suggested Reading: Robert. L. Boylsted and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education, 9th edition, 2009.	
MODULE 2: FEEDBACK AND TUNED AMPLIFIERS	**(9L+3T=12)**
Characteristics of negative feedback amplifiers – Voltage / current, series/shunt feedback - Characteristics of tuned amplifiers – Single & double tuned amplifier, Stagger tuned and Synchronized tuned amplifiers and Neutralization Techniques. **Suggested Reading:** Robert. L. Boylsted and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education, 9th edition, 2009.	**CO-2** **BTL-4**
MODULE 3: LINEAR OP-APMPs AND ITS APPLICATIONS	**(9L+3T=12)**
Linear Circuits using operational amplifiers and their analysis, Inverting and Non inverting Amplifiers, Differentiator, Integrator, Voltage to current converter, Instrumentation amplifier, Low-pass and band-pass filters, Comparator, Triangular wave generator, Precision rectifier, Log and Antilog amplifiers, Non-linear function generator. **Suggested Reading: T**homas L. Floyd, "Electronic Devices", 9th edition, Pearson education, 2011.	**CO-3** **BTL-4**
MODULE 4: WAVE GENEATION AND WAVE SHAPING CIRCUITS	**(9L+3T=12)**
Theory of sinusoidal oscillators – RC Phase shift and Wien bridge oscillators using Op-Amps – Comparators, Multivibrators: Monostable, Astable Multivibrators– Schmitt triggers, Triangular wave generator, Non-linear function generator **Suggested Reading:** Ramakant A. Gayakwad, 'Op-Amps and Linear Integrated Circuits', Prentice Hall of India, FourthEdition,2009	**CO-4** **BTL-4**
MODULE 5: D/A AND A/D CONVERTORS AND SPECIAL ICs	**(9L+3T=12)**
Introduction, Basic DAC techniques, Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different types of ADCs - Flash ADC, Counter type ADC, Successive approximation ADC and Dual slope ADC. PLL, VCO, Astable and Monostable Multivibrators using 555 Timer, Voltage regulators. **Suggested Reading:** D. Roy Choudhury & Shail B. Jain, 'Linear Integrated Circuits', New Age International Publishers, Fourth Edition, 2010	**CO-5** **BTL-4**
TEXT BOOKS	
1.	Robert. L. Boylsted and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education, 9th edition, 2009.
2.	Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", 6th Edition, Oxford University Press, 2010.

3.	David A Bell, “Solid State Pulse Circuits", Oxford University Press, 2007
4.	D. Roy Choudhury & Shail B. Jain, 'Linear Integrated Circuits', New Age International Publishers, Fourth Edition, 2010.
5	Ramakant A. Gayakwad, 'Op-Amps and Linear Integrated Circuits', Prentice Hall of India, FourthEdition,2009
REFERENCE BOOKS	
1	Jacob Millman, Christos C Halkias, Satyabrata Jit "Electron Devices and Circuits", Tata McGraw Hill, 3rd edition 2010
2	Donald .A. Neamen, Electronic Circuit Analysis and Design –2nd Edition, Tata Mc Graw Hill, 2009.
3	Thomas L. Floyd, "Electronic Devices", 9th edition, Pearson education, 2011.
4	David A. Bell,” Electronic Devices and Circuits”, Oxford Higher Education Press, 5th Edition, 2010.
E BOOKS	
1.	http://www.qiau.ac.ir/teacher/files/24955/27-06-1387-13-58-57-Wiley%20-%20Fundamentals%20of%20Microelectronics%20%28Razavi,%202006%29.pdf
MOOC	
1	http://nptel.ac.in/courses/113106062/
2	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-spring-2009/

COURSE TITLE	**ELECTROMAGNETIC FIELDS AND WAVES**			**CREDITS**	**4**
COURSE CODE	**ECB4202**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-2**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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 discusses classical electrostatic, magnetostatic, and electromagnetic phenomena, and waveguides. Although an effort is made to revisit the main elements of elementary vector calculus, coordinate systems, a good grasp of the fundamental notions of calculus, vector manipulation, are necessary for this course. The course prepares the students for the third-year courses where electromagnetic fields are encountered, particularly those including an in-depth description of the antennas and wave propagation.				

Course Objective	1. To introduce students with different coordinate systems. 2. To familiarize the students with the different concepts of electrostatic, magneto static and time varying electromagnetic systems. 3. Apply Maxwell's equations and their application to time-harmonic fields, boundary conditions, wave equations, and Poynting's power-balance theorem 4. To expose the students to the ideas of electromagnetic waves and structure of transmission line. 5. To solve problems involving lossless transmission lines with time-harmonic excitation.
Course Outcome	Upon completion of this course, the students will be able to 1. Solve simple problems related to different coordinate systems and apply basic vector calculus theorems 2. Apply Gauss's law and Ampere's law to simple structures and problems and examine electromagnetic forces on different charged elements. 3. Analyze wave propagation through different media, differentiate different polarizations, and inspect various cases of reflection of plane waves 4. Apply Maxwell's equations to obtain solutions in parallel plate systems and examine the characteristic features of wave – waveguide interaction. 5. Analyze rectangular and cylindrical waveguides using Maxwell's equations and associated characteristics and solve associated simple problems

Prerequisites: Engineering Mathematics & Applied 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
CO-1	3	1	1	1	-	-	-	-	-	-	-	-	3	-
CO-2	3	2	2	2	1	1	-	-	-	-	-	-	3	-
CO-3	3	1	2	1	2	1	-	-	-	-	-	-	3	-
CO-4	3	2	2	2	1	-	-	-	-	-	-	-	3	-
CO-5	3	2	2	1	1	1	-	-	-	-	-	-	3	-

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

MODULE 1: VECTOR ANALYSIS **(4L+3T=7)**

Coordinate Systems: Cartesian, cylindrical and spherical co-ordinate systems, Vector Calculus: differential lengths, surfaces and volumes in Cartesian, cylindrical and spherical coordinate systems, del operator, gradient, divergence and curl. **Suggested Readings:** Vector algebra: Scalars and Vectors, Unit Vector, Vector Addition and Subtraction, Position and Distance Vectors, Vector Multiplication.	**CO-1** **BTL-2**

MODULE 2: ELECTROSTATICS AND STATIC MAGNETIC FIELDS **(12L+3T=15)**

Coulomb's law, electric field intensity, field due to point charge, field due to line charge, field due to sheet of charge, electric flux density, Gauss's law, applications of Gauss's law, divergence theorem, potential difference and potential gradient, electric dipole and dipole moment. Biot-Savart's law, Ampere's circuital law and applications, Stokes theorem, Magnetic flux and magnetic flux density, Scalar and Vector magnetic potential, Force on a moving charge (Lorentz's force equation), Force on a differential current element, Force and Torque on a closed circuit. **Suggested Readings:** Field streamlines, superposition theorem. Force between differential current elements, magnetic dipole moment.	**CO-2** **BTL-4**
MODULE 3: TIME VARYING FIELDS AND WAVES	**(12 L+3T=15)**
Faraday's law, displacement current, ampere's circuital law for time varying fields, Maxwell's equations in phasor form, differential and integral form, wave propagation in free space, Helmholtz equation, uniform plane wave, pointing vector and the flow of power. Wave Propagation in Lossy Dielectrics, Plane Waves in Lossless Dielectrics, Plane Waves in Free Space, Plane Waves in Good Conductors, skin effect, Wave polarization: linear, elliptical and circular polarization, Reflection of uniform plane wave: normal and oblique incidence. **Suggested Readings:** Transformer and Motional emf, retarded potentials, MATLAB® programs for computations and animations of EM principles, Snell's law, critical and Brewster's angle, standing waves, MATLAB® programs for computations and animations of wave propagation.	**CO-3** **BTL-4**
MODULE 4: GUIDED WAVES	**(5L+3T=8)**
Waves between parallel planes of perfect conductors – Transverse electric and transverse magnetic waves – characteristics of TE and TM Waves – Transverse Electromagnetic waves –Velocities of propagation – component uniform plane waves between parallel planes – Attenuation of TE and TM waves in parallel plane guides – Wave impedances. **Suggested Readings:** Propagation, attenuation and impedance in parallel planes guides.	**CO-4** **BTL-4**
MODULE 5: RECTANGULAR AND CIRCULAR WAVEGUIDES	**(12L+3T=15)**
Transverse Magnetic Waves and Transverse Electric Waves in Rectangular Waveguides – characteristic of TE and TM Waves – Cut off wavelength and phase velocity – Impossibility of TEM waves in waveguides – Dominant mode in rectangular waveguide –Attenuation of TE and TM modes in rectangular waveguides – Wave impedances – characteristic impedance – Excitation of modes. Bessel functions – Solution of field equations in cylindrical co-ordinates – TM and TE waves in circular guides – wave impedances and characteristic impedance – Dominant mode in circular waveguide – excitation of modes. **Suggested Readings:** Propagation, attenuation, excitation and impedances.	**CO-5** **BTL-4**
TEXT BOOKS	

1	Mathew. N. O. Sadiku “Principles of Electromagnetics”, 6th edition, Oxford University Press, 2015.
2	William H. Hayt, Jr., John A. Buck, “Engineering Electromagnetics”, 8th edition, Tata McGraw Hill, 2011.
3	Jorden, Ballman, “Electromagnetic Fields & Radiating Systems”, 2nd edition, Pearson, 2015.
REFERENCE BOOKS	
1	John Kraus, Daniel Fleisch, “Electromagnetics with applications”, 5th edition, McGraw Hill Education, 2017.
2	David. K. Cheng, “Fields and Wave electromagnetics, 2nd edition, Pearson Education, 2002.
E BOOKS	
1	Constantine Balanis, “Advanced Engineering Electromagnetics”, 2nd edition, John Wiley & Sons, Inc., 2012.
2	Sophocles J. Orfanidis, “Electromagnetic Waves and Antennas”, 2016. Web page: www.ece.rutgers.edu/~orfanidi/ewa
3	Robert E. Collin, “Field Theory of Guided Waves”, 2nd edition, Wiley-IEEE Press, 1990.
MOOC	
1	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-013-electromagnetics-and-applications-spring-2009/
2	http://nptel.ac.in/courses/108106073/ : Dr.Harishankar Ramachandran, IIT Madras.
3	http://nptel.ac.in/courses/117101057/40
4	www.cdeep.iitb.ac.in/webpage_data/nptel/Electrical%20.../Lec46(m6).html

COURSE TITLE	**PROFESSIONAL ETHICS AND LIFE SKILLS**			**CREDITS**	**2**
COURSE CODE	**GEA4216**	**COURSE CATEGORY**	**BS**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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 provides knowledge about Human Values, Ethics in Professional Engineering life and different types of theories. It also describes about society, communities, sense of survival, security & social responsibilities.

Course Objective	1. To comprehend about Human values and ethics. 2. To identify the engineering ethics and types of moral development theories. 3. To recognize the values of safety, risk, basic right of human. 4. To interpret the concepts of life skills and personal values and self-strengths. 5. To discuss about types of society, communities and sense of Survival and securities.
Course Outcome	Upon completion of this course, the students will be able to 1. Explain about business ethics, Morals and train oneself to be ethical. 2. Illustrate about engineering ethical principle, Reasoning, Roles and responsibilities 3. Demonstrate about corporate responsibilities towards product safety and reliability and types of rights. 4. Analyze about values and value education, self-strengths and weaknesses. 5. Describe about society and communities, sense of survival, security & social responsibilities.

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

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

MODULE 1: HUMAN VALUES	**(6L)**
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 *Self-Study: Case study of Discovery failure* **Suggested Readings:** Basic of Morals and Ethics.	**CO-1** **BTL-2**
Module 2: ENGINEERING ETHICS	**(6L)**

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. *Self-study: Study the Bhopal gas tragedy* **Suggested Readings:** Moral Development theory	**CO-2** **BTL-3**
MODULE 3: SAFETY, REPONSIBILITIES AND RIGHTS	**(6L)**
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. *Self-study: Chernobyl explosion, Nuclear and thermal power plant issues* **Suggested Readings:** Safety , Risk and Human Rights	**CO-3** **BTL-3**
MODULE 4: LIFE SKILLS	**(6L)**
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 *Self-study: Influences - Peer pressure, familial and societal expectations, media* **Suggested Readings:** Life Values and self-strengths	**CO-4** **BTL-3**
MODULE 5: SOCIETIES IN PROGRESS	**(6L)**
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 *Self-study: Personal value and professional value of Engineers on societies perception* **Suggested Readings:** Structure of Society and *value of Engineers on societies*	**CO-5** **BTL-3**

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
E BOOKS	
1.	https://easyengineering.net/professionalethicsinengineeringbooks/
MOOC	
1	https://www.coursera.org/learn/ethics-technology-engineering
2	https://www.edx.org/course/moral-problems-and-the-good-life

COURSE TITLE	**ANALOG ELECTRONICS LAB**			**CREDITS**	**1**
COURSE CODE	**ECB4231**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-3-0**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-4**

ASSESSMENT SCHEME

CIA	**ESE**
80%	**20%**

Course Description	This laboratory is designed to meet the requirement of syllabus of Analog Electronics for the students of III semester. In the lab students explore the design, construction and debugging of analog electronics circuit. Laboratory experiments investigate the performance characteristics of diode, transistors, JFET and Op-amp including the construction of a small audio amplifier and preamplifier.
Course Objective	1. To prepare students to perform the analysis of any Analog electronics circuit. 2. To empower students to understand the design and working of BJT / FET amplifiers, oscillators and Operational Amplifier 3. To prepare the students for advanced courses in Communication system Circuit Design.
Course Outcome	Upon completion of this course, the students will be able to 1. Design the different biasing configurations of the amplifier circuits and obtain their frequency response. 2. Design and study the characteristics of tuned amplifier and feedback Amplifiers. 3. Design, debug and analyze various circuits using op-amps. 4. Design, debug and analyze the wave shaping circuits.

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**

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

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

LIST OF EXPERIMENTS

1. Plot the frequency response of a RC coupled BJT amplifier in common emitter configuration. Calculate gain & Bandwidth.
2. Power amplifier – Class A & Class B power amplifiers: Efficiency calculations. Cross over distortion in Class B power amplifiers.
3. Series and shunt feedback amplifiers: Frequency response, input and output impedance calculation.
4. Frequency response of Single Tuned Amplifier with gain and bandwidth calculations.
5. Inverting & Non-inverting amplifier, Integrator and Differentiator.
6. Instrumentation amplifier.
7. Low Pass and Bandpass filter design.
8. Phase shift & Wein Bridge Oscillator using op-amp.
9. Precision half wave and full wave rectifiers.
10. Triangular Wave generator.
11. Astable and Monostable using IC 555 timer.
12. PLL characteristics and frequency multiplier using PLL.

REFERENCE BOOKS

1.	Jacob Millman, Christos C Halkias, Satyabrata Jit "Electron Devices and Circuits", Tata McGraw Hill, 3rd edition 2010
2.	Donald .A. Neamen, Electronic Circuit Analysis and Design –2nd Edition, Tata Mc Graw Hill, 2009
3.	Thomas L. Floyd, "Electronic Devices", 9th edition, Pearson education, 2011.
4.	David A. Bell,"Electronic Devices and Circuits", Oxford Higher Education Press, 5th Edition, 2010.

E BOOKS

1	http://www.qiau.ac.ir/teacher/files/24955/27-06-1387-13-58-57-Wiley%20-%20Fundamentals%20of%20Microelectronics%20%28Razavi,%202006%29.pdf

MOOC

1	http://nptel.ac.in/courses/113106062/
2	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-spring-2009/

COURSE TITLE	CIRCUITS SIMULATION LAB			CREDITS	1
COURSE CODE	ECB4232	COURSE CATEGORY	PC	L-T-P-S	0-0-2-0
Version	1.0	Approval Details	24TH ACM, 30.05.2018	LEARNING LEVEL	BTL-4

ASSESSMENT SCHEME

CIA	ESE
80%	20%

Course Description	This course helps the students to acquire a deep understanding of the fundamental effects that limit the performance of high-speed transistor circuits and op amp circuits commonly found in electronic products. Knowledge acquired will prepare for a successful career as a transistor level integrated circuit designer.
Course Objective	1. To enable students to design and simulate the electronic circuits using multisim. 2. To impart the practical approach on the operations of electronic circuits.
Course Outcome	Upon completion of this course, the students will be able to 1. Design and simulate basic simple circuits using diodes and passive elements 2. Design and simulate basic amplifier circuits using BJT and FET. 3. Design and Simulate basic circuits using op-amp.

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
CO-1	3	2	-	-	1	-	-	-	1	1	1	2	2	1
CO-2	3	2	-	-	1	-	-	-	1	1	1	2	2	1
CO-3	3	2	-	-	1	-	-	-	1	1	1	2	2	1

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

LIST OF EXPERIMENTS

LIST OF SIMULATION EXPERIMENTS USING MULTISIM

1. Verification of Low pass and High pass Filter
2. Verification of Clippers & Clampers
3. Design and Verification of Attenuators
4. Verification of Half–Wave and Full-Wave Rectifier
5. Design and Verification of Voltage Regulator

6. Frequency Response of CE Amplifier
7. Frequency Response of CS Amplifier
8. Frequency Response of CC Amplifier
9. Design of Wein-Bridge and RC phase shift Oscillator
10. Design and Verification of Class-A Power Amplifier
11. Design and Verification of Pre-emphasis and De-emphasis circuits
12. Design and Verification of RC coupled amplifier
13. Design and Verification of Differential amplifier
14. Astable Multivibrator using op-amp
15. Monostable Multivibrator using op-amp

REFERENCE BOOKS

1.	L K Maheswari and M M S Anand, "Laboratory Manual for Introductory Electronic Experiments", New Age, 2010
2.	S Poornachandra Rao and B Sasikala, "Handbook of Experiments in Electronics and Communication Engineering",Vikas publishers, 2003.

COURSE TITLE	**DESIGN PROJECT - I**			**CREDITS**	**1**
COURSE CODE	**ECB4233**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-5**

ASSESSMENT SCHEME

FIRST REVIEW	**SECOND REVIEW**	**THIRD REVIEW**	**PROJECT REPORT AND VIVA VOCE**
20%	**30%**	**20%**	**30%**

Course Description	In this course, each team with maximum of four members is expected to design and develop practical solutions to real life problems related to Industry and Information Technology research. Software usage should be followed during the development. The theoretical knowledge gained from the subject in the current and previous semesters should be applied to develop effective solutions to various applications.
Course Objective	1. To elaborate the concepts of development of a product from planning to prototype 2. To analyze, apply and design electronic products using various software tools and methodologies.
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate to identify and solve real time problems of the society 2. Develop practical solutions to the societal problems 3. Apply the knowledge of the engineering design concepts and its relevant applications

Prerequisites: Engineering and Design, Digital System Design, Analog Electronics

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

The design project shall be carried out in the field of Electronics & Communication Engineering. Students shall work in convenient groups of not more than four members in a group. Every team shall have a Supervisor. During this period the supervisor shall guide the students to implement the Project. The students shall give periodical presentations of the progress made in the design project.

Each group shall finally produce a report covering background information, literature survey, problem statement, design details, analysis and conclusions with future scope. This final report shall be typewritten form as specified in the guidelines.

Assessment	
Review / Exam	**Weightage**
First Review	20%
Second Review	30%
Third Review & Demo	20%
Project report and Viva-Voce	30%
TOTAL	**100%**

SEMESTER IV

COURSE TITLE	RANDOM PROCESS			CREDITS	4
COURSE CODE	MAA4218	COURSE CATEGORY	BS	L-T-P-S	3-0-2-1
Version	1.0	Approval Details	24th ACM, 30.05.2018	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	To make the student understand the basic concepts and techniques of numerical solution of algebraic equation, numerical solution of differentiation, integration and their application to engineering and science.
Course Objective	1. To understand the concept of probability 2. To understand the concept of discrete and continuous case 3. To understand about random variables in two dimensions 4. To classify the random process 5. To find the correlation and spectral density
Course Outcome	Upon completion of this course, the students will be able to 1. formulate theorems about the concept of probability and Calculate probabilities using Conditional probability. 2. recognize the standard distributions and apply them appropriately in real time problems 3. compute the covariance and correlation 4. classify the different types of random process 5. compute power spectral density and cross spectral density of a random process.

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

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

MODULE 1:PROBABILITY AND RANDOM VARIABLES (9L+3T=12)

Axioms of Probability– Bayes' Theorem -Random variables – Moments – Moment generating functions. **Suggested Reading:** Basic Probability	**CO-1** **BTL-4**
MODULE 2: STANDARD DISTRIBUTIONS	**(9L+3T=12)**
Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions Suggested Reading: Discrete and Continuous Functions	**CO-2** **BTL-4**
MODULE3: TWO-DIMENSIONAL RANDOM VARIABLES	**(9L+3T=12)**
Joint distribution – Marginal and conditional distribution – Co-variance – Correlation and Regression **Suggested Reading:** Random Variables	**CO-3** **BTL-4**
MODULE 4: CLASSIFICATION OF RANDOM PROCESS	**(9L+3T=12)**
Definition and examples– first order, second order, strictly, wide sense stationary and Ergodic processes– Markov process –Binomial, Poisson processes. **Suggested Reading:** Random Variable	**CO-4** **BTL-4**
MODULE 5: CORRELATION AND SPECTRAL DENSITIES	**(9L+3T=12)**
Auto-correlation – Cross-correlation – Properties (Statement only) – Power spectral density – Cross spectral density–Properties (Statement only) –Wiener-Khinchin relation (Statement only) –Relationship between power spectrum and cross correlation function. **Suggested Reading:** Correlation	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", Academic Press, 2004.
2.	A. Chandrasekaran, G.Kavitha,"Probability, Statistics, Random Processes and Queuing Theory", Dhanam Publications, 2014
3.	Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma, "MATLAB and its Applications in Engineering", Pearson Publication, Second Edition, 2016.
REFERENCE BOOKS	
1.	Ibe. O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007.
2.	Cooper. G.R., Mc Gillem. C.D., "Probabilistic Methods of Signal and System Analysis", 3rd Indian Edition, Oxford University Press, New Delhi, 2012.
3.	Dean G. Duffy., "Advanced Engineering Mathematics with MATLAB", CRC Press, Third Edition 2013.
E BOOKS	
1.	http.//nptel.ac.in/courses/IIT-MADRAS/Principles_of_Communication1/Pdfs/1_5.pdf
MOOC	
1.	https://www.edx.org/course/introduction-probability-science-mitx-6-041x-2

COURSE TITLE	**TRANSMISSION LINES AND NETWORKS**	**CREDITS**	**4**

COURSE CODE	ECB4216	COURSE CATEGORY	PC	L-T-P-S	3-1-0-1
Version	1.0	Approval Details	24TH ACM, 30.05.2018	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	Courses introduce the various types of transmission lines and discuss the losses associated with it. It also gives the thorough understanding about impedance transformation and matching. Brings the impart knowledge on filter theories and waveguide theories. Clears to solve problems using Smith chart.
Course Objective	1. To learn the fundamentals of T and Pi networks 2. To Analyze the fundamentals of passive filters 3. To study attenuators and equalizers and solve problems on it. 4. To learn transmission line theory to solve problems 5. To understand Smith Chart for transmission line analysis.
Course Outcome	Upon completion of this course, the students will be able to 1. Illustrate the fundamentals of T and Pi networks 2. Analyze the fundamentals of passive filters 3. Distinguish between attenuators and equalizers and solve problems on it. 4. Pertain transmission line theory to solve problems 5. Solve problems by Smith Chart for transmission line problems

Prerequisites: Calculations pertaining to electromagnetic fields, lay a strong foundation on the theory of transmission lines and wave guides by highlighting their 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
CO-1	3	3	3	-	-	-	-	-	-	-	-	1	3	1
CO-2	3	3	3	1	1	-	-	-	-	-	-	1	3	1
CO-3	3	3	3	1	-	1	-	-	-	-	-	1	3	1
CO-4	3	3	3	1	-	-	-	-	-	-	-	1	3	1
CO-5	3	3	3	-	1	1	-	-	-	-	-	1	3	1

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

MODULE 1 – Symmetrical & Asymmetrical networks (9L+3T)

Symmetrical networks, characteristic impedance and propagation constant. Asymmetrical networks, Image and Iterative impedances. Image transfer constant and iterative transfer constant. Properties of L, T and Pi section types. **Suggested Readings:** Two port network theory	**CO-1** **BTL-2**
MODULE 2- Passive Filters	**(9L+3T)**
Classification of filters, filter networks, equation of filter networks, classification of pass band and stop band, characteristics impedance in pass band and stop band, constant k-low pass and high pass filter, band pass filter, band elimination filter. **Suggested Readings:** Microwave filter design, different methods	**CO-2** **BTL-3**
MODULE 3- Attenuators and Equalizers	**(9L+3T)**
Attenuators and equalizers Attenuators-type, π-type, Lattice, Bridge, L-Type attenuators; series, shunt, delay, attenuation equalizers **Suggested Readings:** Microwave Filters	**CO-3** **BTL-3**
MODULE 4 – Transmission Line Theory	**(9L+3T)**
The Lumped-Element Circuit Model for a Transmission Line, Transmission line equations and their solutions, Transmission line parameters, Characteristic impedance, Propagation constant, Attenuation constant, Phase constant, Waveform distortion, Distortion less transmission lines, Input impedance of lossless lines – reflection on a line not terminated by Z_o - Transfer impedance– reflection factor and reflection loss – T and Π Section equivalent to lines. **Practical component:** Slotted line impedance measurement. **Suggested Readings:** Impedance matching using transmission line sections.	**CO-4** **BTL-3**
MODULE 5 – Transmission Lines At Radio Frequencies	**(9L+3T)**
Loading of transmission lines, Reflection coefficient and VSWR. Equivalent circuits of transmission lines, Transmission lines at radio frequency. Open circuited and Short circuited lines, Smith Chart, Application of the Smith Chart– Conversion from impedance to reflection coefficient and vice-versa. Impedance to Admittance conversion and vice versa – Input impedance of a lossless line terminated by an impedance – Stub matching: single stub matching and double stub matching. **Practical component:** Slotted line measurement of VSWR **Suggested Readings:** Applications of Smith Chart	**CO-5** **BTL-4**
TEXT BOOKS	

4.	E.C.Jordan and Balmain, "Electro Magnetic Waves and Radiating Systems", PHI, 1968, Reprint 2005
5.	J.D. Ryder, “Networks, Lines and Fields”, 2nd edition, Pearson Education India, 2015.
REFERENCE BOOKS	
1	G.S.N. Raju, “Electromagnetic field theory and transmission lines”, 1st edition (3rd reprint), Pearson Education India, 2009
2	John D.Kraus and Ronalatory Marhefka, "Antennas", Tata McGraw-Hill Book Company, 2002.
3	R.E.Collins, 'Antennas and Radio Propagation ", McGraw-Hill, 1985.
4	Ballany, "Antenna Theory " , John Wiley & Sons, second edition , 2003.
5	Prasad, K.D. “Antennas and Wave Propagation”, Khanna Publications, 2001.
E BOOKS	
1	http://engineeronadisk.com/book_modeling/
2	Text book companion http://www.scilab.in/Completed_Books#2
MOOC	
1	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-630-electromagnetics-fall-2006/index.htm
2	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-661-receivers-antennas-and-signals-spring-2003/lecture-notes/
3	http://www.creativeworld9.com/2011/02/learn-antennas-and-wave-propagation.html

COURSE TITLE	**SIGNALS AND SYSTEMS**			**CREDITS**	**4**
COURSE CODE	**ECB4217**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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 module provides the basic of signals and systems its representations and response. It also describe the different response using Laplace Transform, Z- transform and Fourier Transform too.				

Course Objective	1. To know about types of signals and systems and its representations. 2. To understand the LTI systems and its properties. 3. To identify the response of signal using Laplace transform. 4. To visualize the effect of z Transform on the signals. 5. To interpret the effects of FS, FT on the signals.
Course Outcome	Upon completion of this course, the students will be able to 1. Classify the continuous time & discrete time signals and systems 2. Apply the properties of LTI systems and perform time domain analysis of continuous and discrete time signals and systems. 3. Analyze and determine the impulse and step response of LTI systems using Laplace transforms and its properties 4. Examine and determine the impulse and step response of LTI systems by applying Z-transform, its properties and inverse Z-transform 5. Outline the properties of Fourier series, Fourier transform, discrete time Fourier transform and Discrete Fourier Transform and analyze the given system.

Prerequisites: Basic understanding of differential and integral calculus, limits and adequate knowledge of 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
CO-1	3	3	2	3	1	-	-	-	-	-	-	2	2	3
CO-2	3	2	2	3	1	-	-	-	-	-	-	2	2	3
CO-3	3	3	2	2	1	-	-	-	-	-	-	2	2	3
CO-4	3	2	2	3	1	-	-	-	-	-	-	2	2	3
CO-5	3	3	2	3	1	-	-	-	-	-	-	2	2	3

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

MODULE 1: Continuous and Discrete Time Signals and Systems	**(9L+3T=12)**
Mathematical representation, classification of Continuous Time and Discrete Time signals, arithmetic operations on the signals, transformation of independent variable, Mathematical representation, classification of CT and DT systems, Sampling and reconstruction, aliasing effect **Suggested Readings:** Basic of Continuous and Discrete signals	**CO-1** **BTL-4**
MODULE 2: Time Domain Analysis of Continuous and Discrete Time Signals And Systems	**(9L+3T=12)**
Properties of LTI systems, impulse and step response, Use of convolution integral and convolution sum for analysis of LTI systems, Properties of convolution integral/sum. **Suggested Readings:** LTI systems and convolution.	**CO-2** **BTL-4**

MODULE 3: Frequency Domain Analysis of Continuous Time System Using Laplace Transform **(9L+3T=12)**	
Need of Laplace transform, review of Laplace transform, properties, inverse of Laplace transform, concept of ROC, poles and zeros, Unilateral Laplace transform, Analysis and characterization of LTI system using Laplace transform: impulse and step response, causality, stability, stability of causal system, Block diagram representation of Continuous Time systems. **Suggested Readings:** Laplace transform	**CO-3** **BTL-4**
MODULE 4: Frequency Domain Analysis of Discrete Time System Using Z- Transform **(9L+3T=12)**	
Need of Z transform, definition, properties of unilateral and bilateral Z Transform, mapping with s plane, relationship with Laplace transform, Z transform of standard signals, ROC, poles and zeros of transfer function, inverse Z transform, Analysis and characterization of LTI system using Z transform: impulse and step response, causality, stability of causal system, Block diagram representation and system realization. **Suggested Readings:** Z- transform	**CO-4** **BTL-4**
MODULE 5: Frequency Domain Analysis of Continuous and Discrete Signals using Fourier **(9L+3T=12)**	
Review of Fourier series, Discrete time Fourier series and its properties, Fourier transform, properties of Fourier transform, relationship with Laplace and Z transform, Discrete time Fourier transform, Properties, Frequency sampling, Discrete Fourier transform, Properties. **Suggested Readings:** DTFS, DTFT,FT	**CO-5** **BTL-4**
TEXT BOOKS	
1.	Allan V.Oppenheim, S.Wilsky and S.H. Nawab, “Signals and Systems”, Pearsons,2007
2	Edward W Kamen & Bonnie’s Heck, “Fundamentals of Signals and Systems”, Pearson Education, 2007.
REFERENCE BOOKS	
1	John G.Proakis and DimitrisG.Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, 4th Edition, PHI, 2006.
2	B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.
3	R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson, 2007.
4	John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007
5	M.J.Roberts, “Signals & Systems Analysis using Transform Methods & MATLAB”, Tata McGraw Hill, 2007.
E BOOKS	

1.	http://bookboon.com/en/introduction-to-digital-signal-and-system-analysis-ebook
MOOC	
1	Signals and Systems (web), http://nptel.ac.in/courses/117104074/
2	Signals and Systems (web), http://nptel.ac.in/courses/117101055/

COURSE TITLE	**MICROCONTROLLERS AND EMBEDDED SYSTEMS**			**CREDITS**	**3**
COURSE CODE	**ECB4218**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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	The microprocessors and microcontrollers are programmable integrated devices that have computing and decision making capability similar to that of CPU of the computer. Microcontrollers along with embedded systems have a wide range of applications in industry and day-today life. The module focuses on programming of various controllers and interfacing with peripheral devices. An introduction to embedded systems, designing process of an embedded system and real time operating systems are also discussed in this course.				
Course Objective	1. To study architecture, instruction set, addressing modes and programming of 8085 & 8086 2. To study architecture of 8051, ARM and programming of 8051 3. To study the concepts of interfacing peripherals. 4. To study the basics of Embedded Systems. 5. To study the basic concepts of Real Time Operating Systems.				

Course Outcome	Upon completion of this course, the students will be able to 1. Describe the architecture, instruction set and programming of 8085 and 8086 microprocessor. 2. Describe the architecture of 8051 and ARM microcontroller 3. Interface peripherals with microprocessor and microcontroller. 4. Elaborate the concepts of embedded processors hardware, software and System on a Chip. 5. Interpret the concepts of real time operating system, inter process communication and their significance.

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

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

MODULE 1: OVERVIEW OF MICROPROCESSOR	**(9L)**
Overview of Microprocessor-Architecture-Interrupts- Instruction set -Assembly language programming-8 bit arithmetic using 8085 & 8086 **Suggested Readings:** Evolution of Microprocessors	**CO-1** **BTL-4**
MODULE 2: MICROCONTROLLERS	**(9L)**
8051 Functional block diagram –Addressing mode – Interrupts-Instruction set- Simple Programming- Introduction to RISC processors; ARM microcontrollers interface designs. **Suggested Readings:** Introduction to microcontrollers	**CO-2** **BTL-4**
MODULE 3: PHERIPHERAL INTERFACING	**(9L)**
Interfacing with peripherals - timer, serial I/O, parallel I/O, keyboard and display, A/D and D/A converters. **Suggested Readings:** Concepts of interfacing	**CO-3** **BTL-4**
MODULE 4: INTRODUCTION TO EMBEDDED SYSTEMS	**(9L)**
Introduction and Classification – Overview of Processors and hardware units in an embedded system – Software embedded into the system –– Embedded Systems on a Chip (SoC)- Examples of an Embedded System-Design tradeoff. **Suggested Readings:**	**CO-4** **BTL-3**

Applications of Embedded Systems	
MODULE 5: REAL TIME OPERATING SYSTEMS	**(9L)**
Operating System Services- Goals – Structures- Kernel –RTOS Task scheduling models - Inter Process Communications using Signals – Semaphore Flag or mutex as Resource key – Message Queues – Mailboxes – Pipes – Virtual (Logical) Sockets – Remote Procedure Calls (RPCs)-Overview of real time programming language. **Suggested Readings:** Applications of Real Time Operating Systems	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Ramesh S. Gaonkar, "Microprocessor – Architecture, Programming and Applications with the 8085", Fifth Edition, Prentice Hall. 2002.
2.	K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.
3.	Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, Second Edition-2009.
REFERENCE BOOKS	
1	William Kleitz, 'Microprocessor and Micro Controller Fundamental of 8085 and 8051 Hardware and Software', Pearson Education, 1998.
2	Steve Heath, Embedded Systems Design, Second Edition-2003
3	David E.Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.
E BOOKS	
1.	https://www.pdfdrive.net/the-8051-microcontroller-and-embedded-e952238.html
2.	http://www.ebooklibrary.org/articles/arm_architecture
3.	engineersevanigam.blogspot.com/.../embedded-systems-by-raj-kamal-ebook-pdf.html
MOOC	
1	https://onlinecourses.nptel.ac.in/noc17_cs05
2	nptel.ac.in/courses/106105036/24

COURSE TITLE	**MATLAB AND SIMULINK LAB**			**CREDITS**	**1**
COURSE CODE	**ECB4241**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME	
CIA	**ESE**
80%	**20%**
Course Description	This module gives an insight about the fundamental concepts of MATLAB programming. MATLAB is used to model and simulate physical problems in the field of electronics and communication engineering. To name a few it is used for scrutiny and analysis of problems in control systems, communication systems, signal processing, image processing and neural networks. The study of simulink facilitates the student to work in a graphical programming environment for modeling, simulating and analyzing multidomain dynamical systems which can be used for varied applications of interest. The knowledge gained through this module helps the student to integrate computation, visualization, and programming in an easy-to-use environment.
Course Objective	1. To enable students to implement the arrays, functions, conditional loops, statements and arithmetic and logic operators in MATLAB. 2. To use the plotting functions in MATLAB 3. To implement modulation system using Simulink blocks
Course Outcome	Upon completion of this course, the students will be able to 1. Apply the concept of arrays, functions, conditional loops, statements and arithmetic and logic operators in MATLAB for developing simple programs. 2. Analyze the various plotting and special plotting functions in MATLAB. 3. Utilize the Simulink block sets for modelling the basic modulation systems
Prerequisites: Familiar with MATLAB programming environment and the usage of Simulink block sets for communication 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
CO-1	3	3	3	-	3	1	-	-	2	1	-	1	1	2
CO-2	3	3	3	-	3	1	-	-	2	1	-	1	1	2
CO-3	3	3	3	-	3	1	-	-	2	1	-	1	1	2

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

LIST OF EXPERIMENTS

1. Introduction to MATLAB, MATLAB help system
2. Arrays, Multidimensional arrays, Operations
3. Functions
4. Arithmetic and Logical operators
5. Conditional statements and loops
6. Plotting, special plotting: 3D plotting

7. Generation of various signals and sequences 8. Simulink Basics 9. Simulink modeling of basic modulation systems 10. Editing and Debugging MATLAB Programs	
REFERENCE BOOKS	
1.	Rudra Pratap, (2004), "Getting Started with MATLAB 6.0", 1st Edition, Oxford University Press, 1-187.
2.	Duane Hanselman ,Bruce LittleField, (2005), "Mastering MATLAB 7" , Pearson Education Inc, pp. 1-825
3.	William J.Palm, (2001) "Introduction to MATLAB 6.0 for Engineers", Mc Graw Hill & Co, pp. 1-316.
4.	Fausett L.V. (2007) "Applied Numerical Analysis Using MATLAB", 2nd Ed., Pearson Education, pp.1-673
5.	MATLAB Tutorial files, www.mathworks.com

COURSE TITLE	**MICROCONTROLLERS AND EMBEDDED SYSTEMS LAB**			**CREDITS**	**1**
COURSE CODE	**ECB4242**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-3-0**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-5**

ASSESSMENT SCHEME	
CIA	**ESE**
80%	**20%**

Course Description	This course is intended to provide the learners with the basic concepts of programming. Programming of microcontrollers can be done by using the instructions. Microcontrollers can be programmed to serve a variety of applications in industry and day-today life. The microcontrollers can be interfaced with various peripheral devices for several applications in real time.
Course Objective	1. To enable students to write assembly language programs using 8085,8086,8051 2. To Interface the peripheral devices with microcontroller for specific applications.
Course Outcome	Upon completion of this course, the students will be able to 1. Programme and execute arithmetic and logical operations using 8085 , 8086 & 8051 2. Interface the peripheral devices with microcontroller for specific 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**

CO-1	3	3	3	-	1	-	-	-	-	-	-	1	2	1
CO-2	3	3	3	-	1	-	-	-	-	-	-	1	2	1

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

LIST OF EXPERIMENTS

1. Addition and Subtraction of two 8 bit numbers and 16bit numbers using 8085
2. Multiplication and Division of two 16bit numbers using 8086
3. Programs for String manipulation operations using 8086
4. Interfacing ADC and DAC
5. Interfacing and Programming 8279 and 8253.
6. Addition and Subtraction of two 8bit numbers using 8051
7. Multiplication and Division of two 8bit numbers using 8051
8. Interfacing of Stepper Motor
9. Interfacing of Keyboard and LCD with ARM microcontroller using keiluvision software
10. Interfacing of Real time clock and LED with ARM microcontroller using keiluvision software

REFERENCE BOOKS

1.	Ramesh S. Gaonkar, “Microprocessor – Architecture, Programming and Applications with the 8085”, Fifth Edition, Prentice Hall. 2002.
2.	K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.
3.	Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, Second Edition-2009.
4.	William Kleitz, ‘Microprocessor and Micro Controller Fundamental of 8085 and 8051 Hardware and Software’, Pearson Education, 1998.
5.	Steve Heath, Embedded Systems Design, Second Edition-2003
6.	David E.Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.

COURSE TITLE	**DESIGN PROJECT -II**			**CREDITS**	**1**
COURSE CODE	**ECB4243**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

FIRST REVIEW	**SECOND REVIEW**	**THIRD REVIEW**	**PROJECT REPORT AND VIVA VOCE**
20%	**30%**	**20%**	**30%**

Course Description	This module gives a strong Engineering and Practical foundation for understanding the different types of social problems and its solution based on engineering knowledge. It is suitable for general engineering students to understand the importance of engineering concepts and its relevant applications
Course Objective	1. To find the real time needs of the society 2. To apply engineering concepts and find the solution
Course Outcome	Upon completion of this course, the students will be able to 1. Design and develop prototype based on the knowledge gained 2. Propose a project and defend it as a team 3. Solve real time problem in electronics or communication domain

Prerequisites: All Subjects

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
CO-1	3	3	3	3	3	1	2	2	2	2	2	2	1	1
CO-2	3	3	3	3	3	1	2	2	2	2	2	2	1	2
CO-3	3	3	3	3	3	1	2	2	2	2	2	2	1	2

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

LIST OF EXPERIMENTS

In this project, each team with maximum of four members is expected to design and develop practical solutions to real life problems related to Industry and Information Technology research. Software usage should be followed during the development. The theoretical knowledge gained from the subject in the current and previous semesters should be applied to develop effective solutions to various applications. At the end of the course the group should submit a complete report of the project work carried out.

Assessment	
Review / Exam	**Weightage**
First Review	20%
Second Review	30%
Third Review & Demo	20%
Project report and Viva-Voce	30%
TOTAL	**100%**

SEMESTER V

COURSE TITLE	**OPTIMIZATION TECHNIQUES**			**CREDITS**	**4**
COURSE CODE	**MAA4301**	**COURSE CATEGORY**	**BS**	**L-T-P-S**	**3-1-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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	To make the student develop a knowledge in the field of optimization techniques, their basic concepts, principles of linear and integer programming, assignment and transportation problems
Course Objective	1. To understand the concept of optimization 2. To formulate linear programming model 3. To understand the concept of integer programming 4. To understand the assignment and transportation problem 5. To understand the concept of network analysis
Course Outcome	Upon completion of this course, the students will be able to 1. formulate the linear programming problem 2. determine the solutions of the linear programming problem 3. obtain the solutions of integer programming problem 4. determine the optimal solution of assignment and transportation problem 5. construct the network diagram and compute the project duration
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
CO-1	3	3	2	-	2	2	-	-	-	-	-	-	-	1
CO-2	3	3	2	-	-	2	-	-	-	-	-	-	-	1
CO-3	3	3	-	-	2	2	-	-	-	-	-	-	-	1
CO-4	3	3	2	-	2	2	-	-	-	-	-	-	-	1
CO-5	3	3	3	-	-	2	-	-	-	-	-	-	-	1

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

MODULE 1:INTRODUCTION TO OPTIMIZATION	**(9L+3T=12)**
Introduction to operations research – Objective – Scope of OR – Limitations of OR – Introduction and formulation of linear programming – Solving LPP using Graphical method. Suggested Reading: Basics of inequalities	**CO-1** **BTL-2**
MODULE 2:LINEAR PROGRAMMMING PROBLEM	**(9L+3T=12)**
Solving LPP using simple method – Big-M method – Two phase method – Conversion of primal to dual. Suggested Reading: System of equations	**CO-2** **BTL-3**
MODULE 3:INTEGER PROGRAMMING	**(9L+3T=12)**
Integer programming – Cutting plane method – Gomory's Mixed integer method – Branch and Bound method	**CO-3** **BTL-3**

Suggested Reading: System of equations	
MODULE 4:ASSIGNMENT AND TRANSPORTATION PROBLEM	**(9L+3T=12)**
Hungarian Method – Maximization and unbalanced assignment problem – Basic feasible solution of transportation problem – Modi method – Degeneracy – Unbalanced Transportation problem. Suggested Reading: Arithmetic Calculation	**CO-4** **BTL-3**
MODULE 5:PERT AND CPM	**(9L+3T=12)**
Network diagram – Representation – Labeling – CPM – PERT probabilities of CPM – PERT probabilities of project duration. Suggested Reading: Basics of graphs	**CO-5** **BTL-3**
TEXT BOOKS	
1.	Chandrasekaran A, "A Text book of Operation Research", Dhanam Publications, Chennai, 2017
2.	V. Sundaresan, K. S. Ganapathy Subramanian, K. Ganesan, "Resource Management Techniques", A. R. Publications, 2004
3.	S. D. Sharma, "Operation Research", Kedarnath Ramnath & Co, 2002
REFERENCE BOOKS	
1.	Hamdy A. Taha, "Operations Research: An Introduction (9th Edition)", Prentice Hall, 2010
2.	D S Hira & Prem Kumar Gupta, "Introduction to Operations Research", S. Chand Publishing, 2012
E BOOKS	
1.	http://nptel.ac.in/courses/112106134/1
2.	https://onlinecourses.nptel.ac.in/noc17_mg10/preview
MOOC	
1.	https://www.edx.org/course/operations-management-iimbx-om101-1x

COURSE TITLE	**CONTROL SYSTEMS**			**CREDITS**	**4**
COURSE CODE	**ECB4301**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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 gives a strong theoretical foundation for understanding open loop and closed loop control system analysis and is suitable for general engineering students. It covers standard analytical tools such as Bode plot, Polar plot, root-loci and nyquist plots. Later part of the course focus on the design of compensators using analysis tools.
Course Objective	1. Analyze representation of systems and to derive transfer function models, 2. Provide adequate knowledge in the time response of systems and steady state error analysis, 3. Give basic knowledge in obtaining the open loop and closed–loop frequency responses of systems, 4. Provide the concept of stability of control system and methods of stability analysis 5. Study the three ways of designing compensation for a control system, various components of control system
Course Outcome	Upon completion of this course, the students will be able to 1.Analyze electromechanical systems using mathematical modelling and to build transfer function 2. Determine Transient and Steady State behavior of systems using standard test signals and compute Steady state error 3. Analyze the stability of the system using frequency response plots 4. Analyze the stability of the system by applying various stability criteria. 5. Design a compensator for stable control system satisfying requirements of stability and reduced steady state error

Prerequisites: Trigonometric formulas, Methods of differentiation, Methods of integration, Partial Fractions, Matrices, Laplace Transforms.

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

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

MODULE 1 : SYSTEM REPRESENTATION **(9L+3T=12)**

Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and rotational systems – Transfer function – Synchros – AC and DC servo motors – Block diagram reduction techniques – Signal flow graphs. **Suggested Reading:-** Differential Equations, Laplace Transforms, Modelling Electrical motors.	**CO-1** **BTL-4**

MODULE 2 : TIME RESPONSE **(9L+3T=12)**

Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control. **Suggested Reading: -** Error analysis, Time series, Binomial Series, Controller Design, Continuous time systems analysis.	**CO-2** **BTL-4**
MODULE 3 : FREQUENCY RESPONSE	**(9L+3T=12)**
Frequency response – Bode plot – Polar plot – Constant M and N circles – Nichols chart – Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications. **Suggested Reading:** - Frequency Domain characteristics and Analysis.	**CO-3** **BTL-4**
MODULE 4: STABILITY OF CONTROL SYSTEM	**(9L+3T=12)**
Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criteria. **Suggested Reading: -** Stability analysis of Systems.	**CO-4** **BTL-4**
MODULE 5: COMPENSATOR DESIGN	**(9L+3T=12)**
Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plot. Introduction to Digital Control Systems, Introduction to State Variable Analysis and Design - Advances in Control Systems. **Suggested Reading:-** Compensator Design, SISO, MISO	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Ogata.K, Modern Control System Engineering Fifth Edition –Pearsons, 2010.
2.	I.J. Nagrath& M. Gopal, Control Systems Engineering, New Age International Publishers, Sixth edition, 2017.
3	"Automatic Control Systems" by B.C. Kuo, Tenth Edition, 2017, McGraw-Hill Education.
REFERENCE BOOKS	
1.	M. Gopal, Control Systems, Principles & Design, Fourth edition, Tata McGraw Hill, New Delhi, 2012.
2	M.N. Bandyopadhyay, Control Engineering Theory and Practice, Prentice Hall of India, 2009
E BOOKS	
1.	http://engineeronadisk.com/book_modeling/
2.	Text book companion http://www.scilab.in/Completed_Books#2
MOOC	
1.	Control Engineering (web), http://nptel.ac.in/courses/108102044/
2.	Control Engineering(video), http://nptel.ac.in/courses/108102043/
3.	Advanced control system(video), http://nptel.ac.in/courses/108103007/

COURSE TITLE	COMMUNICATION SYSTEMS			CREDITS	3
COURSE CODE	ECB4302	COURSE CATEGORY	PC	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	24TH ACM, 30.05.2018	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 focusses on analysis and design of communication systems with an emphasis on digital communications based on time and frequency domain analysis. Fourier transform techniques, linear systems, and filtering are reviewed. Power and energy spectral density of communication signals. Sampling and quantization of analog signals. Baseband and binary bandpass digital modulation including line coding, pulse shaping, and both pulse and carrier modulation techniques. Wireless communication system concepts including link budgets and multiple access. Transmitter and receiver design concepts. Signal-to-noise ratio, bit error rate, and their relationship. Analog techniques such as Amplitude Modulation (AM) and Frequency Modulation (FM) radio will be reviewed for conceptual and comparative purposes.
Course Objective	1. To Compute the Fourier transform and the energy and power spectral densities of communications signals. 2. To calculate the bandwidth and signal-to-noise ratio of a signal at the output of a linear system or filter. 3. To explain the operation of basic digital communication systems (both baseband and bandpass) in both the time and frequency domains. 4. To evaluate the performance, in terms of bit error rate, of a digital communication link. 5. To explain the concepts of link budget and multiple access as it applies to wireless communication.
Course Outcome	Upon completion of this course, the students will be able to 1. Inspect and distinguish various digitization techniques and explain multiplexing techniques. 2. Apply theory of sampling process to different pulse modulation techniques to comprehend the process and then compare them. 3. Inspect and distinguish various digitization techniques and explain multiplexing techniques 4. Analyze digital modulation schemes, M - ary techniques and examine their performance. 5. Distinguish and appraise the effectiveness of various channel coding 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**
CO-1	3	3	3	-	1	-	-	-	-	-	-	1	3	2
CO-2	3	3	3	-	-	-	-	-	-	2	-	1	3	2
CO-3	3	3	3	-	-	1	-	-	-	-	-	1	3	2
CO-4	3	3	3	-	-	-	-	-	-	-	-	1	3	2
CO-5	3	3	3	-	-	-	-	-	-	-	-	1	3	2

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

MODULE 1 – FUNDAMENTALS OF ANALOG COMMUNICATION SYSTEMS	**(9L)**
Introduction to Communication Systems: Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PMBand Pass Signals and Systems, Band Pass Transmission, Bandwidth, Double Side Band Amplitude Modulation – AM Signals and Spectra, DSB Signals and Spectra, Suppressed Side Band Amplitude Modulation - Single Side Band Signals and Spectra, Single Side Band Generation, Vestigial Side Band Signals and Spectra, Illustrative Problems.	**CO-1 BTL-2**
MODULE 2 - PULSE MODULATION TECHNIQUES	**(9L)**
Pulse amplitude modulation – Flat top sampling and Pulse amplitude modulation (PAM), Pulse-Time Modulation – Pulse Duration and Pulse Position modulations, PPM spectral analysis, Illustrative Problems	**CO-2 BTL-2**
MODULE 3 : DIGITIZATION TECHNIQUES	**(9L)**
Pulse Code Modulation (PCM) - Generation and Reconstruction, Quantization Noise, Non-Uniform Quantization and Companding, PCM with Noise, Delta modulation, Adaptive Delta Modulation, Differential PCM systems (DPCM), Digital Multiplexing-Multiplexers and Hierarchies	**CO-3 BTL-3**
MODULE 4 – BAND PASS DIGITAL TRANSMISSION	**(9L)**
Quadrature Carrier and M–ary Systems- Quadrature Carrier Systems,M–ary PSK Systems, M–ary QAM Systems, M–ary FSK Systems, BPSK and FSK, Timing and Synchronization, Interference, Non-Coherent Binary Systems, Non-Coherent FSK, Differentially Coherent PSK, Optimum Binary Detection, Coherent ASK (OOK (on-off keying)).	**CO-4 BTL-2**
MODULE 5 - CHANNEL CODING	**(9L)**
Error Detection & Correction - Repetition & Parity Check Codes, Interleaving, Code Vectors and Hamming Distance, Forward Error Correction (FEC) Systems, Automatic Retransmission Query (ARQ) Systems, Linear Block Codes – Matrix Representation of Block Codes, Convolutional Codes – Convolutional Encoding, Decoding Methods	**CO-5 BTL-2**
TEXT BOOKS	

1.	A. Bruce Carlson, & Paul B. Crilly, —Communication Systems – An Introduction to Signals & Noise in Electrical Communication‖, McGraw-Hill International Edition, 5th Edition, 2010
2.	Simon Haykin, —Communication Systems‖, Wiley-India edition, 3rd edition, 2010
REFERENCE BOOKS	
1	Sam Shanmugam,"Digital and Analog Communication Systems" ,John Wiley, 2005
E BOOKS	
1.	http://www.eem.anadolu.edu.tr/tansufilik/EEM%20409/icerik/Communication%20Systems%20-%204ed%20-%20Haykin.pdf
2.	http://www.freebookcentre.net/Electronics/Communications -Systems-Books.html
3.	*https://www.efxkits.co.uk/download-free-ebook-on-communication-systems/*
MOOC	
1.	https://nptel.ac.in/courses/108/104/108104091/
2.	https://nptel.ac.in/courses/117/102/117102059/

COURSE TITLE	**DIGITAL SIGNAL PROCESSING**			**CREDITS**	**4**
COURSE CODE	**ECB4303**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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 covers theory and methods of digital signal processing including basic principles, the analysis and design of discrete-time systems. Aim to provide working knowledge of design, implementation and analysis of various DSP systems.				
Course Objective	1. To compute Discrete Fourier transform effectively using its properties 2. To identify the frequency characteristics of discrete-time signals and systems 3. To design FIR and IIR digital filters as per the required specifications 4. To manipulate (up or down) the original sampling rate value				
Course Outcome	Upon completion of this course, the students will be able to 1. Compare the performances of DFT using FFT algorithms. 2. Design IIR filters as per the given specifications 3. Design and compare the responses of practical FIR Filter as per the given specifications				

	4. Analyze the effects of quantization errors and the need of Multirate sampling techniques 5. Layout the internal building blocks and their functionality of different DSP Processor family.

Prerequisites: MAA4201- Partial Differential Equations and Transforms and ECB4217- Signals and Systems

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

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

MODULE 1 – EXISTENCE OF FOURIER TRANSFORM IN DSP	**(9L+3T)**
The Discrete Fourier Transform –Frequency Domain Sampling, Properties of DFT. Computation of DFT - FFT Algorithms (Radix 2 only), Linear Filtering and Correlation using DFT. **Suggested reading:** Application of FFT in real time examples	**CO-1** **BTL-3**
MODULE 2 – FIR FILTER DESIGN TECHNIQUES	**(9L+3T)**
Design of FIR Filters- FIR Filters using Window method and Frequency Sampling Method, Design of Linear-Phase FIR Filters. **Suggested reading:** Kaiser window technique and its importance	**CO-2** **BTL-4**
MODULE 3 – IIR FILTER DESIGN CONCEPTS	**(9L+3T)**
Design of IIR Digital Filters from Analog Filters- IIR Filter Design by Impulse Invariance, IIR Filter Design by Bilinear Transformation. Implementation of efficient Filter structures: **Suggested reading:** Performance comparison of Butterworth and Chebyshev filter design concepts	**CO-3** **BTL-4**
MODULE 4: FINITE WORD LENGTH EFFECTS IN DSP	**(9L+3T)**
Analysis of finite word length effects- Quantization noise, round off errors, input and output quantization error, limit cycles in IIR filters. Multi-rate Digital Signal Processing- Decimation and Interpolation concepts - Sampling Rate Conversion for real time applications	**CO-4** **BTL-4**

Suggested reading: Need for QMF and Poly phase filters for real time applications	
MODULE 5: ARCHITECTUREL DESCRIPTIONS OF DSP PROCESSORS	**(9L+3T)**
Computer architecture for signal processing - Architecture of TMS320C 5416 and 6713 processors and its functional characteristics, Case study of multistage sampling applications in real time. **Suggested reading:** Selection of appropriate DSP processor to perform the given real time task	**CO-5** **BTL-3**

TEXT BOOKS	
1.	John G Proakis, Dimitris G Monolakis-Digital Signal Processing, 4/e, PHI. 2006
2.	B.Venkataramani & M. Bhaskar, Digital Signal Processor Architecture, Programming and Application, TMH 2002
REFERENCE BOOKS	
1.	Sanjith K Mitra: *Digital Signal Processing*, 4/e, Tata Mc Graw Hill, 2010
2	Rulph Chassaing, *Digital Signal Processing and Applications with the C6713 and C6416 DSK,* Wiley Inter-science, 2005.
3	Emmanuel C Ifeachor, Barrie W Jervis: *Digital Signal Processing*, 2/e, Pearson Education /PHI, 1993.
4	P.P. Vaidyanathan, *Multirate Systems and Filter Banks*, PHI, 2004.
5	Avtar singh, S.Srinivasan, "DSP Implementation using DSP microprocessor with Examples" from TMS32C54XX -Thamson / Brooks cole Publishers, 2003
E BOOKS	
1.	http://electronicsforu.com/resources/cool-stuff-misc/8-free-ebooks-digital-signal-processing
2.	http://www.freebookcentre.net/Electronics/DSP-Books-Download.html
MOOC	
1.	http://nptel.ac.in/courses/117104070/
2.	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/readings/

COURSE TITLE	**COMMUNICATION SYSTEMS LAB**			**CREDITS**	**1**
COURSE CODE	**ECB4331**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-3-0**

Version	1.0	Approval Details	24TH ACM, 30.05.2018	LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

CIA	ESE
80%	20%

Course Description	Communication lab have the objective of demonstrate the analog and digital modulation schemes and simulation of digital pulse modulation techniques using MATLAB tool.
Course Objective	1. Implement the line coding techniques 2. To help in demonstrating and apply digital pulse modulation 3. To help students to develop algorithm using MATLAB.
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate analog modulation and demodulation scheme 2. Demonstrate the digital modulation & Demodulation scheme 3. Demonstrate the concept of line coding techniques 4. Simulation of BPSK, QPSK & QAM signal constellation, FSK PSK & DPSK digital modulation schemes using MATLAB 5. Simulation using communication link (MATLAB Simulink) & also the error control coding, equalization

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

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

LIST OF EXPERIMENTS

1. Signal Sampling and reconstruction. 2. Time Division Multiplexing. 3. AM Modulator and Demodulator 4. FM Modulator and Demodulator. 5. Pulse Code Modulation and Demodulation. 6. Delta Modulation and Demodulation Observation (simulation) of signal constellations of BPSK, QPSK and QAM 7. Line coding schemes 8. FSK, PSK and DPSK schemes (Simulation) 9. Error control coding schemes - Linear Block Codes (Simulation) 10. Communication link simulation 11. Zero forcing & LMS algorithm

REFERENCE BOOKS	
1.	A. Bruce Carlson, & Paul B. Crilly, —Communication Systems – An Introduction to Signals & Noise in Electrical Communication‖, McGraw-Hill International Edition, 5th Edition, 2010
2.	Simon Haykin, —Communication Systems‖, Wiley-India edition, 3rd edition, 2010

COURSE TITLE	**DIGITAL SIGNAL PROCESSING LAB**			**CREDITS**	**1**
COURSE CODE	**ECB4332**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-3-0**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-4**

ASSESSMENT SCHEME	
CIA	**ESE**
80%	**20%**

Course Description	The aim of this course to consolidate student's theoretical knowledge on DSP concepts by revisiting using MATLAB and Simulink software. This course is also aimed to provide Code composer studio software package skill to embed it with Texas instrument's hardware such as TMS320C5416, 6317 for DSP characteristics analysis.
Course Objective	1. To handle discrete/digital signals using MATLAB and Simulink tool 2. To code and perform the basic operations of Signal processing concepts 3. To analyze the spectral characteristics of various window functions 4. To Design IIR and FIR filters- band pass, band stop, low pass and high pass.

Course Outcome	Upon completion of this course, the students will be able to 1. Analyze and observe the simulated characteristics of digital signal processing concepts using MATLAB and Simulink software tool 2. Analyze and observe the characteristics of real-time and Non real-time signal Processing algorithms, such as filtering & noise reduction using TEXAS Instruments DSP evaluation board

Prerequisites: ECB4241- MATLAB and Simulink Lab

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
CO-1	3	3	3	1	3	1	-	-	1	1	2	2	2	3
CO-2	3	3	3	-	3	1	-	-	1	1	2	2	2	3

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

LIST OF EXPERIMENTS

MATLAB & SIMULINK Based Experiments:

1. Generation of various Signals thereby to understand their characteristics
2. Calculation of Linear and circular convolution for the given two sequences
3. Analyze the Sampling process and effect of Aliasing due to sampling
4. Design of various FIR filter for the given specifications as per the application
5. Design of Butterworth and Chebyshev analog filters for the given specifications
6. Calculation of FFT and IFFT of a time domain signal.
7. Design of digital IIR filter for the given specifications based on Impulse Invariant and Bilinear Transformation method

LIST OF EXPERIMENTS USING DSP PROCESSOR-TMS C 4516,6713,6748

1. Experiments using DSP processor and Code composer studio tools
2. Understand various addressing modes of Digital Signal Processors using simple programming examples.
3. Calculate Sample values of the given continuous sinusoidal input signal.
4. Calculation of Linear and circular convolution between two sequences
5. Calculation of FFT.
6. Real time Audio signal processing using TMS C 6748processor and Noise reduction of real time signal using TMS C 6748processor

TEXT BOOKS

1.	S. J. Orfanidis, DSP Lab Manual, 2011
2.	S. J. Orfanidis, Introduction to Signal Processing, Prentice-Hall, 1996, and available freely oline http://www.ece.rutgers.edu/~orfanidi/intro2sp/

REFERENCE BOOKS

1.	R. Chassaing and D. Reay, Digital Signal Processing and Applications with the

	TMS320C6713and TMS320C6416 DSK, 2nd ed., Wiley, Hoboken, NJ, 2008
2.	D.L. Jones, "Effective DSP Laboratory Course Design," DSPSFest'99, Houston, Texas, August 4-6, 1999
MOOC	
1.	http://www.ti.com/product/TMS320C6748
2.	http://www.ti.com/processors/dsp/overview.html

COURSE TITLE	**DESIGN PROJECT- III**			**CREDITS**	**1**
COURSE CODE	**ECB4333**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-5**

ASSESSMENT SCHEME

FIRST REVIEW	**SECOND REVIEW**	**THIRD REVIEW**	**PROJECT REPORT AND VIVA VOCE**
20%	**30%**	**20%**	**30%**

Course Description	This module gives a strong Engineering and Practical foundation for understanding the different types of social problems and its solution based on engineering knowledge. It is suitable for general engineering students to understand the importance of engineering concepts and its relevant applications
Course Objective	1. To find the real time needs of the society 2. To apply engineering concepts and find the solution
Course Outcome	Upon completion of the course the students will be able to: 1. Identify and develop the system for the real life needs of the society 2. Realize and apply the Engineering concepts in product development

Prerequisites: ECB4243, ECB4301, ECB4302, ECB4303, MATLAB, MULTISIM

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**
CO-1	3	3	3	3	3	1	2	2	2	2	2	2	1	1
CO-2	3	3	3	3	3	1	2	2	2	2	2	2	1	2
CO-3	3	3	3	3	3	1	2	2	2	2	2	2	1	2

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

LAB/MINI PROJECT

In this project, each team with maximum of four members is expected to design and develop practical solutions to real life problems related to Industry and Information Technology research. Software usage should be followed during the development. The theoretical knowledge gained from the subject in the current and previous semesters should be applied to develop effective solutions to various applications. At the end of the course the group should submit a complete report of the project work carried out.

Assessment	
Review / Exam	**Weightage**
First Review	20%
Second Review	30%
Third Review & Demo	20%
Project report and Viva- Voce	30%
TOTAL	**100%**

SEMESTER VI

COURSE TITLE	**COMPUTER NETWORKS**			**CREDITS**	**3**
COURSE CODE	**ECB4316**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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 module introduces computer networks, with a special focus on the Internet architecture and protocols. Data communication and Networks have changed the way business and other daily affair works. Through this module Graduates are focused on Performances of computer Networks: Transit time, Response time, Number of users, Reliability, Security.
Course Objective	1. To Describe how computer networks are organized with the concept of layered approach 2. To obtain a theoretical understanding of data communication and computer networks 3. To implement a simple LAN with hubs, bridges and switches.
Course Outcome	Upon completion of this course, the students will be able to 1. Categorize different computer networking concepts based on their performance. 2. Identify the appropriate switching/ Routing technology for the given Source and destination pair. 3. Classify the characteristics of connection-oriented and connectionless communication protocols

	4. Identify the proper IP addressing scheme for effective data forwarding mechanism of the given scenario 5. Validate the error-free received information using the appropriate 6. security protocols

Prerequisites: Knowledge in basics of computers and 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
CO-1	3	-	-	-	2	1	-	-	-	-	-	-	3	1
CO-2	`3	-	3	-	2	1	-	-	-	-	-	2	3	1
CO-3	3	-	3	2	1	1	-	-	-	-	-	-	3	1
CO-4	2	-	2	3	1	1	-	-	-	-	-	2	3	1
CO-5	3	-	2	2	1	1	1	-	-	-	-	2	3	1

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

MODULE 1 : INTRODUCTION TO COMPUTER NETWORKS	**(9L)**
Introduction to computer networks and the Internet - Application layer - Principles of network Applications - The Web and Hyper Text Transfer Protocol - File transfer - Electronic mail – Domain name system - Peer-to-Peer file sharing - Socket programming - Layering concepts. **Suggested Reading:** IEEE Standards and Specifications.	**CO-1** **BTL-2**
MODULE 2 : SWITCHING IN NETWORKS	**(9L)**
Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing. **Suggested Reading:** Queuing Theory Applications.	**CO-2** **BTL-3**
MODULE 3 : TRANSPORT LAYER	**(9L)**
Connectionless transport - User Datagram Protocol, Connection oriented transport – Transmission Control Protocol, Remote Procedure Call. **Suggested Reading:** Internet Traffic Management.	**CO-3** **BTL-2**
MODULE 4: NETWORK LAYER	**(9L)**
Logical addressing: IPv4, IPv6 addresses Internet Protocol: Internetworking – IPv4, IPv6 - address mapping – ARP, RARP, BOOTP, DHCP, ICMP, IGMP, Delivery - Forwarding - Routing – Unicast, Multicast routing protocols. **Suggested Reading:** ISP responsibilities.	**CO-4** **BTL-2**
MODULE 5: APPLICATION LAYER	**(9L)**

Domain Name System (DNS) – E-mail – FTP – WWW – HTTP – Multimedia Network Security: Cryptography – Symmetric key and Public Key algorithms - Digital signature – Management of Public keys – Communication Security – Authentication Protocols. **Suggested Reading:** DES and AES algorithms	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw-Hill, Fourth edition, July 2017.
2.	William Stallings, "High Speed Networks and Internet", Pearson Education, Second Edition,2014.
REFERENCE BOOKS	
1.	Andrew S. Tannenbaum, "Computer Networks", Pearson Education, Fifth Edition,2010.
E BOOKS	
1.	http://intronetworks.cs.luc.edu/
2.	https://www.topfreebooks.org/free-books-on-computer-networking/
3.	https://www.kobo.com/us/en/ebook/basics-of-computer-networking
MOOC	
1.	http://nptel.ac.in/courses/106105082/30
2.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-263j-data-communication-networks-fall-2002/
3.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-976-high-speed-communication-circuits-and-systems-spring-2003/

COURSE TITLE	**OPTICAL COMMUNICATION**			**CREDITS**	**3**
COURSE CODE	**ECB4317**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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 gives an introduction about optical communication, optical fiber modes configuration and various signal degradation factors associated with optical fibers. It covers optical sources and receivers. Final part of the course focusses on optical networks and system transmission.

Course Objective	1. To learn mode theory of light propagation through fibers 2. To brief the different loss mechanism in fibers 3. To compare different optical sources 4. To summarize the concepts of various photodetectors and their applications. 5. To familiarize digital optical transmission system.
Course Outcome	Upon completion of this course, the students will be able to 1. Comprehend the mode theory of light propagation through fibers 2. Identify the different loss mechanism in fibers 3. Analyze the performance of different optical sources and compare them 4. Distinguish between APDs and PIN photo detectors and calculate error performance of simple systems 5. Illustrate the design aspects of digital optical transmission system

Prerequisites: Communication Systems

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

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

MODULE 1 – INTRODUCTION TO OPTICAL COMMUNICATION	**(9L)**
Evolution of fiber optic system- Element of an Optical Fiber Transmission link- Ray Optics- Optical Fiber Modes and Configurations –Mode theory of Circular Wave guides- Overview of Modes-Key Modal concepts- Linearly Polarized Modes –Single Mode Fibers-Graded Index fiber structure, Photonic Crystal Fibers (PCF) and characteristics **Suggested Readings:** Wireless optical communication systems.	**CO-1** **BTL-2**
MODULE 2 – SIGNAL DEGRADATION ON OPTICAL FIBERS	**(9L)**
Attenuation – Absorption losses, scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave Guides-Information Capacity determination –Group Delay- Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers-Mode Coupling. **Suggested Readings:** PCF and its working principle.	**CO-2** **BTL-3**
MODULE 3 – FIBER OPTIC SOURCES AND COUPLING	**(9L)**

Direct and indirect Band gap materials-LED structures –Light source materials – Modulation of a LED, lasers Diodes-Modes–External Quantum efficiency –Resonant frequencies –Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers- Power Launching and coupling, Lensing schemes, Fiber –to- Fiber joints, Fiber splicing **Suggested Readings:** VCSEL and its applications.	**CO-3** **BTL-3**
MODULE 4 – RECEIVERS	**(9L)**
PIN and APD diodes –Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise –Comparison of Photo detectors –Fundamental Receiver Operation – preamplifiers, Error Sources –Receiver Configuration –Probability of Error – Quantum Limit. **Suggested Readings:** Performance analysis of optical communication systems.	**CO-4** **BTL-3**
MODULE 5 – DIGITAL TRANSMISSION SYSTEM	**(9L)**
Point-to-Point links System considerations –Link Power budget –Rise - time budget –Noise Effects on System Performance-Operational Principles of WDM, Solitons-Erbium-doped Amplifiers. Basic on concepts of SONET/SDH Network. Passive Optical Networks-FTTH Systems **Suggested Readings:** ATM, GPON etc.	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Gerd Keiser, “Optical Fiber Communication” McGraw –Hill International, 4th ed., 2010
2.	J.Senior, “Optical Communication, Principles and Practice”, Third Edition, Prentice Hall of India, 2010.
REFERENCE BOOKS	
1	Keiser, “Optical Communication essentials”, McGraw-Hill Companies (28 July 2003)
2	G.P Agrawal, “Fiber-Optic Communication Systems”, Wiley; Third edition, 2007
E BOOKS	
1	http://www.scilab.in/Completed_Books#2
2	https://www.intechopen.com/books/optical-communication
MOOC	
1	https://nptel.ac.in/courses/117/101/117101002/

COURSE TITLE	**ANTENNA AND WAVE PROPAGATION**			**CREDITS**	**4**
COURSE CODE	**ECB4318**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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 covers in depth knowledge of Basic antenna principles, concepts of antenna wave propagation, antenna theory, design, and measurements.
Course Objective	1. To explain the antenna fundamentals and the radiation of the thin linear wire antennas 2. To discuss the array of point sources and uniform linear arrays and know about the loop antennas 3. To summarize the radiation mechanism of travelling wave and wideband antennas 4. To analyse the radiation of rectangular aperture, slot, parabolic reflector and lens antennas 5. To know the basic propagation and its types.
Course Outcome	Upon completion of this course, the students will be able to 1. Comprehend the radiation mechanism of wired antennas and measurement of antenna parameters 2. Develop the performance characteristics of antennas arrays, its operating principles, methods, and concepts to design 3. Design and analyze wide band antennas 4. Design and analyze aperture antennas and smart antennas 5. Comprehend the behavior of nature on EM wave propagation and identify the type of radio-wave propagation for different communication

Prerequisites: Electromagnetic Fields and Waves

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

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

MODULE 1: ANTENNA FUNDAMENTALS AND RADIATION FIELDS OF WIRE ANTENNAS REPRESENTATION (9L+3T=12)

Radiation intensity. Directive gain. Directivity. Power gain. Beam Width. Band Width. Gain and radiation resistance of current element. Half-wave dipole and folded dipole. Reciprocity principle. Effective length and Effective area. Relation between gain effective length and radiation resistance. Concept of vector potential. Modification for time varying, retarded case. Fields associated with Hertzian dipole. Power radiated and radiation resistance of current element. Radiation resistance of elementary dipole with linear current distribution. Radiation from half-wave dipole and quarter-wave monopole.	**CO-1** **BTL-2**
MODULE 2: ANTENNA ARRAYS AND LOOP ANTENNAS	**(9L+3T=12)**
Antenna Arrays: Expression for electric field from two and three element arrays. Uniform linear array. Method of pattern multiplication. Binomial array. Use of method of images for antennas above ground. Loop Antennas: Radiation from small loop and its radiation resistance. Helical antenna. Normal mode and axial mode operation.	**CO-2** **BTL-3**
MODULE 3: BROADBAND ANTENNAS	**(9L+3T=12)**
Radiation mechanisms of traveling wave on a wire. Analysis and design of Rhombic antenna. Coupled Antennas-Self and mutual impedance of antennas. Yagi antennas. Log periodic antenna.	**CO-3** **BTL-4**
MODULE 4: APERTURE ANTENNAS	**(9L+3T=12)**
Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts of Microstrip antennas **Basic Concepts of Smart Antennas:** Concept and benefits of smart antennas, Fixed weight beamforming basics, Adaptive beamforming	**CO-4** **BTL-3**
MODULE 5: WAVE PROPAGATION	**(9L+3T=12)**
The three basic types of propagation; ground wave, space wave and sky wave propagation. **Sky wave propagation:** Structure of the ionosphere. Effective dielectric constant of ionized region. Mechanism of refraction. Refractive index. Critical frequency. Skip distance. Effect of earth's magnetic field. Energy loss in the ionosphere due to collisions. Maximum usable frequency. Fading and Diversity reception. **Space wave propagation:** Reflection from ground for vertically and horizontally polarized waves. Reflection characteristics of earth. Resultant of direct and reflected ray at the receiver. Duct propagation. **Ground wave propagation:** Attenuation characteristics for ground wave propagation. Calculation of field strength at a distance	**CO-5** **BTL-3**
TEXT BOOKS	
1.	E.C.Jordan and Balmain, "Electro Magnetic Waves and Radiating Systems", PHI, 1968, Reprint 2005
REFERENCE BOOKS	

1	John D.Kraus and Ronalatory Marhefka, "Antennas", Tata McGraw-Hill Book Company, 2002.
2	R.E.Collins, 'Antennas and Radio Propagation ", McGraw-Hill, 1987.
3	Ballany , "Antenna Theory " , John Wiley & Sons, second edition , 2003
4	Prasad, K.D./ Antennas and Wave Propagation/ Khanna Publications, 2001.
E BOOKS	
1	http://engineeronadisk.com/book_modeling/
2	Text book companion http://www.scilab.in/Completed_Books#2
MOOC	
1	Antenna and wave propagation(web), http://nptel.ac.in/downloads/117101057/
2	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-661-receivers-antennas-and-signals-spring-2003/lecture-notes/
3	http://www.creativeworld9.com/2011/02/learn-antennas-and-wave-propagation.html

COURSE TITLE	**WIRELESS COMMUNICATION SYSTEMS**			**CREDITS**	**3**
COURSE CODE	**ECB4319**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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	Wireless communication have the main objective of study about the basics wireless LAN concepts ,Fundamentals of cellular basics, Bluetooth technology and MIMO techniques
Course Objective	1. Summarize the Wireless signal types and propagation models and classify various fading techniques of wireless communication 2. Interpret the cellular system design fundamentals 3. Choose the concepts of wireless LAN and Bluetooth technologies suitable for IEEE std communication

Course Outcome	Upon completion of this course, the students will be able to 1. Explain the fundamental concept and architecture of cellular system. 2. Familiarize with fundamentals of wireless LAN concepts. 3. Use standard concepts of Bluetooth technology. 4. Recognize the features of MIMO techniques.

Prerequisites: COMMUNICATION SYSTEMS

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

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

MODULE 1: Basics of Wireless Communication	**(9L)**
History of Wireless Communication - General Model of Wireless Communication Link - Types of Signals - Wireless Channel and Radio Communication - Free Space Propagation Model - Channel Noise and Losses – Fading - Multipath Fading - Fading Effects on Signal and Frequency – Shadowing - Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel. **Suggested Reading:**Nakagami Fading Channel, Ocumura and Hata Path Loss Model.	**CO-1** **BTL-2**
MODULE 2: Medium Access Alternatives for Wireless Communication	**(9L)**
Spread Spectrum Modulation - Pseudo-Noise Codes with Properties and Code Generation Mechanisms - DSSS and FHSS Systems - Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques - Zero Inter Symbol Interference Communication Techniques - Detection Strategies - Diversity Combining Techniques: Selection Combining - Threshold Combining - Equal Gain Combining - Maximum Ratio Combining. **Suggested Reading:** CDMA, TDMA and FDMA	**CO-2** **BTL-2**
MODULE 3: Cellular System Design Fundamentals	**(9L)**
Introduction to Cellular Communications - GSM system for mobile Telecommunication - Frequency reuse - Multiple Access Technologies - Cellular Processes - Call Setup, Handover - Teletraffic Theory - General Packet Radio Service – EDGE Technology - CDMA Based Standards: IS 95 to CDMA 2000 - Wireless Local Loop.	**CO-3** **BTL-3**
MODULE 4: Wireless LAN and Bluetooth Technology	**(9L)**

Introduction to Mobile Adhoc Networks – IEEE 802.11 Architecture and Services - Bluetooth – Bluetooth Protocol Stack - Wi-Fi Standards - WiMax Standards – WLAN Technology – Requirements of WLAN – Infrared Communication - Li-Fi Communication. **Suggested Reading:** Piconets and Scatternets	**CO-4** **BTL-2**
MODULE 5: LTE and MIMO Technologies	**(9L)**
Ultra-Wideband Communication - Mobile data networks - Introduction to 4G and concept of NGN - Long Term Evolution (LTE) - Mobile Satellite Communication - Introduction to MIMO - MIMO Channel Capacity - SVD and Eigenmodes of the MIMO Channel - MIMO Spatial Multiplexing – MIMO Diversity – MIMO - OFDM. **Suggested Reading:** Wireless Geo Location	**CO-5** **BTL-2**
TEXT BOOKS	
1.	T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson Publications, Second Edition, 2010.
REFERENCE BOOKS	
1	UpenaDalal and Manoj K. Shukla, "Wireless and Mobile Communication", Oxford Press Publications, 2016.
2	Ezio Biglieri and Robert Calderbank, "MIMO Wireless Communications", Cambridge University Press, 2015..
MOOC	
1	http://nptel.ac.in/courses/117102062/
2	https://onlinecourses.nptel.ac.in/noc17_cs37/

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**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-2**
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 gives the broad idea of business economics that studies the financial, organizational, market-related, and environmental issues faced by corporations. It helps the students to deal with the problems, analyze the financial aspects and involve in decision making. It enables them to know the fundamental concepts related to cost, consumer and producer's behavior, budget and financial services.				

Course Objective	1. To understand the concepts of business economics 2. To know the fundamentals of cost analysis 3. To build knowledge about the consumer's and producer's behaviour 4. To explain the key concepts of budget 5. To elaborate the financial services in economic sector
Course Outcome	Upon completion of this course, the students will be able to 1. Outline the fundamentals of economics 2. Explain the importance of cost analysis 3. Summarize the laws related to consumer's and producer's behaviour 4. Describe the various concepts pertaining to the budgetary aspects 5. Elaborate the different financial services that aid in business decisions.

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

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

MODULE 1 – INTRODUCTION TO ECONOMICS	**(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. **Suggested Readings:** Micro and macro economics	**CO-1** **BTL-2**
MODULE 2: COST ANALYSIS	**(6L)**
Types of Cost, Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis, Economies of Scale Cost Classification **Suggested Readings:** Demand and supply analysis	**CO-2** **BTL-2**
MODULE 3: CONSUMER'S AND PRODUCER'S BEHAVIOUR	**(6L)**
Consumer Behavior: Law of Diminishing Marginal utility – Equi marginal Utility – Consumer's Equilibrium - Indifference Curve – Production: Law of Variable Proportion – Laws of Returns to Scale – Producer's equilibrium – Economies of Scale Cost Classification **Suggested Readings:** Supply Chain	**CO-3** **BTL-2**

MODULE 4: BUDGET	(6L)
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. **Suggested Readings:** Goods and Service Tax	**CO-4** **BTL-2**
MODULE 5: FINANCE	**(6L)**
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. **Suggested Readings:** Basics of Stock exchange	**CO-5** **BTL-2**

TEXT BOOKS	
1.	S.Shankaran, Business Economics - Margham Publications, 2012.
2.	H.L. Ahuja, Business Economics – Micro & Macro - Sultan Chand & Sons - New Delhi – 55, 2016.
REFERENCE BOOKS	
1	S.A.Ross, R.W.Westerfield, J.Jaffe and Roberts: Corporate Finance, McGraw-Hill, 2007.
2	Joseph E Stiglitz: Economics of the Public Sector, 2015.
E BOOKS	
1.	https://sites.google.com/site/readbookpdf7734/pdf-download-business-economics-by---mark-taylor-read-online
2.	https://bookboon.com/en/economics-ebooks
MOOC	
1	https://www.coursera.org/specializations/managerial-economics-business-analysis
2	https://www.coursera.org/learn/financial-markets-global
3	https://nptel.ac.in/courses/110/101/110101005/

COURSE TITLE	COMPUTER NETWORKS LAB			CREDITS	1
COURSE CODE	ECB4341	COURSE CATEGORY	PC	L-T-P-S	0-0-3-0
Version	1.0	Approval Details	24TH ACM, 30.05.2018	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					

CIA	ESE
80%	20%

Course Description	This lab is designed to develop the knowledge and skill level in computer networking domain. Students will carry out the experiments using both hardware and software tools for performance measurement analysis.
Course Objective	1. To learn and measure the performance of various networking concepts and algorithms 2. To compare the performance of different Routing programs 3. To exchange the data between nodes using socket programming
Course Outcome	Upon completion of this course, the students will be able to 1. Evaluate the performance measurements of various networking concepts and algorithms 2. Create the computer network scenario to measure routing delay 3. Write the Socket Processing techniques using TCP & UDP protocols to exchange the data between computer nodes

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
CO-1	1	-	-	-	1	1	-	-	1	-	-	-	1	-
CO-2	1	-	2	-	1	1	-	-	1	-	-	1	1	-
CO-3	1	-	1	1	1	2	-	-	1	-	-	-	1	-

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

LIST OF EXPERIMENTS

The following experiments are conducted using the Hardware.

1. PC to PC Communication.
   Parallel Communication using 8 bit parallel cable.
   Serial communication using RS 232C.
2. Ethernet LAN protocol.
   To create scenario and study the performance of CSMA/CD Ethernet protocols using simulation.
3. Token bus and token ring protocols.
   To create scenario and study the performance of token bus and token ring protocols through simulation.
4. Wireless LAN protocols
   To create scenario and study the performance of network with CSMA / CA protocol and Compare with CSMA/CD protocols.

5. Implementation of distance vector and Link state routing algorithm.
6. Transfer of files from PC to PC using Windows / Unix socket processing.

The following experiments are conducted using MATLAB.

7. Basic WLAN Link Modeling
8. Design & Model WLAN Link.
9. Analysis of the performance of an IEEE® 802.11ac™ link by using beamforming
10. 802.11ax Parameterization for Waveform Generation and Simulation.
11. Generate an IEEE® 802.11ac™ transmission containing MAC frames suitable for performing radio packet error rate (PER) receiver test
12. 802.11ac Packet Error Rate Simulation for 8x8 TGac Channel
13. 802.11ac Signal Recovery with Preamble Decoding
14. WLAN Link Modeling in Simulink

TEXT BOOKS	
1.	Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw-Hill,Fourth edition, July 2017.
2.	William Stallings, "High Speed Networks and Internet", Pearson Education, Second Edition, 2014.
REFERENCE BOOKS	
1	Andrew S. Tannenbaum, "Computer Networks", Pearson Education, Fifth Edition, 2010.
MOOC	
1	http://nptel.ac.in/courses/106105082/30
2	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-263j-data-communication-networks-fall-2002/
3	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-976-high-speed-communication-circuits-and-systems-spring-2003/

COURSE TITLE	**DESIGN PROJECT – IV**			**CREDITS**	**1**
COURSE CODE	**ECB4342**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-5**

ASSESSMENT SCHEME

FIRST REVIEW	**SECOND REVIEW**	**THIRD REVIEW**	**PROJECT REPORT AND VIVA VOCE**
20%	**30%**	**20%**	**30%**

Course Description	In this course, each team with maximum of four members is expected to design and develop practical solutions to real life problems related to Industry and Information Technology research. Software usage should be followed during the development. The theoretical knowledge gained from the subject in the current and previous semesters should be applied to develop effective solutions to various applications. At the end of the course the group should submit a complete report of the project work carried out.
Course Objective	1. Design and develop prototype based on the knowledge gained 2. Propose a project and defend it as a team 3. Solve real time problem in electronics or communication domain
Course Outcome	Upon completion of this course, the students will be able to 1. Identify and work for the real life needs of the society. 2. Give practical solutions to the societal problem. 3. Realize the importance of Engineering concepts and its relevant application.

Prerequisites: ECB4333 - Design Project -III, ECB4316 – Computer Networks, ECB4317 – Optical Communication, ECB4318 – Antenna and Wave Propagation, ECB4319 – Wireless Communication Systems, MATLAB, MULTISIM

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
CO-1	3	3	3	3	3	1	2	2	2	2	2	2	2	1
CO-2	3	3	3	3	3	1	2	2	2	2	2	2	2	2
CO-3	3	3	3	3	3	1	2	2	2	2	2	2	2	2

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

LIST OF EXPERIMENTS

The Project Work shall be carried out in the field of Electronics & Communication Engineering. Students shall work in convenient groups of not more than four members in a group. Every Project Work shall have a Supervisor. During this period the supervisor shall guide the students to implement the Project. The students shall give periodical presentations of the progress made in the Project Work.

Each group shall finally produce a report covering background information, literature survey, problem statement, Project work details and conclusions. This final report shall be typewritten form as specified in the guidelines

Assessment	
Review / Exam	**Weightage**
First Review	20%
Second Review	30%
Third Review & Demo	20%
Project report and Viva-Voce	30%
TOTAL	**100%**

CO-1, 2,3
BTL-5

COURSE TITLE	COMPREHENSION			CREDITS	1
COURSE CODE	ECB4343	COURSE CATEGORY	PC	L-T-P-S	1-0-0-1
Version	1.0	Approval Details	24TH ACM, 30.05.2018	LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

First Periodical Assessment Basic Sciences (MCQ)	Second Periodical Assessment Core Engineering (MCQ)	Third Periodical Assessment Emerging areas (Presentation)
20%	50%	30%

Course Description	This course helps the Electronics and Communication Engineering students to understand and comprehend any given problem related to their field by using appropriate technology and helps the students to organize, present and communicate information to address a range of audiences, purposes and genres.
Course Objective	To develop the skills required for employability.
Course Outcome	Upon completion, students will be able to 1. Develop the analytical and technical skills 2. Perform as an individual, and as a member or leader of a team 3. Communicate effectively on complex engineering matters with technical and non-technical audiences.

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
CO-1	2	2	2	2	2	1	1	-	2	3	1	2	2	2
CO-2	2	2	2	2	2	1	1	-	2	3	1	2	2	2
CO-3	2	2	2	2	2	1	1	-	2	3	1	2	2	2

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

SEMESTER VII

COURSE TITLE	VLSI DESIGN TECHNIQUES			CREDITS	4
COURSE CODE	ECB4401	COURSE CATEGORY	PC	L-T-P-S	3-1-0-1
Version	1.0	Approval Details	24TH ACM, 30.05.2018	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	The aim of this course is to provide an introduction to the design and layout of Very Large Scale Integrated (VLSI) circuits for complex digital systems. It covers custom design, cell-based hierarchical design, and algorithmic aspects of VLSI CAD tools. With a focus on CMOS technology, students generate layouts of CMOS chips on engineering workstations in an associated laboratory. By the end of the course, students will have designed, laid out, and testing all digital circuits.
Course Objective	1. To comprehend the fabrication concepts and CMOS circuits 2. To study MOS transistor theoretical concepts 3. To familiarise the VLSI concepts in combinational and sequential circuits 4. To discuss ASIC and FPGA architecture. 5. To develop VERILOG code for digital circuits
Course Outcome	Upon completion of this course, the students will be able to 1. Illustrate the techniques used for VLSI fabrication, design of CMOS logic circuits, Layout and Stick Diagram. 2. Analyze the behavior of a DC characteristics of MOS Transistor 3. Analyze and design combinational and sequential circuits using CMOS gates. 4. Interpret the techniques of chip design using programmable devices. 5. Demonstrate the knowledge of Verilog HDL and to design the digital circuits Verilog language.

Prerequisites: ECB4116-DIGITAL SYSTEM DESIGN

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

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

MODULE 1 – CMOS TECHNOLOGY **(9L+3T=12)**

MOS transistor, CMOS logic- Inverter, NAND gate, NOR gate, logic gates, compound gates, Pass transistors and Transmission gates, multiplexers, CMOS Fabrication and Layout- Inverter fabrication process, Layout design rules, Gate layouts and Stick diagram. **Suggested Readings:** MOS transistor, IC fabrication, logic gates	**CO-1** **BTL-2**
MODULE 2 – MOS TRANSISTOR THEORY	**(9L+3T=12)**
MOS transistor introduction, Long channel I-V characteristics, Non ideal I-V characteristics, DC transfer characteristics, Delay- Elmore delay model, Power- Sources of power dissipation, Dynamic power and Static power. **Suggested Readings:** VI characteristics ,power dissipation	**CO-2** **BTL-2**
MODULE 3 – COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS	**(9L+3T=12)**
Examples of combinational circuit, Static and dynamic latches and registers, Timing issues, Pipelines, Clock strategies, Memory and memory control circuits, Synchronous and Asynchronous design. **Suggested Readings:** Latches, flipflops, registers, memory	**CO-3** **BTL-3**
MODULE 4 – ASIC AND FPGA ARCHITECTURE	**(9L+3T=12)**
CMOS chip design options-Full custom ASICs, Std. Cell based ASICs Gate Array based ASICs Channeled, Channel less and structured GA, FPGA, Fusible link technologies, Anti-fuse technologies, Mask programmable devices, PROM's, EPROM, EEPROM, FLASH, SRAM- based technologies, Fine-, medium- & coarse-grained architectures. **Suggested Readings:** Memory, SRAM, DRAM	**CO-4** **BTL-3**
MODULE 5 – VERILOG HDL	**(9L+3T=12)**
Basic Concepts: Identifiers, gate primitives, value set, ports, gate delays, structural gate level and switch level modeling, Design hierarchies, Behavioral and RTL modeling: Operators, timing controls, Procedural assignments conditional statements, Data flow modeling and RTL. **Suggested Readings:** Digital circuits, gates, combinational circuits and sequential circuits	**CO-5** **BTL-4**
TEXT BOOKS	
1.	CMOS VLSI Design A Circuits and Systems Perspective, Fourth Edition by Neil H.E. Weste, David Money Harris, 2011
2.	M.J. Smith, —Application specific integrated circuits‖, Addisson Wesley, 2002.
3.	Samir Palnitkar; Verilog HDL - Guide to Digital design and synthesis, III edition, Pearson Education, 2003.
REFERENCE BOOKS	

1	Jan Rabaey, AnanthaChandrakasan, B.Nikolic, “Digital Integrated Circuits: A Design Perspective”, Second Edition, Prentice Hall of India, 2003.
2	A.Pucknell, Kamran Eshraghian, “BASIC VLSI Design”, Third Edition, Prentice Hall of India, 2007.
3	Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005
E BOOKS	
1.	https://www.pinterest.com/pin/348677196134415137/
2	http://www.freebookcentre.net/electronics-ebooks-download/
MOOC	
1	http://nptel.ac.in/courses/117101058/
2	http://nptel.ac.in/courses/117106092/2

COURSE TITLE	**RF AND MICROWAVE ENGINEERING**			**CREDITS**	**4**
COURSE CODE	**ECB4402**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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	RF and Microwave engineering pertains to the study and design of microwave circuits, components and systems. Fundamental principles are applied to analysis, design and measurement techniques in this field. This course deals with analysis of circuit properties of active and passive devices. It also focus on the measurement techniques of various microwave parameters.				
Course Objective	1. To lay a strong foundations in the basics techniques of RF components and filters. 2. To impart the knowledge of Scattering Matrix and establish the S-Matrix for various types of microwave junctions. 3. To provide in-depth knowledge of semiconductor devices relevant for high frequency-microwave operation. 4. To introduce the basic techniques of modern RF and microwave measurements.				

Course Outcome	Upon completion of this course, the students will be able to 1. Relate microwave measurement parameters and identify, design and solve elements in impedance matching and filter circuits. 2. Apply the concepts of reciprocity, scattering matrix in Microwave Components, determine resonance frequencies and Q-value for open or short-circuited transmission line resonators. 3. Choose analysis methods to determine circuit properties of passive or active microwave devices. 4. Design microwave high frequency and broadband amplifiers. 5. Analyze the measurement techniques of various microwave parameters and experimental setup.

Prerequisites: Transmission Lines and Waveguides

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

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

MODULE 1 – RF COMPONENTS AND FILTERS	**(9L+3T=12)**
Transmission Line Transformers , Baluns, Wilkinson Power Dividers/Combiners, Couplers; Filter Design; Microwave applications, relation between dB, dBm, dBw.	**CO-1** **BTL-2**
MODULE 2 – MICROWAVE NETWORK ANALYSIS AND WAVEGUIDE COMPONENTS	**(9L+3T=12)**
Impedance and Admittance Matrices, The Scattering Matrix, Power Waves and Generalized Scattering Parameters, Three-Port Networks (T-Junctions), Basic Properties of Dividers and Couplers, Ferrites— Composition and Characteristics, Faraday Rotation, Ferrite Components — Gyrator, Isolator, Circulator.	**CO-2** **BTL-2**
MODULE 3 – MICROWAVE DEVICES	**(9L+3T=12)**
Microwave Tubes: Klystron, TWT, Magnetron; Schottky Diodes and Detectors, PIN Diodes and Control Circuits, Varactor Diodes, Heterojunction Bipolar Transistor, High Electron Mobility Transistor, Avalanche Transit Time (ATT) Devices, Transfer Electron Devices – GUNN Diode.	**CO-3** **BTL-3**
MODULE 4 – MICROWAVE HIGH EFFICIENCY BROADBAND AND POWER AMPLIFIER	**(9L+3T=12)**

Overdriven Class B, Class-F Circuit Design, Inverse Class F, Class E with Shunt Capacitance Class E with Finite DC-Feed Inductance, Bode-Fano Criterion, Matching Networks with Lumped Elements, Matching Networks with Mixed Lumped and Distributed Elements, Matching Networks with Transmission Lines, Power Amplifiers with Lossy Compensation Networks, Broadband Class-E Power Amplifiers	**CO-4 BTL-3**
MODULE 5 – MICROWAVE COMMUNICATION AND MEASUREMENTS	**(9L+3T=12)**
Microwave Antennas (parabolic reflector Antennas), RADAR Systems, The RADAR Equation, Types of RADAR, RADAR Ranging, Theory and Applications of Radiometry, The Dicke Radiometer, Description of microwave bench, Noise at microwave frequency and measurement of noise figure, Power measurement, attenuation, frequency, impedance, VSWR, EIRP and Gain Over Noise Temperature (G/T)	**CO-5 BTL-4**

TEXT BOOKS	
1.	Gottapu Sasi Bhushana Rao "Microwave and Radar Engineering" Pearson Education, 2013
2.	Andrei Grebennikov, “RF and Microwave Power Amplifier Design”, McGraw-Hill Education, 2nd Ed, 2015
3.	Samuel V. Liao “Microwave Devices and Circuits” Pearson, 3rd Edition, 2003
4.	A. Das and S.K. Das, “ Microwave Engineering” TMH, 2nd Ed., 2009
REFERENCE BOOKS	
1	David M Pozar Microwave Engineering” Wiley Publications, 4th Ed , 2012
2	R.E. Collin “Foundations for Microwave Engineering” IEEE Press, John Wiley, 2nd Edition, 2002.
3	Matthew M Radmanesh “Advanced RF and Microwave Circuit Design: The Ultimate Guide to Superior Design”, Author House, 2009
E BOOKS	
1.	http://www.ibook4u.com/2014/03/microwave-engineering-by-david-m-pozar.html
2.	https://www.accessengineeringlibrary.com/browse/rf-and-microwave-power-amplifier-design-second-edition#fullDetails
MOOC	
1	https://www.conted.ox.ac.uk/courses/practical-rf-microwave-design

COURSE TITLE	**INTERNET OF THINGS**			**CREDITS**	**3**
COURSE CODE	**ECB4403**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**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	The Internet of Things (IoT) is everywhere. It provides advanced data collection, connectivity, and analysis of information collected by computers everywhere. This course gives a foundation in the Internet of Things, including the components, tools, and analysis by teaching the concepts behind the IoT and a look at real-world solutions.
Course Objective	1. To provide knowledge on the significance of the Internet of Things 2. To Discuss the architecture, operation, and business benefits of an IoT solution 3. To Explore the relationship between IoT, cloud computing, and big data
Course Outcome	Upon completion of this course, the students will be able to 1. Interpret the basic concepts and scope of internet of things 2. Apply the concepts of networking and communication in IoT and design a simple projects with sensors, Arduino and Raspberry PI 3. Interpret the Edge Architecture Model & Cloud-Cloud device connectivity in a typical IoT system. 4. Analyze the IoT & iCore Reference model, different Architecture and the need of privacy in preserving and sharing of data in IoT for various applications 5. Apply the concept of IoT in Industry and also explain the challenges to be taken into consideration during the implementation.

Prerequisites: Embedded systems, Microprocessor and microcontrollers, Programming in C

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

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

MODULE 1 : INTRODUCTION TO INTERNET OF THINGS	**(9L)**
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.	**CO-1 BTL-2**
MODULE 2 : NETWORKS AND COMMUNICATION	**(9L)**

Networking Technology, Communication Technology, Processes Data Management, Prototyping embedded devices, Sensors and actuators, Embedded computing basics, Introduction to ARDUINO, RASPBERRY PI **Suggested Readings:** Working Principle of different sensors and Actuators, Network and Communication Protocols	**CO-2** **BTL-3**
MODULE 3 : FOUNDATIONAL ELEMENTS OF AN IOT SOLUTION	**(9L)**
The Edge of the IoT, An Abstract Edge Architecture Model, Device Types, The Cloud-to-Device Connectivity, Topology of the Cloud Data Normalization and Protocol Translation	**CO-3** **BTL-2**
MODULE 4: COMMON ARCHITECTURAL APPROACH FOR IOT EMPOWERMENT	**(9L)**
The IoT Reference Model, IoT Reference Architecture, The iCore Functional architecture, Privacy-preserving Sharing of IoT Data	**CO-4** **BTL-4**
MODULE 5: IOT APPLICATIONS	**(9L)**
IoT Applications — Value Creation for Industry, Value Creation and Challenges, The Smart Factory Initiative, Cost-effective Process Integration of IoT Devices, IoT for Retailing Industry **Suggested Readings:** Case study on few IOT applications	**CO-5** **BTL-3**
TEXT BOOKS	
1.	Ovidiu Vermesan ,Peter Friess "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", 2013 River Publishers
2.	Joe Biron and Jonathan Follett " Foundational Elements of an IoT Solution The Edge, The Cloud, and Application Development" , 2016 O'Reilly Media, Inc.
REFERENCE BOOKS	
1.	Adrian McEwen,Hakim Cassimally "Designing the Internet of Things" 2014 John Wiley and Sons, Ltd.
E BOOKS	
1.	https://webofthings.org/2016/04/24/free-book-using-the-web-to-build-the-iot/
2.	http://spmkck.co.in/Notes/Learning%20Internet%20of%20Things.pdf
3.	http://www.qorvo.com/design-hub/ebooks/internet-of-things-for-dummies
MOOC	
1.	http://nptel.ac.in/courses/106105166/
2.	https://onlinecourses.nptel.ac.in/noc17_cs22/preview

COURSE TITLE	MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE			CREDITS	4
COURSE CODE	ECB4404	COURSE CATEGORY	PC	L-T-P-S	3-1-0-1
Version	1.0	Approval Details	24TH ACM, 30.05.2018	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 gives a basic introduction to machine learning (ML) and artificial intelligence (AI). Through an algorithmic approach, the students are given a practical understanding of the methods being taught, through making their own implementations of several of the methods. The course covers supervised classification based on e.g., artificial neural networks (deep learning), as well as unsupervised learning (clustering), regression, optimization (evolutionary algorithms and other search methods) and reinforcement learning.
Course Objective	To understand the concepts of machine learning 1. To know the fundamentals of regression and neural networks 2. To comprehend the classifiers based on supervised and unsupervised learning 3. To explain the key concepts of AI models 4. To elaborate the logical inferences in AI
Course Outcome	Upon completion of this course, the students will be able to 1. Solve real world machine learning problems with fundamental of Machine learning data, variable model representation (Single, gradient and multi etc.) 2. Apply basic regression, classification methods, propagation algorithms to train the neural network 3. Distinguish between supervised and unsupervised learning and its application in machine learning task (computational problems, models, algorithm etc.,) 4. Apply the basic principles, models and algorithms to AI to recognize, model and solve problems in the analysis and design of information systems. 5. Analyze, evaluate and verify the correctness of logical inferences in AI.

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
CO-1	2	2	-	-	-	1	-	-	-	-	-	-	-	-
CO-2	3	2	3	2	-	-	-	-	-	-	-	-	-	2

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

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

MODULE 1 – INTRODUCTION TO MACHINE LEARNING LANGUAGE	**(9L+3T=12)**
Idea of Machine learning from data, Classification of problems – Regression and classification, Supervised and Unsupervised learning, Model representation for single variable, Single variable cost function, Gradient Decent for Linear Regression, Multivariable model Representation, Multivariable cost function, Gradient Decent in Practice, Normal Equation and non-invertibility. **Suggested Readings:** Symbolic and fuzzy regression	**CO-1** **BTL-2**
MODULE 2: LOGISTIC REGRESSION AND NEURAL NETWORKS	**(9L+3T=12)**
Classification, Hypothesis Representation, Decision Boundary, cost function, Advanced optimization, Multi-classification, Problem of Over fitting, Regularization, Non-linear Hypothesis, Biological neurons, Model Representation, Intuition for neural Networks, Multiclass classification, Cost function, Back Propagation Algorithm, Back Propagation Intuition, Weight Initialization, Neural Network Training. **Suggested Readings:** Perceptron Networks	**CO-2** **BTL-3**
MODULE 3: SUPPORT VECTOR MACHINES AND UNSUPERVISED LEARNING	**(9L+3T=12)**
Optimization Objective, Large Margin classifiers, Kernels, SVM practical, Consideration, Unsupervised learning introduction, k-means Algorithm, Optimization objective, Random Initialization, choosing number clusters, Problem Formulation, Content based recommendations, Collaborative Filters, Vectorization, Implementation Details. **Suggested Readings:** Linear Discriminant Classifiers	**CO-3** **BTL-4**
MODULE 4: FUNDAMENTALS AND SEARCH TECHNIQUES	**(9L+3T=12)**
Defining Artificial Intelligence, Defining AI Techniques, defining problems as state space search, Production Systems and characteristics, Hill climbing, Breadth first and depth first search, Best first search, Representations and Mapping, Approaches to knowledge representation. **Suggested Readings:** Basics on Expert Systems	**CO-4** **BTL-3**
MODULE 5: PREDICATE LOGIC,KNOWLEDGE RULES AND SYMBOLIC LOGIC	**(9L+3T=12)**
Representing simple facts in logic, Computable functions and predicates, Procedural vs Declarative knowledge, Logic programming, Forward vs Backward reasoning, Non Monotonic reasoning, Logics for Non-monotonic reasoning. **Suggested Readings:** AI application in medicine	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Tom M. Mitchell, “Machine Learning”,McGraw-Hill Science/Engineering/Math; 1997.
2.	Rich and Knight. “Artificial Intelligence”: 2nd Edition, 2017
REFERENCE BOOKS	
1	Staurt Russel, Peter Norvig,“Artificial Intelligence: A Modern Approach”, Pearson New International Edition, 2014.
2	Christoper M Bishop, “Neural Network for pattern recognition”, Oxford university press, 2008
3	Richert and Coelho, “Building Machine Learning System with Python”, Packt Publishing 2013
E BOOKS	
1.	https://www.pdfdrive.com/machine-learning-step-by-step-guide-to-implement-machine-learning-algorithms-with-python-e158324853.html
2.	https://twimlai.com/ebooks/
MOOC	
1	https://www.coursera.org/learn/machine-learning
2	https://online-learning.harvard.edu/subject/artificial-intelligence

COURSE TITLE	**VLSI DESIGN LAB**			**CREDITS**	**1**
COURSE CODE	**ECB4431**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-3-0**
Version	**1.0**	**Approval Details**	**24TH ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-4**
ASSESSMENT SCHEME					
CIA					**ESE**
80%					**20%**
Course Description	This laboratory course helps to develop and design combinational and sequential circuits using Verilog HDL. This course helps the students to know about the application of these circuits in system on chip.				
Course Objective	To enable students to learn Verilog HDL concepts. 1. To develop and design digital circuits using Vivado 2015.3 tool. 2. To practice the layout of CMOS logic gates using Tanner EDA tool.				

Course Outcome	Upon completion of this course, the students will be able to 1. Develop HDL modules using the Verilog HDL concepts. 2. Design the Combinational and Sequential Circuits using HDL. 3. Design the advanced digital circuits using HDL. 4. Design, simulate and extract the layouts of analog IC using EDA too.

Prerequisites: Digital System Design

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

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

LIST OF EXPERIMENTS

FPGA Based Experiments:

1. HDL based Design entry and Simulation using Combinational Logic Circuits
2. Synthesis, Area, Power and Timing report generation using Sequential Circuits
3. Verilog implementation of carry look ahead adder
4. Design of finite state machines based on Mealy.
5. Design of finite state machines based on Moore.

IC DESIGN EXPERIMENTS: (BASED ON TANNER/CADENCE/EQUIVALENT)

1. Schematic design of transistor level Inverter using CMOS logic
2. Schematic design of transistor level NAND and NOR gates using CMOS logic
3. Schematic design of 4:1 Multiplexer using Pass Transistor
4. Schematic design of D-Latch and D-Flip Flop
5. Layout design of CMOS Inverter

TEXT BOOKS

1.	Neil Weste and David Harris, “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Tata McGraw Hill, 2010
2.	M.J. Smith, —Application specific integrated circuits‖, Addisson Wesley, 1997
3.	Samir Palnitkar; Verilog HDL - Guide to Digital design and synthesis, III edition, Pearson Education, 2003.

REFERENCE BOOKS

1	Jan Rabaey, Anantha Chandrakasan, B.Nikolic, “Digital Integrated Circuits: A Design Perspective”, Second Edition, Prentice Hall of India, 2003.
2	A.Pucknell, Kamran Eshraghian, “BASIC VLSI Design”, Third Edition, Prentice Hall of India, 2007.

E BOOKS	
1.	https://www.pinterest.com/pin/348677196134415137/
MOOC	
1	http://nptel.ac.in/courses/117101058/
2	http://nptel.ac.in/courses/117106092/2

COURSE TITLE	MICROWAVE AND OPTICAL LAB			CREDITS	1
COURSE CODE	ECB4432	COURSE CATEGORY	PC	L-T-P-S	0-0-3-0
Version	1.0	Approval Details	24TH ACM, 30.05.2018	LEARNING LEVEL	BTL-5

ASSESSMENT SCHEME	
CIA	ESE
80%	20%

Course Description	This laboratory course provides in depth knowledge to the students to analyze, design and build the microwave and optical equipment using RF tool box, microwave and optical bench setup. This course also helps them to do the experiments using software such as Optsim Software and MATLAB.
Course Objective	1. To learn the various characteristics of optical sources, detectors and links in Optical systems. 2. To provide knowledge on the concepts of DWDM communication system and EDFA and simulate using Optsim software 3. To enhance the knowledge of microwave components and practice the microwave measurement procedures. 4. To familiarize the RF tool box in MATLAB to understand the characteristics of RF components.
Course Outcome	Upon completion of this course, the students will be able to 1. Analyze the various characteristics of optical sources, detectors and links in Optical systems. 2. Design, implement and test DWDM communication system and EDFA using Optsim Software. 3. Apply the basic knowledge of waveguide and microwave resonator circuits. 4. Assess the methods used for generation and amplification of the microwave power. 5. Analyze the characteristics of RF components and S parameters using RF tool box and MATLAB.

Prerequisites: Optical communication, RF and Microwave fundamentals

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

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

LIST OF EXPERIMENTS

1. Comparison of NRZ, RZ, CRZ and CSRZ modulations using Optsim Software
2. Dense Wavelength Division Multiplexing (DWDM) link using Optsim Software
3. Gain Characteristics of EDFA amplifier using Optsim Software
4. Effect of ISI on BER study using Optsim Software
5. Characteristics of Photodiode - Hardware
6. Characteristics of LED -Hardware
7. Fiber optic links – Hardware
8. Introduction to microwave measurements:
    - Detection of RF power
    - Measurement of SWR and Impedance of an unknown load
    - S-parameter calculation for RF component networks using RF Toolbox
9. To plot the S- parameters of Two Port Network for the given frequency using MATLAB
10. Obtain Power coupling using directional coupler
11. Study of Reflex Klystron Repeller mode characteristics
12. Study of GUNN Diode characteristics
13. Study of radiation pattern of Microstrip patch antenna
14. Radio-frequency characteristics of components using RF toolbox
15. Analyzing gain and noise figure of transmitters using RF budget analyzer App

TEXT BOOKS

1	Gerd Keiser, “Optical Fiber Communication” McGraw –Hill International, 4th ed., 2009.
2	Annapurna Das, Sisir K. Das “Microwave Engineering”, Tata McGraw-Hill Education, 2000.

REFERENCE BOOKS

1	G.P Agrawal, “Fiber-Optic Communication Systems” , Wiley; Third edition, 2007

E BOOKS

1	https://www.intechopen.com/books/optical-communication

MOOC

1	http://nptel.ac.in/courses/117104127/

2	http://nptel.ac.in/courses/117101054/

COURSE TITLE	DESIGN PROJECT - V			CREDITS	1
COURSE CODE	ECB4433	COURSE CATEGORY	PC	L-T-P-S	0-0-2-1
Version	1.0	Approval Details	24TH ACM, 30.05.2018	LEARNING LEVEL	BTL- 5

ASSESSMENT SCHEME

FIRST REVIEW	SECOND REVIEW	THIRD REVIEW	PROJECT REPORT AND VIVA VOCE
20%	30%	20%	30%

Course Description	This module gives a strong Engineering and Practical foundation for understanding the different types of social problems and its solution based on engineering knowledge. It is suitable for general engineering students to understand the importance of engineering concepts and its relevant applications.
Course Objective	1. To allow students to demonstrate a wide range of the skills learned during their course of study by delivering a product that has passed through the design, analysis, testing and evaluation 2. To encourage multidisciplinary research by integrating the concepts learned in a various courses. 3. To allow students to develop problem solving, analysis, synthesis and evaluation skills. 4. To encourage teamwork. 5. To improve students' communication skills by emphasizing them to prepare project report, poster and oral presentation
Course Outcome	Upon completion of this course, the students will be able to 1. Identify and work for the real life needs of the society 2. Implement practical solutions to the societal problem 3. Demonstrate the importance of Engineering concepts and its relevant application

Prerequisites: ECB4342, ECB4401,ECB4402, ECB4403, ECB4404, MATLAB, MULTISIM, TANNER 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

CO-1	3	3	3	3	3	2	2	1	3	2	3	3	3	3
CO-2	`3	3	3	3	3	2	2	1	3	3	3	2	3	3
CO-3	3	3	3	3	2	1	1	1	2	2	1	2	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related														

LAB / MINI PROJECT

In this project, each team with maximum of five members is expected to design and develop practical solutions to real life problems related to Industry and Information Technology research. Software usage should be followed during the development. The theoretical knowledge gained from the subject in the current and previous semesters should be applied to develop effective solutions to various applications. At the end of the course the group should submit a complete report of the project work carried out. Assessment is made as follows

BTL 5

Assessment	
Review / Exam	**Weightage**
First Review	20%
Second Review	30%
Third Review & Demo	20%
Project report and Viva-Voce	30%
TOTAL	**100%**

SEMESTER VIII

COURSE TITLE	PROJECT AND VIVA VOCE			CREDITS	8
COURSE CODE	ECB4441	COURSE CATEGORY	PC	L-T-P-S	0-0-24-11
Version	1.0	Approval Details	24TH ACM, 30.05.2018	LEARNING LEVEL	BTL-6

ASSESSMENT SCHEME

FIRST REVIEW	SECOND REVIEW	THIRD REVIEW	PROJECT REPORT AND VIVA VOCE
10%	20%	20%	50%

Course Description	The aim of this course will vary in nature from design and make to computational and research-based projects. All proposed projects will give the opportunity to achieve the learning outcomes. The module aims to provide students with a vehicle to develop and/or integrate knowledge and skills as well as discover and (in some cases) create new knowledge using literature, experimentation or modelling and analysis where appropriate. The module also aims to reward curiosity and motivation with a satisfying experience involving close interaction with an academic supervisor.
Course Objective	1. To make students apply data mining tools for various phases of data mining. 2. To enable students to implement the classification techniques with different algorithms. 3. To help in demonstrating and apply clustering techniques with different algorithms. 4. To apply association rule for mining. 5. To help students design a single and multi-layer neural network.
Course Outcome	Upon completion of this course, the students will be able to 1. Design and develop prototype based on the knowledge gained 2. Propose a project and defend it as a team 3. Solve real time problem in electronics or communication domain

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
CO-1	3	3	2	3	3	2	2	2	2	2	3	2	3	3
CO-2	3	3	2	3	3	2	2	2	2	2	3	2	3	3
CO-3	3	3	2	3	3	2	2	2	2	2	3	2	3	3

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

The Project Work shall be carried out in the field of Electronics & Communication Engineering. Students shall work in convenient groups of not more than four members in a group. Every Project Work shall have a Supervisor. During this period the supervisor shall guide the students to implement the project. The students shall give periodical presentations of the progress made in the Project Work.

Each group shall finally produce a report covering background information, literature survey, problem statement, project work details and conclusions. This final report shall be typewritten form as specified in the guidelines.

Assessment	
Review / Exam	**Weightage**
First Review	10%
Second Review	20%
Third Review & Demo	20%
Project report and Viva-Voce	50%
TOTAL	**100%**

DEPARTMENT ELECTIVES

SEMESTER III

COURSE TITLE	**LOGIC SYSTEM DESIGN WITH VHDL**			**CREDITS**	**3**
COURSE CODE	**ECC4251**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 provides knowledge to design and simulate VHDL model using concurrent and sequential modelling techniques. It covers the design of hazard free combinational circuit and also to design and analyse the sequential function using Moore and Mealy machine.				

Course Objective	1. To Identify, eliminate and design hazard free combinational circuits. 2. To derive State diagram, State Table and circuit diagram for the given sequence 3. To interpret the VHDL design syntax and concept. 4. To write VHDL code for combinational circuits. 5. To write VHDL code for sequential.
Course Outcome	Upon completion of this course, the students will be able to 1. Design hazards free combinational circuits. 2. Analyze and apply Moore and Mealy machine concept to design sequential circuits such as Sequence detection and Sequence generation. 3. Write the VHDL design syntax. 4. Design combinational circuits such as Adders, Subtractors, Multiplexers and Comparators using VHDL language. 5. Design sequential circuits such as Flip Flops, Shift registers, Counters and FSM using VHDL language.

Prerequisites: ECB4116 – Digital System Design

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

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

MODULE 1: REALIZATION OF HAZARD FREE DIGITAL FUNCTIONS	**(9L)**
Hazards in combinational circuits. Design of hazard free combinational logics. Set up and Hold time concepts in Flip flop. Excitation tables and conversion of flip flop from one type to another type **Suggested Readings:** Dynamic Hazards and Essential Hazards	**CO-1** **BTL-4**
MODULE 2: DESIGN AND ANALYSIS OF SEQUENTIAL FUNCTIONS	**(9L)**
Structure of sequential circuits: Moore and Melay machines-State tables, state diagrams and timing diagrams. FSM techniques to design the sequential functions for sequence detection and sequence generation **Suggested Readings:** Sequence Counting	**CO-2** **BTL-4**
MODULE 3: VHDL DESIGN CONCEPTS	**(9L)**

Introduction to Hardware description language- Assignment statements, sequential statements and process, conditional statements, case statement, Array and loops, Packages and Libraries, concurrent statements **Suggested Readings:** Access types and File Types	**CO-3** **BTL-3**
MODULE 4: COMBINATIONAL CIRCUIT DESIGN	**(9L)**
VHDL design of combinational circuits such as Full Adder, Full Subtractor, Multiplexers, Demultiplexers, encoders, decoders , code converters, comparators, implementation of Boolean functions, Serial and Parallel adder. **Suggested Readings:** Different Types of Adders	**CO-4** **BTL-4**
MODULE 5: DESIGN OF LOGIC SYSTEM USING VHDL	**(9L)**
VHDL design of Sequential Circuits such as Flip flops, Shift Registers, Counters, Basic ROM and Finite State machine. **Suggested Readings:** Design of real time systems using FSM	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Morris Mano, "Digital design", 5 th Edition, Prentice Hall of India, 2012
2.	Parag K. Lala, "Digital System Design Using Programmable Logic Devices" first Edition, BS Publications/BSP Books (2003)
REFERENCE BOOKS	
1	Albert Paul Malvino, Donald P Leach, Gautam Saha, "Digital Principles and Applications", 7 Edition- Tata McGraw - Hill Education ,2011
2	John M. Yarbrough, "Digital logic: Applications and Design", Thomas – Vikas Publishing House, 2002.
E BOOKS	
1.	https://www.researchgate.net/publication/264005171_Digital_Electronics
MOOC	
1	http://nptel.ac.in/courses/117106086/1
2	https://www.openlearning.com/courses/SKEE1223x

COURSE TITLE	**BASIC ELECTRICAL ENGINEERING**			**CREDITS**	**3**
COURSE CODE	**ECC4252**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 deals with the fundamentals of house wiring and its significance so that the students can use this concept for their own needs. This course also allows the students to learn the essence of electrical machines such as DC motor, DC generator, Transformer, Induction motor and Alternator and their characteristics in order to choose a suitable machine for a given application
Course Objective	1. To understand the wiring types used for domestic and Industry 2. To acquire knowledge on DC machines 3. To know the performance of Transformer 4. To understand Synchronous and Induction machines 5. To get ideas on Electrical energy and Energy conservation
Course Outcome	Upon completion of this course, the students will be able to 1. Analyze the basic concepts of electrical wiring and distinguish between single phase and three phase circuits 2. Discuss the working principles and Constructions of DC machines and analyze their Performance 3. Describe the construction and operational characteristics of Transformer under various load types and analyze the performance 4. Interpret the construction, operation and starting methods of Induction and synchronous machines and examine the characteristics. 5. Discuss the basics of renewable and non-renewable electrical energy sources

Prerequisites: CSB231 – Engineering 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
CO-1	1	2	2	2	-	-	-	-	-	-	1	-	-	-
CO-2	3	3	3	2	-	-	-	-	-	-	1	-	-	-
CO-3	3	1	3	2	-	-	-	-	-	-	1	-	-	-
CO-4	3	1	3	2	-	-	-	-	-	-	1	-	-	-
CO-5	1	1	1	2	-	-	1	-	-	-	1	-	-	-

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

MODULE 1 – HOUSE WIRING & SAFETY (9L)

Single phase and three phase system – phase, neutral and earth-Basic house wiring - tools and components for wiring -Types of wiring – Wiring for staircase, florescent lamp and ceiling fan-Basic safety measures at home and industry-Earthing **Suggested reading:** Electrical Wiring of Tube light, Fan, Staircase etc.	**CO-1** **BTL-3**
MODULE 2 – DC MACHINES	**(9L)**
Construction of DC machines – Theory of operation of DC generators – Characteristics of DC generators- Operating principle of DC motors – Types of DC motors and their characteristics – Speed control of DC motors- Applications. **Suggested reading:** Efficiency test on dc machines	**CO-2** **BTL-3**
MODULE – 3 : TRANSFORMER	**(9L)**
Introduction – Single phase transformer construction and principle of operation – EMF equation of Transformer-Transformer no–load phasor diagram –– Transformer on–load phasor diagram –– Equivalent circuit of transformer – Regulation of transformer –Transformer losses and efficiency **Suggested reading:** Efficiency test on Transformers	**CO-3** **BTL-3**
MODULE–4: INDUCTION MACHINES AND SYNCHRONOUS MACHINES	**(9L)**
Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit – Construction of single-phase induction motors – Types of single phase induction motors – Double revolving field theory – starting methods - Principles of alternator – Construction details – Types – Equation of induced EMF – Voltage regulation- Methods of starting of synchronous motors **Suggested reading:** Regulation test on Alternator	**CO-4** **BTL-3**
MODULE 5 – ELECTRICAL ENERGY AND CONSERVATION	**(9L)**
Introduction to conventional and non-conventional sources of Electrical Energy- Working of Thermal Power Plant-Introduction to Solar PV- Basics of Windmill- Electrical Energy Conservation-Working of energy efficient devices- CFL-LED **Suggested reading:** Solar module testing, testing of LED lamps	**CO-5** **BTL-2**

TEXT BOOKS	
1.	D. C. Kulshreshtha, “Basic Electrical Engineering”, Tata Mcgraw Hill Education Private Limited, 1st Edition, 2011.
2.	D. P. Kothari and I. J. Nagrath, 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, Reprint 2008
REFERENCE BOOKS	
1.	Edward Hughes, Ian Mckenzie Smith, Dr John Hiley, Keith Brown Hughes, “Electrical and Electronic Technology”, Pearson Publishers, 2016.
2.	Hambley, “Electrical Engineering: Principles and Applications”, Phi Learning Pvt. Ltd., 2016.Del Toro, Vincent "Electrical Engineering Fundamentals", Phi Learning Pvt. Ltd., 2014

E BOOKS	
1.	https://www.pdfdrive.com/basic-electrical-engineering-e187288438.html https://www.pdfdrive.com/basic-electrical-engineering-e185233224.html
MOOC	
1	https://alison.com/course/introduction-to-electrical-wiring-systems-revised

COURSE TITLE	**INSTRUMENTATION ENGINEERING**			**CREDITS**	**3**
COURSE CODE	**ECC4253**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-5**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	Instrumentation engineering is the science of the measurement and control of process variables within a production or manufacturing area. This course describes the basic functions of instruments, characteristics, error mechanism and calibration. It covers the basic mechanical, electrical and electronics instruments system and their applications. Transducer, classification, characteristics and digital technology also included in this module. Last module focus completely on the applications of the real time world and identifying the suitable instrumental method of analysis such applications				
Course Objective	1. To understand the performance characteristics of instruments 2. To Analyze the fundamentals of mechanical instruments 3. To study transducers and their performance. 4. To learn basic electronic instruments 5. To understand PLC and its implementation.				
Course Outcome	Upon completion of this course, the students will be able to 1. Discuss the basic functions of instruments and different characteristics of electronic instruments. 2. Classify the various types of mechanical measurement system and their applications. 3. Summarize the principle of transduction, classifications, characteristics of different transducers and its applications. 4. Categorize different types of electronic measurement and instrument relevance with digital technology 5. Explain the fundamental concepts of PLC and its implementation using basic Boolean functions				
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**
CO-1	1	1	1	-	-	-	-	-	-	-	-	-	1	-
CO-2	1	1	1	1	1	-	-	-	-	-	-	-	1	-
CO-3	1	1	1	1	-	1	-	-	-	-	-	-	1	-
CO-4	2	1	1	1	-	-	-	-	-	-	-	-	1	-
CO-5	1	1	2	-	1	1	-	-	-	-	-	1	1	-

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

MODULE 1 Measurement, Instrumentation and Calibration	**(9L)**
Introduction to instrument and measurement, Scope of instrumentation in Industrial Organization Generalized instrumentation systems with block diagram representation, Performance Characteristics-static and dynamic characteristics. Errors in instrumentation, Calibration and Standards **Suggested Readings:** Measurements, instrumentation, error	**CO-1** **BTL-2**
MODULE 2 – Mechanical Instrumentation	**(9L)**
Basics of temperature measurement, Basics of pressure measurement, Basics of force Measurement, Basics of torque measurement, Basics of flow Measurement **Suggested Readings:** Force, flow, pressure, torque concepts	**CO-2** **BTL-3**
MODULE 3 –Electrical Instrumentation	**(9L)**
Passive: Resistive temperature, pressure, strain, displacement transducers, Inductive displacement thickness transducers, capacitive displacement and moisture transducers. **Active:** Piezoelectric (force, pressure, strain), Magneto-striction transducer, Electrochemical transducers (reference, pH), electromechanical transducer (Tachometer), electromagnetic flow meter, photoelectric transducer (volatile, emissive), Digital Tachometer. **Suggested Readings:** Strain, temperature, photo voltaic	**CO-3** **BTL-3**
MODULE 4 –Electronic Instrumentation	**(9L)**
Digital electronic meters: Ammeter, Voltmeter, ohmmeter, Multimeter, CRO's (Traditional, Sampling, dual trace, storage),Signal generator, function generator, Spectrum Analyzer. **Suggested Readings:** Analog Ammeter, voltmeter, multimeter, sources.	**CO-4** **BTL-3**
MODULE 5 –PLC	**(9L)**
PLC-Basics, types, Applications, parts of PLC, Principle of operation, AND,OR,NOT function ,XOR, Boolean algebra, Hardware components, Discrete I/O module, Analog I/O module, Memory types, CPU **Suggested Readings:**	**CO-5** **BTL-4**

Applications of PLC	
TEXT BOOKS	
1.	Transducers & Instrumentation, by DVS Murthy, PHI 2013, 2nd edition.
2.	Electrical and Electronic Measurement and Instrumentation by AK Sawhney; DhanpatRai and Co., New Delhi, 1985.
REFERENCE BOOKS	
1	Electrical and Electronic Measurement and Instrumentation by JB Gupta; S.K Kataria and Sons Publishers, New Delhi, 2015.
2	Doeblin & Manek, Measurement Systems, 4/e, McGraw Hill, New York, 1992, 5th edition..
3	H.S Kalsi, Electronic Instrumentation, McGraw Hill, 4th edition, 2010.
4	D. Patranabis, Sensors and Transducers, PHI, 2nd edition, 2003.
5	Frank D. Petruzella, Programmable Logic Controllers, McGraw Hill, 4th edition, 2005.
E BOOKS	
1	http://www.kelm.ftn.uns.ac.rs/literatura/si/pdf/Measurement%20Instrumentation%20Sensors.pdf
2	http://engineeronadisk.com/book_modeling/
3	https://www.studynama.com/community/threads/electrical-measurements-instrumentation-pdf-download-ebook-lecture-notes.325/
MOOC	
1	http://nptel.ac.in/courses/108105064/
2	http://nptel.ac.in/courses/103105064/35
3	http://nptel.ac.in/syllabus/108106070/

COURSE TITLE	**MICROPROCESSOR AND APPLICATIONS**			**CREDITS**	**3**
COURSE CODE	**ECC4254**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 describes the basic microprocessors 8085 & 8086, followed by its applications in modern processors. It covers the basic architecture, registers, instructions, addressing modes and interrupts. Assembly language programming is also developed for 8 bit and 16 bit microprocessors. Last module focusses completely on the applications and gives an introduction about the ARM and PIC processors that are used in real world applications.
Course Objective	1. To illustrate the 8085 architecture and explain the 8085 MPU signals. 2. To write assembly language program using 8085 instruction set. 3. To illustrate the 8086 architecture and explain the 8086 MPU signals. 4. To write assembly language program using 8086 instruction set. 5. To identify the applications of Microprocessor and ARM processors.
Course Outcome	Upon completion of this course, the students will be able to 1. Outline the concepts of Microprocessor and summarize the role of 8085 MPU signals and interrupts. 2. Develop Assembly Language Program using 8085 Instruction set. 3. Illustrate the Architecture and Instructions pertaining to 8086 MPU. 4. Construct Assembly Language Program using 8086 Instruction set. 5. Identify the applications of Microprocessor and ARM processors with various Peripheral Interface.

Prerequisites: Digital Systems

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

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

MODULE 1: 8085 MICROPROCESSOR	**(9L)**
Introduction to Micro Computers, Microprocessors and Assembly Languages - 8085 MPU- signals- Internal architecture- Interrupts **Suggested Readings:** 8085 signals and Internal architecture	**CO-1** **BTL-2**
MODULE 2: 8085 INSTRUCTION SET	**(9L)**

8085 Instruction set –data transfer instructions-stack instructions-I/O instructions-arithmetic instructions-logical instructions-branch instructions-machine control instructions- Addressing modes **Suggested Readings:** 8085 Instruction set and Addressing modes	**CO-2** **BTL-3**
MODULE 3: 8086 MICROPROCESSOR	**(9L)**
8086 MPU -Functional block diagram –Interrupts – Instruction set-string instructions-Addressing modes **Suggested Readings:** 8086 Internal architecture, Instruction set and addressing modes	**CO-3** **BTL-2**
MODULE 4: 8086 ASSEMBLY PROGRAMMING	**(9L)**
8086 Assembly programming- arithmetic operations - addition- subtraction- addition with carry- multiplication- division-logical operations-block transfer of data **Suggested Readings:** 8086 assembly programming for arithmetic and logical operations	**CO-4** **BTL-3**
MODULE 5: 8086 APPLICATIONS AND OVERVIEW OF HIGHER PROCESSORS	**(9L)**
8086 applications-stepper motor speed control- keyboard and display interfacing-introduction to PIC processor- introduction to ARM processor (qualitative analysis) **Suggested Readings:** Stepper motor speed control, keyboard and display interfacing and overview of PIC and ARM Processors	**CO-5** **BTL-2**

TEXT BOOKS	
1.	Ramesh S. Gaonkar, (2002) “Microprocessor – Architecture, Programming and Applications with the 8085”, Fifth Edition, Prentice Hall. pp. 1-820.
2.	A K Ray and K M Burchandi (2006) “Advanced Microprocessor and Peripherals”, 3rd edition, Tata McGraw Hill, pp. 1- 685.
REFERENCE BOOKS	
1	A. Mathur, (1993), 'Introduction to Microprocessor', Third Edition, Tata McGraw-Hill Publishing Co. Ltd., pp. 1-612.
2	Lyla Das (2013), “Embedded Systems: An integrated approach”, First edition, Pearson publication, pp. 1-784.
3	M.A.Mazidi, J.C.Mazidi (2007), “Microcontroller and Embedded systems using Assembly & C”, Second Edition, Pearson Education, pp. 1-560.
E BOOKS	
1.	https://userpages.umbc.edu/~squire/intel_book.pdf
MOOC	
1	http://nptel.ac.in/courses/106108100/

COURSE TITLE	**AN INTRODUCTION TO PROGRAMMING THE INTERNET OF THINGS (IOT)**	**CREDITS**	**3**

COURSE CODE	ECC4255	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	32nd ACM, 07.08.2021	LEARNING LEVEL	BTL-5

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 enables the students to design and implement real word applications. Arduino receives the information from sensors and can control the world around it by adjusting lights, motors and other actuators. This module describes the digital and analog Input/output devices and how to interface them with Arduino. This also introduces the use of software libraries with an Arduino IDE.
Course Objective	1. To provide knowledge of different Smart System applications. 2. To familiarize students with Arduino as IDE, programming language & platform. 3. To provide knowledge of Arduino boards and basic components. 4. To develop skills to design and implement various smart system application.
Course Outcome	Upon completion of this course, the students will be able to 1.Summarize embedded system characteristics and illustrate 8-bit micro controller architecture 2. Demonstrate the Arduino development board and its functions 3. Analyze the interfacing of Digital and Analog I/O devices with Arduino 4. Develop code for embedded C Program in Arduino IDE environment 5. Design Embedded system Applications with Arduino

Prerequisites: Embedded systems, Microprocessor and microcontrollers, Programming in C

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

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

MODULE 1 : EMBEDDED SYSTEM AND 8 BIT MICROCONTROLLERS (9L)

Introduction to Embedded system, Components of Embedded system, Characteristics &Applications. 8-bit Microcontroller: AVR microcontrollers and features, Types, Architecture, Block diagram of controller (At mega 8), Functions of each pins of AT mega. **Suggested Readings:** Case study on few Embedded system Applications& Microcontrollers	**CO-1** **BTL-2**
MODULE 2 : INTRODUCTION TO ARDUINO	**(9L)**
ARDUINO History and Family. Functional Block diagram of Arduino, Architecture, Pin functions. Introduction to sensors and actuators, Working principle of IR sensor, Ultrasonic sensor, Fire sensor and other basic electronic components. **Suggested Readings:** Working Principle of different sensors and Actuators	**CO-2** **BTL-2**
MODULE 3 : INTERFACE DIGITAL AND ANALOG I/O DEVICES	**(9L)**
Introduction to TINKERCAD, General Hardware Interfacing-LED's, Switches, Seven segment display, Relay's, LCD, Buzzer, POT, LM35, Digital and Analog Sensors. **Practical component:** TINKERCAD SIMULATION **Suggested Readings:** Basic Electronic Devices	**CO-3** **BTL-3&BTL-4**
MODULE 4: PROGRAMMING ARDUINO	**(9L)**
Learning Arduino platform, Arduino IDE, writing, saving, compiling and uploading sketches, Programming in Embedded C, Concepts of C Language, Looping Techniques, Decision making Techniques **Suggested Readings:** Embedded C coding	**CO-4** **BTL-2**
MODULE 5: EMBEDDED SYSTEM APPLICATIONS (ARDUINO)	**(9L)**
Mini projects on embedded system using Arduino, Home automation, Solar street light system, Alarm clock, Car parking system, Line follower robot. Etc… **Suggested Readings:** IOT Applications	**CO-5** **BTL-5**
TEXT BOOKS	
1.	Simon Monk, (2013) "30 Arduino Projects for Evil Genius'' *McGraw- Hill professional*, Second edition, pp.1-199
2.	Michael McRobetrs, (2010), "Beginning Arduino", *Technology in Action*, Second edition, pp. 1- 424
REFERENCE BOOKS	
1.	Dale Wheat, (2012) "Arduino Internas", Technology in Action, First edition, pp. 1-392
2.	John-david, Warren Josh Adams, Harald Molle, (2008) "Arduino Robotics, Technology in Action, First edition, pp. 1-581
E BOOKS	

1	Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury, (2017) "Arduino-Based Embedded Systems", *CRC press*, pp. 1-312
2	Ashwin Pajankar (2018), "Arduino Made Simple", *BPB Publications*, First edition, pp. 1-189
3	Michael Pont (2007), "Embedded C", *Pearson Education*, Second edition, pp. 1-312
MOOC	
1.	https://www.coursera.org/learn/arduino-platform
2.	https://www.coursera.org/learn/interface-with-arduino
3.	https://www.coursera.org/learn/arduino

COURSE TITLE	**DATA STRUCTURES AND ALGORITHMS USING C**			**CREDITS**	**3**
COURSE CODE	**ECC4256**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**32nd ACM, 07.08.2021**	**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 enables the students to know the common data structures that are used in various computational problems. The data structures are implemented in C programming language. This course helps to understand what is going on inside a particular built-in implementation of a data structure and what to expect from it.
Course Objective	1. To familiarize with basic techniques of algorithm analysis 2. To develop programming skills to write programs based on pointers, structures, arrays and hash tables. 3. To analyse and make difference between stack, list and queue with different examples 4. To master the implementation of linked data structures such as linked lists and binary trees. 5. To familiarize with several sub-quadratic sorting algorithms including quicksort, mergesort and bubblesort

Course Outcome	Upon completion of this course, the students will be able to 1. Explain the fundamentals of data structures and its datatypes. 2. Write programs based on pointers, structures, arrays and Hash tables. 3. Differentiate linked list, stack and queue. 4. Develop programs for different types of trees. 5. Develop programs for different kinds of sorting.

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

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

MODULE 1 : INTRODUCTION TO DATA STRUCTURES	**(9L)**
Introduction to DS, Algorithm, Asymptotic Analysis, Fundamental of DS, Types of DS **Suggested Readings:** Case study on data structures algorithms	**CO-1** **BTL-3**
MODULE 2 : POINTERS, STRUCTURES,ARRAYS & HASH TABLES	**(9L)**
Introduction to pointers & structures, Types of Arrays (Linear, Non-linear, DS & 2D), Array Representation, Introduction to Hash tables and its applications, Applications of pointers & structures, Applications of arrays in real time **Suggested Readings:** Case study on pointers, hash tables and arrays	**CO-2** **BTL-3**
MODULE 3 : LINKED LIST, STACK AND QUEUE	**(9L)**
Linked list, Types of linked list-(Singly linked list, Doubly linked list, Circular Doubly list and Skip list & Difference between list, linked list representation **DS STACK:** DS stack, Array implementation and linked list implementation. **DS QUEUE:** Introduction to Queue, Types of Queue, Circular Queue, Deque and Priority Queue Difference between Array & Linked list Difference between Stack & Queue **Suggested Readings:** Case study on linked list, stack and queue	**CO-3** **BTL-3**
MODULE 4: TREES, GRAPH AND SEARCH	**(9L)**

Trees: Introduction to Trees, Types of trees (DS tree, binary, binary search tree, AVL tree, B tree & B+ tree), difference between- (Binary & Binary search tree, RED black tree & AVL tree, B tree& B+ tree) **Graph:** Introduction to graphs, Graph implementation, BFS & DFS algorithm, Spanning tree, Difference between BFS & DFS, difference between tree & graph **Search:** Introduction to search, Types of Search (linear & binary), Difference between linear & binary tree **Suggested Readings:** Case study on trees, graph and search	**CO-4** **BTL-3**
MODULE 5: SORTING	**(9L)**
Introduction to sorting, Types of sorting (Bubble, Insertion, Merge, Quick, Selection, etc), Applications of sorting **Suggested Readings:** Case study on sorting	**CO-5** **BTL-3**
TEXT BOOKS	
1.	Robert Horvick (2012), "Algorithms and Data Structures – Part 1", Syncfusion, Inc, First edition, pp.1-111
2.	Jay Wengrow (2017), "A common-sense Guide to Data structures and Algorithms", Pragmatic Bookshelf, First edition, pp. 1-222.
REFERENCE BOOKS	
1.	Karumanchi, Narasimha, (2011), "Data Structures and Algorithms made easy", Second edition, pp.1-417
2.	Alfred V.Aho, John E.Hopcroft, Jeffrey D.Ullman ,"Data Structures and Algorithms", *Pearson publications,* pp.1-448
E BOOKS	
1	John Bullinaria, (2019), "Lecture notes for Data Structures and Algorithms", University of Birmingham, pp.1-126
MOOC	
1.	https://www.javatpoint.com/data-structure-tutorial
2.	https://nptel.ac.in/courses/106/102/106102064/

COURSE TITLE	**CIRCUIT SIMULATION USING PSPICE**			**CREDITS**	**3**
COURSE CODE	**ECC4257**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**32nd ACM, 07.08.2021**	**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 enables the students to verify how the operational amplifier and power switching converter circuits will actually work. Moreover, it helps to understand how to use PSpice for basic circuit analysis.
Course Objective	1. To familiarize the basics of PSPICE 2. To simulate and analyse different DC circuits 3. To simulate and analyse different AC circuits 4. To simulate and analyse different operational amplifier based circuits 5. To simulate and analyse oscillator circuits and logic gates
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the procedures of creating projects in PSPICE software. 2. Demonstrate the basics of DC circuits Simulation and Analysis 3. Illustrate the basics of AC circuits Simulation .and Analysis 4. Assess the transient analysis ,Frequency analysis and OP amp based basic Circuits 5. Simulate Logic Gates, Oscillators and Differential Amplifiers.

Prerequisites: Digital System Design and Microprocessors

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

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

MODULE 1 : SPICE INTRODUCTION **(9L)**

Starting Capture -Creating a PSpice Project - Symbols and Parts - Quick Place of PSpice Components - PSpice Modeling Applications - Design Templates -Exporting Capture Designs - Saving a Project –Examples of diode characteristics **Suggested Readings:** Basics of PSPICE	**CO-1** **BTL-3**

MODULE 2 : DC CIRCUIT SIMULATION AND ANALYSIS **(9L)**

Netlist Generation - Displaying Bias Points -Save Bias Point -Load Bias Point-DC Voltage Sweep –Markers-Simulating Diode , BJT and Darlington pair amplifier Characteristics. **Suggested Readings:** Basics of Biasing, amplifier characteristics	**CO-2** **BTL-3**
MODULE 3 : AC CIRCUIT SIMULATION AND ANALYSIS	**(9L)**
Simulation Parameters - AC Markers-Simulating half and full wave Rectifiers-Diode Clipper, Clamper Circuit simulation and other required examples. **Suggested Readings:** Rectifiers, wave shaping circuits	**CO-3** **BTL-3**
MODULE 4: TRANSIENT ANALYSIS, FREQUENCY RESPONSE AND OP AMP CIRCUITS	**(9L)**
Parametric sweep- Stimulus Editor-Transient Analysis –Simulation of frequency response of BJT, Filters design , Differentiators and Integrators . **Suggested Readings:** Transient analysis, frequency response	**CO-4** **BTL-3**
MODULE 5: OSCILLATORS, DIFFERENTIAL AMPLIFIERS AND BASIC GATES	**(9L)**
Simulation of wein Bridge Oscillators, Differential Amplifiers , Logic gates and other required Examples . **Suggested Readings:** Rectifiers, wave shaping circuits	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Dennis Fitzpatrick (2011), “Analog Design and Simulation Using OrCAD Capture and PSpice, *Elsevier,* second edition, pp.1-329
2.	James W. Nilsson ,Susan A. Riede (2014), “Introduction to PSpice for Electric Circuits, *Addison-Wesley Longman publication*, Fifth edition, pp.1-164
3.	Paul. W. Tuinenga, (1991), “SPICE: A Guide to Circuit Simulation and Analysis Using PSpice”, *Prentice Hall,* Second edition, pp.1-254
4.	Sedra and Smith (1992), “Mircoelectronic Circuits”, *Oxford University Press*, Fourth edition, pp.1-1237
5.	Behzad Razavi (2002), “Design of Analog CMOS Integrated Circuits”, *Tata Mc-Graw-Hill publication*, Second edition, pp.1-684
MOOC	
1.	https://nptel.ac.in/courses/117/105/117105147/
2.	https://nptel.ac.in/courses/108/108/108108166/
3.	https://www.udemy.com/course/orcad-pspice-tutorial-course-for-beginners/
4.	https://www.udemy.com/course/electronic-circuits-analysis-by-pspice/

SEMESTER IV

COURSE TITLE	**DIGITAL IMAGE PROCESSING**	**CREDITS**	**3**

COURSE CODE	ECC4266	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	24th ACM, 30.05.2018	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 module provides an introduction to basic concepts, methodologies and algorithms of digital image processing focusing on the following two major problems concerned with digital images: (1) image enhancement and restoration for easier interpretation of images, and (2) image analysis and object recognition. Some advanced image processing techniques (e.g., wavelet and multiresolution processing) will also be studied in this course. The primary goal of this course is to lay a solid foundation for students to study advanced image analysis topics such as computer vision systems, biomedical image analysis, and multimedia processing & retrieval.
Course Objective	1. Describe and explain basic principles of digital image processing. 2. Design and implement algorithms that perform basic image processing (e.g. noise removal and image enhancement). 3. Design and algorithms for advanced image analysis (e.g. image compression, image segmentation). 4. Assess the performance of image processing algorithms and systems
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the general terminology of digital image processing 2. Apply the various types of image transformations in image processing applications 3. Make use of the different filtering techniques for image enhancement and restoration 4. Utilize the image compression and decompression techniques to image processing applications 5. Apply the image segmentation and morphological image processing techniques to various images and examine them

Prerequisites: Basic understanding of Linear algebra, Statistics and 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
CO-1	2	1	-	2	1	1	1	1	-	-	-	2	1	2
CO-2	2	2	-	2	-	1	-	1	-	-	-	2	1	2

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

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

MODULE 1: DIGITAL IMAGE FUNDAMENTALS	**(8 L)**
Fundamental steps in DIP, Components of digital image processing system, Structure of human eye, Image formation in the eye, Brightness adaptation and discrimination, light, Image sensing and acquisition, Image formation model, Pixels, Basic relationship between pixels, coordinate conventions, Imaging Geometry, sampling and quantization, Basic geometric transformations. **Suggested Reading:-** Image formation	**CO-1** **BTL-2**
MODULE 2 – IMAGE TRANSFORMS	**(7L)**
Definition of image transforms, Need for transforms, applications, Two dimensional Fourier transform, properties, Walsh, Hadamard, Discrete Cosine Transform, Haar, Karhunen – Loeve transforms. **Suggested Reading:-** Wavelet Transform	**CO-2** **BTL-2**
MODULE 3 – IMAGE ENHANCEMENT AND RESTORATION	**(10L)**
Intensity transformations, contrast stretching, histogram equalization, Spatial filtering: Smoothing filters, sharpening filters, gradient and Laplacian, Frequency domain filtering, Homomorphic filtering, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Inverse Filtering, MMSE (Wiener) Filtering. **Suggested Reading:**- Mathematical expressions for Noise models	**CO-3** **BTL-3**
MODULE 4 – IMAGE COMPRESSION	**(8L)**
Encoder-Decoder model, Lossy and Lossless compression, Transform Coding, Sub-image size selection, blocking artifacts, Run length coding, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding. **Suggested Reading:-** Predictive coding	**CO-4** **BTL-3**
MODULE 5 – IMAGE SEGMENTATION AND REPRESENTATION	**(6L)**
Point, line detection, Edge detection, Thresholding, Region-based segmentation, Boundary representation: chain codes- Polygonal approximation – Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors - Regional descriptors –Simple descriptors- Texture.	**CO-5** **BTL-4**
MODULE 6 – MORPHOLOGICAL IMAGE PROCESSING	**(6L)**
Basics, SE, Erosion, Dilation, Opening, Closing, Hole filling, Connected components, convex hull, thinning, thickening, skeletons and pruning.	**CO-6** **BTL-4**

TEXT BOOKS

1.	Gonzalez & Woods —Digital Image Processing, 3rd ed., Pearson education, 2008
2.	Anil K. Jain —Fundamentals Digital Image Processing, Prentice Hall India, 2011

REFERENCE BOOKS

1.	Pratt W.K —Digital Image Processing, 3rd ed., John Wiley & Sons, 2007
2.	Chanda Dutta Magundar – Digital Image Processing and Applications, Prentice Hall of India, 2000.
3.	S. Sridhar - Digital Image Processing, 2nd ed., Oxford University Press, 2016.
E BOOKS	
1.	http://bookboon.com/en/digital-image-processing-part-one-ebook
2.	http://bookboon.com/en/digital-image-processing-part-two-ebook
MOOC	
1	http://nptel.ac.in/courses/117105079/
2	http://nptel.ac.in/courses/106105032/
3	http://www.nptelvideos.in/2012/12/digital-image-processing.html
4	EGGN 510 - Image and Multidimensional Signal Processing
5	https://www.coursera.org/learn/digital
6	Video lectures by Dr. Mubarak Shah (UCF - Center for Research in Computer Vision) (UCF Computer Vision Video Lectures 2012)

COURSE TITLE	**BIOMEDICAL INSTRUMENTATION**			**CREDITS**	**3**
COURSE CODE	**ECC4267**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 gives a strong theoretical foundation for understanding the basics of electronics in Biomedical domain including the origin of Bio-potentials, its characteristics and the methods used to record the bio-signals. It also focuses on the equipment and the internal blocks used in assisting devices and in radiological devices. Final module focuses on the applications in medical field.
Course Objective	1. To brief the origin of bioelectric potentials and its recording setup. 2. To analyse the characteristics of biopotentials and the instrument associated with it. 3. To experiment the working of cardiac pacemaker and defibrillators. 4. To explain the use of radioisotopes and the radiological equipments. 5. To summarize the application of medical instruments in medical field.

Course Outcome	Upon completion of this course, the students will be able to 1. Summarize the origin of Bio-potentials and recording methods of various bio signals 2. Measure and analyse the characteristics of various bio signals 3. Discuss the significance of cardiac pacemakers, DC Defibrillator, Bio-telemetry 4. Describe about the radiological equipment. 5. Explain the role of various medical equipment and its applications in medical field

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

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

MODULE 1: ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING	**(9L)**
The origin of Bio-potentials; biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, EOG, lead systems and recording methods, typical waveforms and signal characteristics. **Suggested Readings:** Biological amplifiers, ECG, EEG, EMG recording setup and working	**CO-1** **BTL-2**
MODULE 2: BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT	**(9L)**
PH, PO2, PCO2, PHCO3, Electrophoresis, colorimeter, photometer, Auto analyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood cell counters. **Suggested Readings:** Parameters to measure the biosignals	**CO-2** **BTL-3**
MODULE 3: ASSIST DEVICES AND BIO-TELEMETRY	**(9L)**
Cardiac pacemakers, DC Defibrillator, Telemetry principles, frequency selection, Bio-telemetry, radio-pill and tele-stimulation. **Suggested Readings:** Applications of Assist devices in medical field	**CO-3** **BTL-2**
MODULE 4: RADIOLOGICAL EQUIPMENTS	**(9L)**

Ionosing radiation, Diagnostic x-ray equipments, CT – scanners, use of Radio Isotope in diagnosis, Radiation Therapy. **Suggested Readings:** Applications of Radiological equipments in medical field	**CO-4** **BTL-3**
MODULE 5: RECENT TRENDS IN MEDICAL INSTRUMENTATION	**(9L)**
Thermograph, endoscopy unit, Laser in medicine, Diathermy units, Elements of Electrical safety, Built-in safety features for medical instruments. **Suggested Readings:** How medical instruments are used practically in medical field	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, (2013) "Biomedical Instrumentation and Measurement", Prentice Hall India Pvt. Ltd., New Delhi, 2nd Edition, Reprint, pp.1-536.
2.	L.A Geddes and L.E.Baker , (2008) "Principles of Applied Biomedical Instrumentation" Third Edition, John Wiley and sons, pp.1-616.
3.	Khandpur R.S, (2014) "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd Edition, pp.1-944.
REFERENCE BOOKS	
1	Albert D.Helfrick and William D.Cooper, (2007) "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, pp.1-460.
2	John G.Webster, (2009), 'Medical Instrumentation Application and Design', 4th edition, John Wiley and Sons, New York, pp.1-712.
E BOOKS	
1.	https://www.academia.edu/39250912/Handbook_of_Second_Edition_Biomedical_Instrumentation
MOOC	
1	https://www.edx.org/learn/biomedical-engineering

COURSE TITLE	**NANO ELECTRONICS AND DEVICES**			**CREDITS**	**3**
COURSE CODE	**ECC4268**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 progress in electronics has been driven by miniaturization. But as electronic devices approach the molecular scale, classical models for device behavior must be abandoned. The rapid growth of the integrated circuit (IC) industry has led to the emergence of nano microelectronics process engineering as a new advanced discipline. Thus, there is a need to impart quality education at a sufficiently advanced level in the current state of art Nano electronics and Nano Micro Fabrication and design discipline. To prepare for the next generation of electronic devices, this course teaches the basic principles that govern the operation and electrical characteristics of nanoelectronic devices and nanotechnology
Course Objective	1. To review the background of nanotechnology. 2. To design the logic gates using nano devices. 3. To familiarize the principle of quantum transport devices. 4. To introduce the operation of memory devices constructed using molecular electronics. 5. To review the process of nanolithography fabrication.
Course Outcome	Upon completion of this course, the students will be able to 1. Analyse the concepts involved in nanotechnology and the process involved in preparation of nanomaterials. 2. Interpret the fundamentals of logic devices and to design logic gates using nanotechnology. 3. Describe the working principle of Silicon MOSFET devices and Quantum transport tunneling devices. 4. Examine the fundamentals and working of molecular devices. 5. Illustrate the nanolithography process.

Prerequisites: - Engineering Physics, Engineering Materials, Analog Electronics

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

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

MODULE 1: INTRODUCTION TO NANOTECHNOLOGY (9L)

Background to nanotechnology: Types of nanotechnology and Nano machines – periodic table –atomic structure – molecules and phases – energy – molecular and atomic size – surface and dimensional space – top down and bottom up approach; Molecular Nanotechnology: microscope –atom manipulation – Nano dots. Nanomaterial's preparation process, applications of nanomaterial's and Nano Machines **Practical component:** **Suggested Readings:** History of the atom, Bohr Model	**CO-1** **BTL-2**
MODULE 2: FUNDAMENTALS OF NANOELECTRONICS	**(9L)**
Fundamentals of logic devices: dynamic properties – threshold gates; classifications – two terminal devices – field effect devices – Design of logic gates using nano devices – coulomb blockade devices – spintronics – quantum cellular automata – quantum computing – DNA computer; performance of information processing systems: basic binary operations, measure of performance processing capability of biological neurons – performance estimation for the human brain, ultimate computation. **Practical component:** **Suggested Readings:** Design of digital circuits using QCA	**CO-2** **BTL-2**
MODULE 3: SILICON MOSFETs, QUANTUM TRANSPORT DEVICES & CARBON NANOTUBES	**(9L)**
Silicon MOSFETS: scaling rules – silicon-dioxide based gate dielectrics – metal gates – junctions & Contacts. Quantum Transport Devices (QTD) : Electron tunnelling – resonant tunnelling diodes & devices; Single electron devices for logic applications; Carbon Nanotube: Fullerenes - types of nanotubes – formation of nanotubes-electronic properties – synthesis of carbon nanotubes – carbon nanotube interconnects – carbon nanotube FETs –Nanotube for memory applications – prospects of an all carbon nanotube in Nano electronics. **Practical component:** **Suggested Readings:** Advanced MOSFET Concepts	**CO-3** **BTL-3**
MODULE 4: MOLECULAR ELECTRONICS	**(9L)**
Electrodes & contacts: functions – molecular electronic devices –fabrication; Random Access Memory – mass storage devices. Single Molecule Magnet (SMM)-Conductive Polymer-Molecular Conductance-Molecular logic Gate- Molecular Wires-Molecular Assembler-Molecular Machine. **Practical component:** **Suggested Readings:** Monomolecular Digital Logic Structures	**CO-4** **BTL-2**
MODULE 5: NANO ENGINEERING DEVICES & NANO LITHOGRAPHY	**(9L)**
Lab-On-a-Chip-Micro machinery-Nano Motor-Nano Pore-Nano Sensor-Quantum Point-Synthetic Molecular Motors-medical Applications of Nano Materials. Dip pen nanolithography-Electron Beam Lithography-Ion Beam Sculpting-Nano Imprint Lithography-Photo Lithography **Practical component:** **Suggested Readings:** Alternate Nanolithography Techniques	**CO-5** **BTL-2**
TEXT BOOKS	

1.	Rainer, Weiser (2012). Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, 3rd Edition.
2.	Hanson, George W. “Fundamentals of nanoelectronics” , Pearson Education, 2008.
REFERENCE BOOKS	
1	Michael Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse, “Nanotechnology: Basic Science and Emerging Technologies” , Chapman & Hall / CRC, 2002
2	Phani Kumar, “Principles of Nano Technology:-Materials, Tools and Process at Nano Scale” SCITECH Publications,2017
E BOOKS	
1.	https://download.e-bookshelf.de/download/0009/7901/42/L-G-0009790142-0019135941.pdf
MOOC	
1	https://www.edx.org/course/fundamentals-nanoelectronics-basic-purduex-nano520x
2	https://www.edx.org/course/fundamentals-nanoelectronics-part-b-purduex-nano521x

COURSE TITLE	**ROBOTICS AND CONTROL**			**CREDITS**	**3**
COURSE CODE	**ECC4269**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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	The purpose of this course is to introduce the basics of modeling, design, planning, and control of robot systems. In essence, the material treated in this course is a brief survey of relevant results from geometry, kinematics, statics, dynamics, and control. This course provides an overview of robot mechanisms, dynamics, and intelligent controls. Topics include planar and spatial kinematics, and motion planning; mechanism design for manipulators and mobile robots, multi-rigid- body dynamics, control design, actuators, and sensors.				

Course Objective	1. To introduce the functional elements of Robotics 2. To impart knowledge on the direct and inverse kinematics 3. To introduce the manipulator differential motion and control 4. To educate on various path planning techniques 5. To introduce the sensors and actuators used in robotics applications. 6. To impart knowledge on various applications of robotics
Course Outcome	Upon completion of this course, the students will be able to 1. Recall the history, concept development and explain the key components of robotics technologies with necessary sketches. 2. Formulate basic mathematic manipulations of spatial coordinate representation and transformation. 3. Inspect the basic robot forward and inverse kinematics problems 4. Examine and solve basic robotic dynamics, path planning and control problems. 5. Interpret and examine the robotics applications based on the above skills

Prerequisites: Engineering Mathematics & Applied 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
CO-1	2	2	1	1	-	-	1	-	-	-	-	1	2	1
CO-2	2	2	1	1	1	-	-	-	-	-	-	1	2	1
CO-3	2	2	1	1	1	-	-	-	-	-	-	1	2	1
CO-4	2	2	1	1	1	-	-	-	-	-	-	1	2	1
CO-5	2	2	1	1	1	-	-	-	-	-	-	1	2	1

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

MODULE 1 – INTRODUCTION **(9L)**

Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system. Components of the Industrial Robotics: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.	**CO-1 BTL-2**

MODULE 2 – MOTION ANALYSIS I **(9L)**

Homogeneous transformations as applicable to rotation and translation – problems Manipulator Kinematics Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.	**CO-2 BTL-4**

MODULE 3 – MOTION ANALYSIS II **(9L)**

Differential transformation and manipulators, Jacobians problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems. Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion – straight line motion – Robot programming, languages and software packages	**CO-3 BTL-4**
MODULE 4 – ROBOT ACTUATORS AND FEEDBACK COMPONENTS	**(9L)**
Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity Sensors.	**CO-4 BTL-3**
MODULE 5 – ROBOT APPLICATION IN MANUFACTURING	**(9L)**
Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.	**CO-5 BTL-3**

RECOMMENDED BOOKS	
1	Groover M P "Industrial Robotics." Pearson Edu., 2008
2	Mittal R K & Nagrath I J "Robotics and Control" TMH. 2003.
3	Fu K S "Robotics" McGraw Hill., 1987.
4	P. Coiffet and M. Chaeronea "An Introduction to Robot Technology", Kogam Page Ltd. 1983 London.
5	Richard D. Klafter, "Robotic Engineering." Prentice Hall, 2006.
REFERENCE BOOKS	
1	John J Craig "Introduction to Robotics" Pearson Edu., 2004.
2	Mark W. Spong and M. Vidyasagar "Robot Dynamics & Control." John Wiley & Sons (ASIA) Pte Ltd., 2002.
E BOOKS	
1	https://crimsonbay.weebly.com/blog/robotics-and-control-by-rk-mittal-pdf
MOOC	
1	https://nptel.ac.in/courses/112/107/112107289/
2	https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-me61/

COURSE TITLE	**PROGRAMMING WITH LABVIEW**			**CREDITS**	**3**
COURSE CODE	**ECC4270**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**32nd ACM, 07.08.2021**	**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 module enables the students to develop models for data acquisition systems. Moreover, it helps to understand how to use LABVIEW for signal processing and real time applications
Course Objective	1. To familiarize the basics of VI concepts 2. To develop GUI for measurements 3. To explore the parameters of data acquisition system 4. To develop model for signal processing concepts 5. To develop model for real time applications
Course Outcome	Upon completion of this course, the students will be able to 1. Appreciate Virtual Instrumentation Concepts 2. Build graphical programming for measurements 3. Select data acquisition systems and parameters 4. Apply LabVIEW programming in signal processing 5. Interpret the concepts of programming to 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
CO-1	3	3	3	2	3	3	-	-	2	-	2	2	3	1
CO-2	3	3	3	2	3	3	-	-	2	-	2	2	1	2
CO-3	3	3	3	2	3	3	-	-	2	-	2	2	1	3
CO-4	3	3	3	2	3	3	-	-	2	-	2	2	3	1
CO-5	3	3	3	2	3	3	-	-	2	-	2	2	3	1

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

MODULE 1 : INTRODUCTION	**(9L)**
History of instrumentation, Comparison of traditional instrumentation with virtual instrumentation, Architecture of virtual instrumentation, Hardware and software in virtual instrumentation. **Lab:** Virtual instrumentation demonstration.	**CO-1** **BTL-3**
MODULE 2 : BASIC FUNCTIONS	**(9L)**
LabVIEW – Controls and Indicators, 'G' programming, Data types, Graphical Programming palettes and tools, Function and Libraries, FOR Loops, WHILE loops, Shift Registers, CASE structure, Formula nodes, Arrays and Clusters, Graphs and charts, File I/O. **Lab:** Graphical programming using LabVIEW	**CO-2** **BTL-3**
MODULE 3 : DATA ACQUISITION SYSTEMS	**(9L)**

Basics of DAQ Hardware and Software, Concepts of Data Acquisition, Installing Hardware, Installing drivers, Hardware - Configuring &addressing, Digital and Analog I/O function, Buffered I/O, Real time Data Acquisition. **Lab:** Data Acquisition demonstration.	**CO-3** **BTL-3**
MODULE 4: SIGNAL PROCESSING	**(9L)**
Signal generation – Normalised frequency, Wave & pattern VI's. Signal Processing – DFT, FFT, Frequency Spacing, Power Spectrum. Measurement - The Measurement VI's, Calculating the frequency spectrum of the signal. **Lab:** Signal analysis of an analog sensor input using DAQ.	**CO-4** **BTL-3**
MODULE 5: ADVANCED CONCEPTS & APPLICATIONS	**(9L)**
LabVIEW communication terminologies, Automotive applications, Industrial applications. **Lab:** Case studies using real time implementation in industries.	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Jovitha Jerome, (2010), "Virtual Instruments using LabVIEW", *PHI Learning Private Ltd*, pp.1-416.
2.	Garry M. Johnson,(2006), "LabVIEW Graphical Programming", *Tata McGraw-Hill*, First Edition, pp. 1-752
REFERENCE BOOKS	
1.	Lisa.K.Wills, (1996), "LabVIEW for Everyone, *Prentice Hall of India.*
2.	Barry Paton, (2000), "Sensor, Transducers and Lab VIEW", *Prentice Hall of India.*
3.	LabVIEW Basics I and II Manual, National Instruments, 2003.
MOOC	
1.	https://www.udemy.com/share/101tBq/
2.	https://www.udemy.com/share/101CtU/

COURSE TITLE	**OBJECT ORIENTED PROGRAMMING USING C++**			**CREDITS**	**3**
COURSE CODE	**ECC4271**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**32nd ACM, 07.08.2021**	**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	Object-oriented programming languages are playing an increasingly important role in computing science and its applications. With the declining hardware costs, the cost of computing systems is now being largely dominated by software. Among the tools that allow a programmer to express ideas are, of course, the programming languages. One such programming language used popularly these days is the C++ language. The basic concepts are programming paradigms, the need for OOP technology, extending C, C++ at a glance, fundamental constructs of the C++ language, classes and objects, inheritance, polymorphism, generic programming. This course introduces these concepts in detail.
Course Objective	The objectives of this course are 1. Understand C++ programming and its applications. 2. Learn Object-Oriented programming concepts using classes and objects. 3. Study friend functions, constructors, and overloading mechanisms. 4. Understand about re-usable code using Inheritance and Runtime Polymorphism. 5. Learn about exception handling, streaming and file handling mechanisms.
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 and Objects. 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: 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
CO-1	2	2	-	1	-	-	-	-	-	-	-	1	1	1
CO-2	2	2	1	1	-	-	-	-	-	-	-	1	1	1
CO-3	2	2	1	1	-	-	-	-	-	-	-	1	1	1
CO-4	2	2	1	1	-	-	-	-	-	-	-	1	1	1
CO-5	2	-	-	1		1	-	-	-	-	-	1	1	1

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

MODULE 1: BEGINNING WITH C++ AND ITS FEATURES (7L+2T)

Introduction to C++ and its features. What is C++? Applications and structure of C++ programming language, Variables, Different Data types, expressions, Operators, operator overloading and control structures in C++. **Suggested reading** Control flow, break and switch statements.	**CO-1** **BTL-2**

MODULE 2: FUNCTIONS, CLASSES AND OBJECTS	(7L+2T)
Abstraction mechanism: Classes, private, public, constructors, destructors, member data, member functions, inline function, friend functions, static members, and references. **Suggested reading** Object initialization and clean up	**CO-2** **BTL-3**
MODULE 3: INHERITANCE	**(7L+2T)**
Inheritance: Class hierarchy, derived classes, single inheritance, multiple, multilevel, hybrid inheritance, role of virtual base class, constructor and destructor execution, base initialization using derived class constructors. **Suggested reading** Virtual functions.	**CO-3** **BTL-3**
MODULE 4: POLYMORPHISM	**(7L+2T)**
Polymorphism: Binding, Static binding, Dynamic binding, Static polymorphism: Function Overloading, Ambiguity in function overloading, Dynamic polymorphism: Base class pointer, object slicing, late binding, method overriding with virtual functions, pure virtual functions, abstract classes. **Suggested reading** Runtime polymorphism and virtual functions	**CO-4** **BTL-3**
MODULE 5: FILES AND EXCEPTION HANDLING	**(7L+2T)**
Introduction, basic concepts, and principles of Streams and Working with files. C++ streams and classes formatted and un-formatted Input Output operations, Output with manipulators, Classes for file stream operations, file operations such as opening and closing a file, End of File. **Suggested reading** Ten Rules for Handling Exceptions Successfully	**CO-5** **BTL-3**

TEXT BOOKS	
1.	K.R.Venugopal, RajkumarBuyya , (2017) “Mastering C++”, 2nd Edition, McGraw Hill Education, pp.1-720
2.	Herbert Schildt, (2017) “C++: The Complete Reference”, 4th Edition, McGraw Hill Education, pp. 1-832
REFERENCE BOOKS	
1.	Bjarne Stroustrup, (2013) , “The C++ Programming Language”, 4th Edition, Addison-Wesley Professional, pp.1-969
2.	Nell Dale, Chips Weems, (2009), “Programming and Problem Solving with C++”, Jones and Bartlett Learning, 5th Edition, pp. 1- 432
3.	Nicolai M. Josuttis, (2012) “The C++ Standard Library: A Tutorial and Reference”, 2nd Edition, Addison Wesley, pp.1-910
E BOOKS	
1.	http://fac.ksu.edu.sa/sites/default/files/ObjectOrientedProgramminginC4thEdition.pdf
MOOC	

1.	https://www.edx.org/course/introduction-c-microsoft-dev210x-5
2.	https://www.coursera.org/learn/c-plus-plus-a#syllabus

COURSE TITLE	DIGITAL DESIGN USING BASYS3 AND NEXSYS4 DDR FPGA BOARD			CREDITS	3
COURSE CODE	ECC4272	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	32nd ACM, 07.08.2021	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 enables the student to get familiarize with architecture, key features and benefits of Basys-3, Nexsys-4 DDR, Genesys-2 and Kintex-7 FPGA boards. The students can design and implement the circuits ranging from basic combinational, sequential and complex digital circuits. The concept of FSM techniques to design sequential circuit is also introduced in this course.
Course Objective	1. To provide overview and programming of Basys-3 FPGA board 2. To familiarize the architecture and programming of Nexsys-4 DDR FPGA board 3. To provide overview and programming of Genesys-2 Kintex-7 FPGA board 4. To develop skills to design and implement sequential circuit using Basys-3 and Nexsys-4 DDR board 5. To analyze the FSM techniques for designing sequential circuits
Course Outcome	Upon completion of this course, the students will be able to 1. Design and implement combinational circuit using Basys-3 board. 2. Develop and implement combinational circuit using Nexsys-2 DDR board. 3. Design and implement combinational circuit using Genesys-2 Kintex-7 board. 4. Design and implement sequential circuit using Genesys-2 Kintex-7 board. 5. Examine sequential circuit using ASM technique

Prerequisites: ECB4116 – Digital System Design

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
CO-1	1	2	1	3	2	-	-	-	1	-	-	2	1	2
CO-2	1	2	1	3	2	-	-	-	1	-	-	2	1	2

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

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

MODULE 1: Basys-3 FPGA Board	**(9L)**
Architecture and features of Basys board, Basys board components and pin routing, Configuration files, Vivado 2015.2 design flow, Synthesis and Basys3 Programming, Synthesis and implementation of combinational. **Practical component:** Testing of Basys-3 board, Implementation of basic Combinational circuits **Suggested Readings:** Basys 3 reference manual	**CO-1** **BTL-4**
MODULE 2: Nexsys-4 DDR board	**(9L)**
Architecture and features of Nexsys-4 DDR board, Nexsys board components and pin routing, Configuration files, Nexsys-4 Programming, Synthesis and implementation of combinational logic. **Practical component:** Testing of Nexsys-4 DDR board, Implementation of basic Combinational circuits **Suggested Readings:** Nexsys-4 DDR board reference manual	**CO** **-2** **BTL-4**
MODULE 3: Genesys-2 Kintex-7 FPGA Development Board	**(9L)**
Architecture and features of Genesys-2 Kintex board, Kintex board components and pin routing, Configuration files, Nexsys-4 Programming, Synthesis and implementation of combinational logic. **Practical component:** Testing of Genesys-2 board, Implementation of basic Combinational circuits **Suggested Readings:** Genesys-2 board reference manual	**CO-3** **BTL-4**
MODULE 4: Sequential Logic design using Basys-3 and Nexsys-4 Board	**(9L)**
Modeling latches and flip flops, Modeling registers and counters, Behavioral modeling and timing constraints, Architectural wizard and IP catalog, Counters, timers and Real time clock. **Practical component:** Implementation of basic sequential circuits using Basys-3 and Nexsys-4 DDR board **Suggested Readings:** Digital System Design With FPGA: Implementation Using Verilog And VHDL	**CO-4** **BTL-2**
MODULE 5: Sequential System design using ASM charts	**(9L)**
Finite state machines, sequential system design using ASM charts, case study using ASM. **Practical component:** Design and Simulation of 4-bit up/down counter using Vivado 2015.3	**CO-5** **BTL-4**

Suggested Readings: Mealy and Moore Machine	
TEXT BOOKS	
1.	Advanced Digital Design with the Verilog HDL, Michael D. Ciletti, Prentice Hall India, 2005
REFERENCE BOOKS	
1	Verilog Digital System Design, Z. Navabi,McGraw Hill Education 2nd Ed. 2008
2	Verilog HDL: A Guide to Digital Design and Synthesis,S. Palnitkar,"Prentice Hall NJ, USA),1996
E BOOKS	
1.	https://www.xilinx.com/support/university/vivado/vivado-teaching-material/hdl-design.html
2.	https://reference.digilentinc.com/_media/basys3:basys3_rm.pdf
MOOC	
1	https://nptel.ac.in/courses/106/105/106105165/
2	https://nptel.ac.in/courses/117/106/117106092/

SEMESTER V

COURSE TITLE	**VIRTUAL AND AUGMENTED REALITY**			**CREDITS**	**3**
COURSE CODE	**ECC4351**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05. 2018**	**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 makes the students know the concepts and framework of virtual reality. The course will cover VR and AR hardware and different modeling techniques. This course provides students with an opportunity to explore the applications and issues in Virtual Reality and Augmented Reality (VR &AR).				

Course Objective	1. To learn the basics of VR and its components 2. To explore the various input output devices available with its advantages and limitations 3. To study about the different modelling techniques available for VR design 4. To learn about human factors research in VR 5. To explore other similar technologies like Augmented reality and Mixed reality with its applications.
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the basics of VR and the components that are the building blocks of VR system 2. Demonstrate the operating principles of various input output devices and summarize its advantages and limitations 3. Explore different modelling techniques available for VR design with their limitations and advantage 4. Examine the different areas of human factors research in VR and to evaluate the benefits and drawbacks of specific VR techniques on the human body 5. Classify the characteristics and components of other similar technologies like Augmented reality and Mixed reality in the area of market potential and applications

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

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

MODULE 1: INTRODUCTION	**(9L)**
The three I's of virtual reality, commercial VR technology and the five classic components of a VR system **Suggested Readings:** Evolution of Virtual Reality	**CO-1** **BTL-2**
MODULE 2: Input Devices and Output Devices	**(9L)**
Trackers, Navigation, and Gesture Interfaces: Three-dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces, Output Devices: Graphics displays, sound displays & haptic **Suggested Readings:** Advances in Tracking devices and Display devices	**CO-2** **BTL-3**
MODULE 3: Modeling	**(9L)**

Geometric modeling, kinematics modeling, physical modeling, behavior modeling, model management **Suggested Readings:** Best practices in Modeling	**CO-3** **BTL-4**
MODULE 4: Human Factors	**(9L)**
Methodology and terminology, user performance studies, VR health and safety issues, Applications: Medical applications, military applications, robotics applications. **Suggested Readings:** VR effect in human – Case study	**CO-4** **BTL-4**
MODULE 5: Introduction to Mixed and Augmented Reality	**(9L)**
Key concepts and techniques at work in Mixed and Augmented Reality. business aspects of augmented reality: AR market, the potential applications and the value chain. characteristics of AR systems, components of an AR architecture. **Suggested Readings:** Latest applications in AR and MR	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Virtual Reality Technology, Second Edition, Gregory C. Burdea & Philippe Coiffet, John Wiley & Sons, Inc., 2003.
2.	Virtual Reality Systems, John Vince, Pearson Education, 1995
3.	Understanding Virtual Reality, interface, Application and Design, William R.Sherman, Alan Craig, Elsevier (Morgan Kaufmann), 2018.
REFERENCE BOOKS	
1.	3D Modeling and surfacing, Bill Fleming, Elsevier (Morgan Kauffman), 1999
2.	3D Game Engine Design, David H.Eberly, Elsevier, 2006.
3.	Killer Game Programming in Java, Andrew Davison, Oreilly-SPD, 2005
E BOOKS	
1.	https://www.queppelin.com/ebooks
2.	https://www.springer.com/gp/book/9789400769090
3.	http://vr.cs.uiuc.edu/vrbook.pdf
MOOC	
1.	https://www.coursera.org/learn/introduction-virtual-reality
2.	https://www.coursera.org/learn/360-vr-video-production
3.	https://www.coursera.org/learn/ar

COURSE TITLE	**EMBEDDED AUTOMOTIVE SYSTEMS**			**CREDITS**	**3**
COURSE CODE	**ECC4352**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**

Version	1.0	Approval Details	24th ACM, 30.05.2018	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 main objective of this course is to provide an understanding of the technology essential to the design and implementation of an embedded system using suitable hardware and software tools for automotive application. The auto industry needs electrical, Electronics and computer engineers in ever-increasing numbers to deal with the number of electronics in the modern car. These engineers deal with electronics, controls, safety systems, infotainment systems, and vehicle-to-vehicle communication. This course endeavors a variety of topics of instant connection to industry and makes the members precisely proper for Automotive Industry.				
Course Objective	1. To introduce the potential of automotive systems in industries 2. To understand Automotive Sensory Systems 3. To explain the importance of Automotive control in system design 4. To make student aware of different Automotive protocols for internal communication 5. To introduce the state-of-art technologies and systems available with the Industry				
Course Outcome	Upon completion of this course, the students will be able to 1. Explain about the trends in automobiles, electromagnetic principle, security and warning systems. 2. Discuss the fundamentals of various mechanical systems along with Sensors, Controller and Actuators. 3. Appreciate Electronic ignition systems principles, types and operation. 4. Elaborate recent advances in embedded automotive systems and multiprocessor communication. 5. Explain the real time development of embedded automotive systems				
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
CO-1	3	2	2	2	2	1	1	1	-	-	-	1	2	-
CO-2	3	2	2	2	2	1	1	-	-	-	-	1	2	1
CO-3	3	2	2	2	2	1	1	1	-	-	-	1	1	1
CO-4	2	2	1	2	1	1	1	1	-	-	-	1	1	-

CO-5	2	2	1	2	1	1	1	1	-	-	-	1	1	-

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

MODULE 1: INTRODUCTION TO AUTOMOBILES	**(9L)**
Current trends in Automobiles, open loop and closed loop systems - components for electronic engine management system. Electromagnetic interference suppression. Electromagnetic Compatibility, Electronic dashboard instruments- predictive maintenance, onboard diagnostic system, security and warming system.	**CO-1 BTL-2**
MODULE 2: ELECTRO CHASSIS SYSTEMS	**(9L)**
Electronic management of chassis systems; Vehicle motion control, Sensors and actuators and their interfacing. Basic sensor arrangement, types of sensors such as- oxygen sensors, crank angle position sensors- Fuel metering/ vehicle speed sensors and destination sensors, Flow sensor, exhaust temperature, air mass flow sensors, throttle position sensor, MEMS – Gyroscope Sensor, solenoids, stepper motors and relays.	**CO-2 BTL-3**
MODULE 3: ELECTRONIC IGNITION SYSTEMS	**(9L)**
Electronic ignition systems; Types of solid state ignition systems and their principle of operation; Digital engine control system, Open loop and closed loop control system, Engine Cranking and warm up control, Acceleration enrichment, Deceleration learning and ideal speed Control, Distributor less ignition – Integrated engine control system, Exhaust emission control Engineering	**CO-3 BTL-3**
MODULE 4: EMBEDDED AUTOMOTIVE SYSTEMS	**(9L)**
Atmel Family (Raspberry –pi) Microcontroller, Recent advances- GLS, GPS, IoT and GSM; Multiprocessor communication using CAN bus,I2C.	**CO-4 BTL-3**
MODULE 5: REAL TIME STUDY OF AUTOMOTIVE SYSTEMS	**(9L)**
Case study- Adaptive cruise control of car, Embedded Airbag System, Embedded Based Automatic Parking System, Embedded Rain-Sensing System, Artificial Intelligence and engine management.	**CO-5 BTL-2**

TEXT BOOKS

1	William B. Riddens, “Understanding Automotive Electronics”, 5th Edition, Butterworth Hennimann Woburn, 1998.
2	Young A.P. & Griffiths, “Automotive Electrical Equipment”, ELBS & New Press-1999.
3	Tom Weather Jr. & Cland c. Ilunter, “Automotive computers and control system” Prentice Hall Inc., New Jersey.
4	Neil kolban” Kolban’s book on Raspberry –pi “1st edition Aug 2016
5	Crouse W.H., “Automobile Electrical Equipment”, Mc Graw Hill Co. Inc., New York, 1995.

REFERENCE BOOKS

1	Bechhold, “Understanding Automotive Electronic”, SAE, 1998.
2	Robert Bosch,” Automotive Hand Book”, SAE (5th Edition), 2000.
3	Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, Second Edition-2009.

E BOOKS	
1	https://www.edgefx.in/importance-of-embedded-systems-in-automobiles-with-applications/
2	energietest.deatleetfabriek.nl/micro_electromechanical_system_mems_sensor.pdf
3	engineersevanigam.blogspot.com/.../embedded-systems-by-raj-kamal-ebook-pdf.html
MOOC	
1	http://nptel.ac.in/courses/112108092/module5/lec39.pdf
2	https://www.youtube.com/watch?v=6CLANV6M2CM
3	nptel.ac.in/courses/117105082/
4	nptel.ac.in/courses/112103174/3

COURSE TITLE	**ADVANCED MICROPROCESSORS**			**CREDITS**	**3**
COURSE CODE	**ECC4353**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 have the familiarization and to write applications in higher level Embedded Processor ARM Cortex M3				
Course Objective	1. To be Familiar with CISC, RISC and ARM Design Philosophy 2. To Understand architecture of ARM cortex M3 processor 3. To Understand instruction set of ARM processor 4. To Write C programs for ARM microprocessor and Interface input/output devices like UART,I^2C and LCD 5. To Understand Advanced Microprocessor Bus Architecture, Exception handling and optimization techniques				
Course Outcome	Upon completion of this course, the students will be able to 1. Explain CISC, RISC and ARM Design Philosophy 2. Describe the architecture of ARM cortex M3 processor 3. Apply the instruction set of ARM processor 4. Write C programs for ARM microprocessor and Interface input/output devices like UART,I^2C and LCD 5. Explain Advanced Microprocessor Bus Architecture, Exception handling and optimization 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**
CO-1	3	3	3	3	3	3	-	-	2	-	2	-	3	1
CO-2	3	3	3	3	3	3	-	-	2	-	2	-	3	1
CO-3	3	3	3	3	3	3	-	-	2	-	2	-	3	1
CO-4	3	3	3	3	3	3	-	-	2	-	2	-	3	1
CO-5	-	-	3	-	-	-	-	-	2	-	2	-	3	1
1: Weakly related, 2: Moderately related and 3: Strongly related														

MODULE 1: RISC PHILOSOPHY	**(9L)**
Advanced microprocessors-CISC- RISC- Design philosophy- ARM processor- History- Design Philosophy **Suggested Reading**:-CISC, RISC and ARM Design Philosophy	**CO-1** **BTL-2**
MODULE 2: ARM ARCHITECTURE	**(9L)**
Acorn RISC Machine- Core data flow model-ARM cortex M3 Architecture- programmer's model: General Purpose Registers –Link Registers-Special Registers-Operation Mode – Memory Map-Development tools **Suggested Reading**:- ARM cortex M3 Architecture, programmer's model and development tools	**CO-2** **BTL-2**
MODULE 3: ARM INSTRUCTION SET	**(9L)**
Data Processing Instructions-Arithmetic and Logical Instructions-Shift Instructions –Flow Control Instructions –Branch Instructions-Data Transfer Instructions – Load and Store Instructions – Software Interrupt Instructions – Program Status Register Instructions – Conditional execution- Stack Instructions- Thumb Instruction set – Advantages **Suggested Reading**:- ARM Instruction Set, Thumb instruction set	**CO-3** **BTL-3**
MODULE 4: C PROGRAMMING	**(9L)**
C compiler-data types-functions-pointers-looping structures-register allocations-portability issues **-** programming-ARM interfacing-UART- I^2C-LCD **Suggested Reading**: - C compiler, Programming and interfacing	**CO-4** **BTL-4**
MODULE 5: BUS ARCHITECTURE	**(9L)**
Advanced microprocessor bus architecture (AMBA)-bus system-user peripherals-exception handling- optimization techniques **Suggested Reading**: - Bus Architecture, exception handling and optimization techniques	**CO-5** **BTL-3**
TEXT BOOKS	

1.	Arm System Developer's Guide, Designing and Optimizing Software, Andrew N. Sloss, Dominic Symes, Chris Wright, Elsevier, First edition, March, 2004.
2	Arm System-on-chip Architecture, 2nd Edition, Steve Furber, Pearson publication, March, 2000
3	Arm Assembly Language, Fundamentals and Techniques, 2nd edition, William Hohl, Christopher Hinds, CRC Press, 2015.
REFERENCE BOOKS	
1.	ARM Assembly Language Programming & Architecture by Muhammad Ali Mazidi,2nd Edition, August, 2013.
2.	Embedded Systems: An integrated approach by. Lyla Das, Pearson publication, 2013.
3.	The Definitive Guide to the ARM® Cortex-M3 by Joseph Yiu,Elsevier, Second Edition, 2010.
E BOOKS	
1.	https://developer.arm.com/support/arm-books
2.	https://developer.mbed.org
3.	http://www.freescale.com/tools/software-and-tools/hardware-development-tools/freedom-development-boards:FREDEVPLA
MOOC	
1.	http://nptel.ac.in/syllabus/117106111/
2.	https://www.udemy.com/course/embedded-system-programming-on-arm-cortex-m3m4

COURSE TITLE	**PATTERN RECOGNITION**			**CREDITS**	**3**
COURSE CODE	**ECC4354**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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	Pattern Recognition is an established but exciting and fast emerging field, which supports advances in similar fields such as computer vision, image processing, text and document analysis and neural networks. It is a very active research area and finds applications in fast developing areas such as biometrics, bioinformatics, multimedia data analysis and most recently data science. This module is important because it is a				

	need that appears in many practical problems. It forms the basis of learning and action for all living things in nature. It is used to extract meaningful information, associate it with the objects or concepts and use the concepts for responses leading to positive results.
Course Objective	1. To understand the concepts of pattern recognition 2. To know the fundamentals of statistical pattern recognition 3. To comprehend the graphical approaches in pattern recognition 4. To explain the neural network based pattern recognition 5. To elaborate various applications based on pattern recognition algorithms
Course Outcome	Upon completion of this course, the students will be able to 1. Outline the concepts and approaches of pattern recognition System. 2. Illustrate the techniques and learning methods in Statistical Pattern recognition 3. Summarize the parsing and graphical approaches in Syntactic pattern recognition 4. Identify the various methods in neural network based pattern recognition 5. Apply pattern recognition algorithms in various applications and case studies

Prerequisites: Basic Mathematics - Probability

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

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

MODULE 1 – PATTERN RECOGNITION OVERVIEW AND BAYESIAN DECISION THEORY (9L)

Pattern recognition, Classification and Description- Patterns and feature Extraction-Training and Learning in PR systems – Bayesian decision theory – continuous and discrete features – minimum error rate – classifiers, discriminant functions for normal densities – Error probability – Error bounds – Bayesian belief networks - Pattern recognition approaches - Statistical, Syntactic, Neural pattern recognition – other approaches to PR **Suggested Readings:** Normal distribution, calculation of mean and variance	**CO-1** **BTL-2**

MODULE 2: STATISTICAL PATTERN RECOGNITION (9L)

Introduction to statistical Pattern Recognition - supervised Learning using Parametric and Non Parametric Approaches. Linear Discriminant Functions Introduction—Discrete and binary Classification problems—Techniques to directly Obtain Linear Classifiers **Suggested Readings:** Parametric and Nonparametric approaches	**CO-2** **BTL-3**
MODULE 3: SYNTACTIC PATTERN RECOGNITION	**(9L)**
Overview of Syntactic Pattern Recognition— Syntactic recognition via parsing and other Grammars–Graphical Approaches to syntactic pattern recognition—learning via grammatical Inference. **Suggested Readings:** Syntactic structures	**CO-3** **BTL-3**
MODULE 4: NEURAL PATTERN RECOGNITION	**(9L)**
Introduction to Neural networks—Feedforward Networks and training by Back Propagation—Content Addressable Memory Approaches and Unsupervised Learning in Neural PR. **Suggested Readings:** Basics on Neural networks	**CO-4** **BTL-3**
MODULE 5: APPLICATIONS AND CASE STUDIES	**(9L)**
Web Applications – Audio and Video Analysis – Medical Applications – Image processing – Financial Applications - Related case studies **Suggested Readings:** Machine Learning	**CO-5** **BTL-3**
TEXT BOOKS	
1.	Robert Schalkoff, “Pattern Recognition: statistical, structural and neural approaches”, JohnWiley &sons , Inc, 2007.
REFERENCE BOOKS	
1	Chen C H, “Handbook of pattern recognition and computer vision”, 4 th edition world scientific co, Pvt. Ltd., 2010
2	Christoper M Bishop, “Neural Network for pattern recognition”, Oxford university press, 2008
3	R.O. Duda, P.E. Hart & D.G Stork, “Pattern Classification 2 nd Edition”, J.Wiley Inc, 2001.
4	Geoff Dougherty, “Pattern Recognition and classification: An introduction”, Springer 2013
E BOOKS	
1.	https://1lib.in/book/604623/6edecd
MOOC	
1	https://nptel.ac.in/courses/117/105/117105101/
2	https://nptel.ac.in/courses/117/105/117105084/
3	https://nptel.ac.in/courses/117/108/117108048/

COURSE TITLE	SYSTEM DESIGN USING RASPBERRY PI PROCESSOR			CREDITS	3
COURSE CODE	ECC4355	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	32nd ACM, 07.08.2021	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 focus on project development skills including basic principles, the analysis and development of codes for desired application. Learners will set up the Raspberry Pi environment with Linux operating system running. Learners will develop and execute some basic Python code on the Raspberry Pi hardware device
Course Objective	1. To install the appropriate OS for the hardware device 2. To connect the device with the display terminal and other external interfaces 3. To be familiar in Linux based IDE environment 4. To develop the code for different applications using Python and C 5. To connect the electronic control circuits using GPIO pins
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate different booting of Raspberry Pi processor with the required OS 2. Perform the configuration settings as specified along-with overclocking 3. demonstrating skill 4. Navigate and control of file resources inside the processor 5. Create a project using GPIO interfacing technique 6. Create a project to access the external internet for the said application

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

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

MODULE 1 – RASPBERRY PI BOARD BOOT UP	(9L)
Power supply unit- preparation of boot with SD-card- configuration of Raspberry Pi- networking with host computer- Raspberry pi interface monitor in Linux terminal mode **Suggested reading:** Different type of OS used in Raspberry Pi	**CO-1** **BTL-3**
MODULE 2 – CONFIGURATION	**(9L)**
Raspberry Pi Processor - Raspberry Pi vs. Arduino - Operating System Benefits- Raspberry Pi IoT- Raspberry Pi Setup - Raspberry Pi Configuration -Overclocking **Suggested reading:** Development of over-clocking experiment	**CO-2** **BTL-3**
MODULE 3 – LINUX TERMINAL CODING	**(9L)**
Linux Basics - Login - Linux Filesystem - Navigating the Filesystem - Text Editors- Accessing Files - Permissions - Processes - Linux Graphic User Interface **Suggested reading:** Text editors and their use in programming	**CO-3** **BTL-3**
MODULE 4 – I/O INTERFACES	**(9L)**
General Purpose IO Pins - Protocol Pins -- GPIO Access - General Purpose IO Pins - Pulse Width Modulation - Demo of a Blink - Graphic User Interface - Tkinter Library **Suggested reading:** Other types of Library function required for Project development	**CO-4** **BTL-4**
MODULE 5 – CONEECTING PI THROUGH INTERNET	**(9L)**
Installing server on Pi -Sending email through programming - Simple Camera Accessing over internet **Suggested reading:** Development of projects using Raspberry Pi	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Derek Molloy (2016), "Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux," *Wiley publication*,1st Edition, pp. 1-720
2.	Eben Upton, Gareth Halfacree (2016) "Raspberry Pi User Guide", 4th Edition, *WILEY Publications,* pp. 1-152
REFERENCE BOOKS	
1.	Steve ora,"Raspberry Pi 3: From Noob to Master; Simple Step By Step Guide to Setting up Your Raspberry Pi 3 and Using It for a Wide Variety of Cool Projects, , WILEY Publication, 2nd edition, pp. 1-271
2	Shawn Wallace, Matt Richardson, (2016) "Getting started with Raspberry Pi: Introduction to Fastest-Selling Computer in the World , 3rd edition.
E BOOKS	

1.	https://nostarch.com/RaspberryPiProject
2.	https://projects-raspberry.com/learn-raspberry-pi-programming-with-python-pdf-e-book/
MOOC	
1.	The Raspberry Pi Platform and Python Programming for the Raspberry Pi from Coursera platform
2.	Interfacing with the Raspberry Pi from Coursera platform
3.	Getting Started with Your Raspberry Pi from Future Learn Platform

COURSE TITLE	**IMAGE SIGNAL PROCESSING USING MATLAB**			**CREDITS**	**3**
COURSE CODE	**ECC4356**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**32nd ACM, 07.08.2021**	**LEARNING LEVEL**	**BTL-5**

ASSESSMENT SCHEME

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

Course Description	Demonstrate knowledge and understanding of frequency domain analysis and synthesis. Be able to use basic techniques to process 1-dimensional signals. Be able to implement standard approaches to process 2-dimensional images.
Course Objective	This module describes the theory of signal processing and its applications; Multidimensional signal processing and digital image analysis and processing; Image restoration and reconstruction.
Course Outcome	Upon completion of this course, the students will be able to 1. Familiarize the fundamental concepts of digital Image and signal processing 2. Evaluate the analysis of 2D and 3D signals and images 3. Select the preprocessing techniques for digital Image and Signal Processing 4. Analyze the enhancement techniques for digital Image and Signal Processing 5. Develop small projects in Image and Signal Processing.

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
CO-1	**3**	-	1	2	-	-	-	-	-	-	-	-	-	1
CO-2	**-**	-	-	2	-	2	-	-	-	-	-	-	-	-

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

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

MODULE 1 – Transformation	**(9L)**
Applications of image and signal processing. Notion of pixel, resolution, quantization, photon noise. Geometric transformations, source-to-target and target-to-source mapping, planar homography, rotational homography, change detection and mosaicing.	**CO-1 BTL-2**
MODULE 2 – 2D and 3D Formation	**(9L)**
Pin-hole versus real aperture lens model, lens as a 2D LSI system, blur circle, Doubly block circulant system matrix, pill box and Gaussian blur models, 3D Shape from Focus: Depth of field, focal stack, focus operators, focus measure curve, Gaussian interpolation, 3D recovery, focused image recovery.	**CO-2 BTL-3**
MODULE 3 – Image Signal Pre-processing	**(9L)**
Theory of histogram equalization and modification, Image sequence and single image filtering in Gaussian Noise, Non local means filtering, Impulse noise filtering, Transform domain filtering, 1D Orthogonal transforms, 2D orthogonal transforms from 1D, 2D DFT, 2D DFT for image matching	**CO-3 BTL-4**
MODULE 4 – Enhancement Techniques	**(9L)**
Image denoising using transform domain techniques. Segmentation using thresholding methods (peak-valley, Otsu), Segmentation by k-means clustering.	**CO-4 BTL-4**
MODULE 5 – Application and Case Studies	**(9L)**
Bayesian methods for data analysis in signal and image processing, Audio analytics, Medical Application, Related case studies	**CO-5 BTL-5**

TEXT BOOKS	
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
REFERENCE BOOKS	
1	Eastman, C. M. (Ed.), Design for X Concurrent engineering imperatives, 1996, XI, 489 p. ISBN 978-94-011-3985-4 Springer
2	Haik, Y. And Shahin, M. T., Engineering Design Process, Cengage Learning, ISBN-13: 978-0-495-66816-9
3	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
4	Voland, G., Engineering by Design, ISBN 978-93-325-3505-3, Pearson India

E BOOKS	
1	https://www.kobo.com/us/en/ebook/engineering-design-3
2	https://www.electronicsforu.com/special/cool-stuff-misc/8-free-digital-signal-processing-ebooks
MOOC	
1	https://nptel.ac.in/courses/108/106/108106168/

SEMESTER VI

COURSE TITLE	MOBILE COMMUNICATION			CREDITS	3
COURSE CODE	ECC4366	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	24th ACM, 30.05.2018	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 is to expose the students to the most recent technological developments in Mobile communication systems. The Course considers the concepts of cellular system. Following this, various propagation effects and propagation models used in mobile communication are included in the course. This course deals with various methodologies to improve the received signal quality in mobile communication. The Course provides various multiple access techniques and Standards in Cellular mobile Communication.
Course Objective	1. To familiar with fundamentals of mobile communication systems 2. To choose system (TDMA/FDMA/CDMA) according to the complexity, installation cost, speed of transmission, channel properties etc 3. To identify the requirements of mobile communication as compared to static communication 4. To choose various receiver system and coders for mobile communication
Course Outcome	Upon completion of this course, the students will be able to 1. Examine the basics of mobile communication, cellular concept, Co-channel Interference and frequency Reuse concept 2. Analyze the Mobile radio propagation models and different types of fading 3. Demonstrate various modulation Techniques and Multiple Access Schemes 4. Analyse Equalization Techniques and Receiver types 5. Design coder for mobile communication systems with key technologies
Prerequisites: Basic concepts of Analog and Digital Communication	

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**
CO-1	2	-	-	2	-	1	1	-	-	-	-	2	3	1
CO-2	3	3	2	2	-	2	1	-	-	-	-	2	3	1
CO-3	3	3	2	2	-	2	1	-	-	-	-	2	3	1
CO-4	3	3	2	2	-	2	1	-	-	-	-	2	2	2
CO-5	3	3	3	2	-	2	1	-	-	-	-	2	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related														

MODULE 1 –Introduction to mobile communication and cellular concept	**(9L)**
Overview to wireless communication: Evolution & Generation of mobile communication. Existing mobile communication technology and current Status. Cellular Concept: Frequency reuse, channel assignment, hand off, Interference and system Capacity, tracking and grade of service, Improving Coverage and capacity in Cellular systems **Suggested Readings:** Computational efficiency and cost requirement of circuits using various codes.	**CO-1** **BTL-3**
MODULE 2 – Mobile Radio Propagation	**(9L)**
Free space propagation model, reflection, diffraction, scattering, link budget design, Outdoor Propagation models, Indoor propagation models, Small scale Multipath propagation, Impulse Model, Small scale Multipath measurements, parameters of Mobile multipath channels, types of Small-scale fading, statistical models for multipath fading channels. **Suggested Readings:** Advanced arithmetic (data manipulation) circuit to reduce delay and cost	**CO-2** **BTL-3**
MODULE 3 – Modulation Techniques and Multiple Access schemes	**(9L)**
Modulation schemes: MSK, GMSK, M-ary QAM, M-ary FSK, multi carrier modulation, OFDM, Performance of Digital Modulation in Slow-Flat Fading Channels and Frequency Selective Mobile Channels. Multiple Access Schemes: FDMA, TDMA, CDMA and SDMA **Suggested Readings:** Asynchronous digital circuit design methods and its challenges	**CO-3** **BTL-4**
MODULE 4 –Equalization and Receiver structure	**(9L)**
Survey of equalization Techniques, Linear Equalization, Non-linear Equalization, Algorithms for Adaptive quantization, Diversity Receiver, RAKE receiver **Suggested Readings:** Advanced materials and their characteristics used for memory construction	**CO-4** **BTL-5**
MODULE 5 –Coding Techniques and System Examples	**(9L)**

coding: Vocoders, Linear Predictive Coders, Selection of Speech Coders for Mobile Communication, GSM Codec, RS codes for CDPD, System examples- GSM, EDGE, GPRS, IS95, CDMA 2000 and WCDMA. **Suggested Readings:** VHDL tools like Xilinx	**CO-5** **BTL-4**

TEXT BOOKS	
1.	T.S.Rappaport, "Wireless Communications: Principles and Practice, Second Edition, Pearson Education/ Prentice Hall of India, Second Edition 2013
2.	Jochen Schiller, Mobile Communications, Person Education – 2003, 2nd Edn
REFERENCE BOOKS	
1.	R. Blake, "Wireless Communication Technology", Thomson Delmar, 2003.
2.	W.C.Y.Lee, "Mobile Communications Engineering: Theory and applications, Second Edition, McGraw-Hill International, 1998.
3.	Stephen G. Wilson, "Digital Modulation and Coding", Pearson Education, 1995
E BOOKS	
1	www.freebookcentre.net/mobile.../Lecture-Notes-on-Mobile-Communication. html
2	http://ggn.dronacharya.info/ECEDept/Downloads/QuestionBank/VIIsem/NPTEL_LINKS_MOBILE_COMM.pdf
MOOC	
1	nptel.ac.in/courses/117102062/38
2	https://www.udemy.com/course/5g-4g-lte-3g-2g-cellular-mobile-communications-wireless

COURSE TITLE	**INFORMATION CODING TECHNIQUES**			**CREDITS**	**3**
COURSE CODE	**ECC4367**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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	Information produced in many ways every day such as text, image, video etc. If directly stored as it received makes the security in question mark also it occupies more storage area. This course discusses about the various forms of information and its storage methods.				

Course Objective	1. To learn basics of information and entropy concepts 2. To understand the source coding theorems. 3. To understand the channel coding theorems 4. To learn the error analysis in the coding concepts and decoding concepts
Course Outcome	Upon completion of this course, the students will be able to 1. Differentiate the information transfer channel characteristic for as per the standards. 2. Analyze various channel capacity measurement system 3. Identify the appropriate channel coding scheme as per the application 4. Discriminate the error from the Data at the receiver end using the liner block codes 5. Apply the convolutional decoding algorithms in communication domain.

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

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

MODULE 1 – INFORMATION THEORY	**(9L)**
Introduction, Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences. Mark-off statistical model for information source, Entropy and information rate of mark-off source. **Source Coding**: Encoding of the source output, Shannon's encoding algorithm. Shannon's Fano Coding, Communication Channels, Discrete communication channels, Continuous channels. **Suggested Readings:** Communication systems, information, channels	**CO-1** **BTL-2**
MODULE 2 – FUNDAMENTAL LIMITS ON PERFORMANCE	**(9L)**
Source coding theorem, Huffman coding, discrete memory less Channels, Mutual information, Channel Capacity, Shannon's Hartley law and its implications. **Suggested Readings:** Probability and random process, channel concepts	**CO-2** **BTL-2**
MODULE 3 – CHANNEL CODING	**(9L)**

Channel coding theorem, Differential entropy and mutual information for continuous ensembles**,** Channel capacity Theorem, **Introduction to Error Control Coding:** Introduction, Types of errors, examples, Types of codes Linear Block Codes: Matrix description, Error detection and correction, Standard arrays and table look up for decoding. **Suggested Readings:** Ensembles, differential entropy, error	**CO-3** **BTL-3**
MODULE 4 – CYCLIC CODES	**(9L)**
Algebraic structures of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation. BCH codes. RS codes, Golay codes, shortened cyclic codes, Burst error correcting codes, Burst and Random Error correcting codes. **Suggested Readings:** Binary codes, encoder, error correction and detection	**CO-4** **BTL-4**
MODULE 5 – CONVOLUTIONAL CODES	**(9L)**
Concept and definitions, properties of convolutional codes, encoding of convolution codes, Time domain approach. Transform domain approach, Viterbi algorithm, Trellis Diagram. **Suggested Readings:** Time domain and Transform domain, convolution	**CO-5** **BTL-4**

TEXT BOOKS	
1.	K. Sam Shanmugam, “Digital and analog communication systems”, John Wiley, 1996
2	Simon Haykin, “Digital communication”, John Wiley, 2003.
3	Ranjan Bose, “ITC and Cryptography”, TMH, II Edition, 2007
4	Glover and Grant; “Digital Communications” Pearson Edition, 2nd Edition, 2008
5	Dr. P.S. Satyanarayana, “Concepts of Information theory and Coding”, Dynaram Publication, 2005
REFERENCE BOOKS	
1	S. Haykin, “Communication Systems”, John Wiley & Sons, 2004.
2	Thomas M. Cover & Joy A. Thomas “Elements Of Information Theory”, 2nd Edition,Wiley India Pvt Ltd ., 2006.
3	Richard. B. Wells, “Applied Coding and Information Theory for engineers’’ Pearson education, 2nd edition, 2009.
4	G. A. Jones and J.M. Jones, “Information and coding theory” Springer, 2nd edition, 2002

COURSE TITLE	**WIRELESS ADHOC SENSOR NETWORKS**			**CREDITS**	**3**
COURSE CODE	**ECC4368**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 provides an understanding of wireless adhoc and sensor networks and enables the students to explore the wide range of applications of these networks. The course also provides an insight to the major design considerations such as protocols and resource constrains.
Course Objective	1. To study the network architectures and applications of ad hoc and wireless sensor networks 2. To study the design issues of ad hoc and sensor networks 3. To study the routing protocols for ad hoc and wireless sensor networks 4. To understand the architecture and Data aggregation strategies of MAC Layer Protocols 5. To study the QoS related performance measurements of ad hoc and sensor networks
Course Outcome	Upon completion of this course, the students will be able to 1. Interpret the concepts, network architectures and applications of ad hoc and wireless sensor networks 2. Analyze the protocol design issues of ad hoc and sensor networks 3. Design routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues 4. Summarize the architecture and Data aggregation strategies of MAC Layer Protocols 5. Evaluate the QoS related performance measurements of ad hoc and sensor networks

Prerequisites: 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
CO-1	2	2	1	1	-	-	1	-	-	-	-	2	2	1
CO-2	2	2	1	1	1	-	-	-	-	-	-	2	2	1
CO-3	2	2	1	1	1	-	-	-	-	-	-	2	2	1
CO-4	2	2	1	1	1	-	-	-	-	-	-	2	2	1
CO-5	2	2	1	1	1	-	-	-	-	-	-	2	2	1

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

MODULE 1 – INTRODUCTION (9 L)

Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel -mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs): concepts and architectures. Applications of Ad Hoc and Sensor networks. Design Challenges in Ad hoc and Sensor Networks. Suggested Reading: Basics of Wireless communication	**CO-1** **BTL-3**
MODULE 2 – MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS	**(9L)**
Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols- Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11 Suggested Reading: Wireless communication protocols	**CO-2** **BTL-4**
MODULE 3 –ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESS NETWORKS (9L)	
Issues in designing a routing and Transport Layer protocol for Ad hoc networks- proactive routing, reactive routing (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks. Suggested Reading: Routing protocols	**CO-3** **BTL-4**
MODULE 4 –WIRELESS SENSOR NETWORKS AND MAC PROTOCOLS	**(9L)**
Single node architecture: hardware and software components of a sensor node - WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4. Suggested Reading: Wireless sensor networks	**CO-4** **BTL-3**
MODULE 5 – WSN ROUTING, LOCALIZATION & QOS	**(9L)**
Issues in WSN routing – OLSR- Localization – Indoor and Sensor Network Localization-absolute and relative localization, triangulation-QOS in WSN-Energy Efficient Design-Synchronization-Transport Layer issues. Suggested Reading: WSN routing	**CO-5** **BTL-3**

TEXT BOOKS

1.	C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008.

REFERENCE BOOKS

1	Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc & Sensor Networks: Theory and Applications”, World Scientific Publishing Company, 2006.
2	Feng Zhao and LeonidesGuibas, "Wireless Sensor Networks", Elsevier Publication - 2002.
3	Holger Karl and Andreas Willig “Protocols and Architectures for Wireless Sensor Networks”, Wiley, 2006.
4	Kazem Sohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks-Technology, Protocols, and Applications”, John Wiley, 2007.
5	Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

COURSE TITLE	DIGITAL TELEPHONE SYSTEMS			CREDITS	3
COURSE CODE	ECC4369	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	24th ACM, 30.05.2018	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 subject aims at introducing to the students the knowledge about the telecommunication industry: its services and market, the theoretical basis about performance (queuing theory) and operation (multiplexing, switching, routing, and signaling) in telecom networks.
Course Objective	1. To introduce the concepts of SONET/SDH multiplexing. 2. To introduce the concepts of space switching, time switching and combination switching. 3. To introduce the need for network synchronization and study synchronization issues. 4. To study the outline network control and management issues. 5. To introduce the concept of Traffic Engineering
Course Outcome	Upon completion, students will be able to 1. Explain the working principle of switching systems involved in telecommunication switching 2. Analyze multi stage switching structures involving time and space switching stages 3. Discuss the network synchronization and management 4. Analyze basic telecommunication traffic characteristics 5. Explain the concepts of wireless communications

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

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

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

MODULE 1: DEVELOPMENT OF TELECOMMUNICATION SWITCHING SYSTEMS	**(9L)**
Message switching, Circuit switching, Manual switching, and Electronic Switching. **Digital switching:** Switching functions, space division switching, time division switching, two dimensional switching, digital cross connect systems, digital switching in an analog environment, Next Generation Network-Standards, Concepts, Architecture and Protocol, Residential or small business access technologies – Digital Subscriber Line (DSL)	**CO-1 BTL-2**
MODULE 2: SWITCHING NETWORKS	**(9L)**
Single Stage Networks, Passive Optical Networks (PON), Cable MODEMS, Grading: Principle, Design of progressive grading, other grading, Traffic capacity of grading, Applications of grading. Link Systems: General, Two stage networks, three stage networks, four stage networks. Grades of service of link systems: General, Two stage networks, three stage networks, four stage networks Call packing, SS.7,CDOT[Indigenous] /EWSD/5ESS switch	**CO-2 BTL-2**
MODULE 3: NETWORK SYNCHRONIZATION CONTROL AND MANAGEMENT	**(9L)**
Timing: Timing Recovery: Phase-Locked Loop, Clock Instability, Jitter Measurements, Systematic Jitter. Timing Inaccuracies: Slips, Asynchronous Multiplexing, Network Synchronization, U.S. Network Synchronization, Network Control, Network Management.	**CO-3 BTL-3**
MODULE 4: TRAFFIC ANALYSIS	**(9L)**
Traffic Characterization: Arrival Distributions, Holding Time Distributions, Loss Systems, Network Blocking Probabilities: End-to-End Blocking Probabilities, Overflow Traffic, Delay Systems: Exponential service Times, Constant Service Times, Finite Queues.	**CO-4 BTL-3**
MODULE 5: CELLULAR TELEPHONE CONCEPTS	**(9L)**
Mobile telephone services, cellular telephone, Frequency reuse, Interference, Cellular system topology, Roaming and handoffs, Cellular telephone network components, Cellular telephone call processing. Cellular Telephone systems: Digital cellular telephone, IS–95. GSM GPRS for Mobile communications, Personal Satellite communication system.	**CO-5 BTL-3**
TEXT BOOKS	

1.	Thiagarajan Vishwanathan, “Telecommunication Switching Systems and Networks”; PHI Publications, 2006.
2.	J. E. Flood , “Telecommunications Switching, Traffic and Networks”, Pearson Education, 2001.
3.	John C. Bellamy, “Digital Telephony”, Third Edition; Wiley Publications, 2000.
4.	Wayne Tomasi, “Electronic Communications Systems”; 5th Edition; Pearson Education, 2014.
E BOOKS	
1	https://www.scribd.com/doc/244713446/Telecommunication-Switching-Systems-And-Networks-pdf
2	EC_8th_Sem_Electronic Switching_P_Gnanasivam - Telecommunication Switching and Networks_2nd-Edition-2008.pdf (ccsuniversity.ac.in)
MOOC	
1	nptel.ac.in/courses/106105080/pdf/M4L1.pdf
2	http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Communication%20network/New_index1.html

COURSE TITLE	**SPEECH SIGNAL PROCESSING**			**CREDITS**	**3**
COURSE CODE	**ECC4370**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 module gives a knowledge to the characteristics of speech signal in regarding its production, perception its characteristics and the digital models. The course also enriches the application of signal processing concepts to the speech signal. It also helps the students to analyze the concepts of homomorphic speech processing and linear prediction for speech signals. The last module focuses on the development of speech recognition systems, speech synthesis systems and speech coding techniques.
Course Objective	1. To brief the fundamentals of speech signal production and perception. 2. To apply the signal processing concepts on speech signals. 3. To explain the concepts of speech production and perception using computational models. 4. To predict the filter coefficients using linear prediction.

	5. To develop automatic speech recognition and speech synthesis systems.
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the characteristics and fundamentals of speech signal production and hearing perception. 2. Enumerate the fundamental concepts of digital signal processing for speech signals 3. Illustrate the computational models of Human speech production and perception 4. Analyze the basic concepts of homomorphic speech processing and linear prediction for speech signals 5. Design systems for basic applications like speech recognition, synthesis, speech coding.

Prerequisites: Basics on signal processing techniques

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

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

MODULE 1: INTRODUCTION TO DIGITAL SPEECH PROCESSING	**(9L)**
Fundamentals of Human Speech Production, Acoustic Properties of American English Speech, Fundamentals of Speech Perception, Computational Models of Speech Perception, Time-Domain Methods for Speech Processing **Suggested Readings:** Basics on human speech processing	**CO-1** **BTL-2**
MODULE 2: FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING	**(9L)**
Review of Discrete-Time Signals and Systems, Review of Transform Representation of Signals and Systems (DFT, STFT), Fundamentals of Digital Filters, Review of Sampling Theory. **Suggested Readings:** Signal processing techniques	**CO-2** **BTL-3**
MODULE 3: HUMAN SPEECH PRODUCTION & PERCEPTION	**(9L)**
The Process of Speech Production, Short-Time Fourier Representation of Speech, The Acoustic Theory of Speech Production, Digital model of speech production, Anatomy and Function of the Ear, The Perception of Sound; Masking; Pitch, Measurement of Speech Quality and Intelligibility. - psychoacoustics **Suggested Readings:**	**CO-3** **BTL-2**

Digital modelling of speech signals	
MODULE 4: HOMOMORPHIC SPEECH PROCESSING & LINEAR PREDICTION	**(9L)**
Homomorphic Systems for Convolution, Homomorphic Analysis of the Speech Model, Computing the Short-Time Cepstrum and Complex Cepstrum of Speech, Homomorphic Filtering of Natural Speech, Cepstrum Analysis of All-Pole Models, Linear Predictive Analysis of Speech Signals, Computation of the Gain for the Model. **Suggested Readings:** Cepstrum, Linear prediction of speech signals	**CO-4** **BTL-3**
MODULE 5: SPEECH RECOGNITION & SPEECH SYNTHESIS	**(9L)**
Feature extraction – MFCC, LPCC - Automatic Speech Recognition and Natural Language Understanding, Building a Speech Recognition System. Speech synthesis – Articulatory synthesizer, Concatenative synthesis –USS – Statistical parametric speech synthesis - DNN-based speech synthesis **Suggested Readings:** ASR & synthesis techniques	**CO-5** **BTL-2**

TEXT BOOKS	
1.	Rabiner, L., Juang, Biing-Hwang and Yegnanarayana, B, (2011) 'Fundamentals of Speech Recognition', Pearson, India, pp.1-507.
2.	Rabiner, L. R. and Schafer, R. W., (2011) "Theory and Applications of Digital Speech Processing", Pearson, pp.1-230.
REFERENCE BOOKS	
1	Ben Gold, Nelson Morgan, Dan Ellis, (2011), "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", John Wiley & Sons, pp. 1-652.
2	Thomas F. Quatieri,(2002) "Discrete-time speech signal processing: Principles and practice", Prentice Hall, pp. 1-781.
3	Douglas O'Shaughnessy, (2009), "Speech Communications: Human and Machine", second edition, Universities Press, pp.1-548.
E BOOKS	
1.	http://research.iaun.ac.ir/pd/mahmoodian/pdfs/UploadFile_2643.pdf
MOOC	
1	http://nptel.ac.in/courses/117101055/cdeep%20demo%20ppt/processing.html

COURSE TITLE	**RADAR SYSTEMS**			**CREDITS**	**3**
COURSE CODE	**ECC4371**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 is an introduction to radar. Its objective is to provide an understanding of the basic concepts, operation, and applications of modern radar systems. It is designed to develop the knowledge and techniques necessary to analyze the performance of radar systems so that ultimately, the student can specify the subsystem performance requirements in a radar system design.
Course Objective	1. To understand about the basics of Radar based system and also the characteristics of radar. 2. To analyze the basics of MTI Radar and Pulse Doppler Radar based system and the characteristics of the above radars. 3. To Illustrate the various aspects of noise and its related effects in Radar. 4. To refresh principles of antennas and propagation as related to radars, also study of transmitters and receivers 5. To Describe detection of signals and propagation as related to radars, also study of receiver
Course Outcome	Upon completion of this course, the students will be able to 1. Outline radar fundamentals and analysis of the radar signals. 2. Examine the different types of Radar and Categorize various tracking radars. 3. Distinguish different types of RADARS and applications based on the type of Transmitters and their functions. 4. Recognize and differentiate various detection of noise, display types and receivers. 5. Distinguish various aspects of propagation of Radar waves

Prerequisites: Antennas and wave propagation

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

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

MODULE 1: AN INTRODUCTION TO RADAR & THE RADAR EQUATION (9L)

Basic Radar-The simple form of Radar Equation-Radar Block Diagram-Radar Frequencies Application of Radar-The origins of Radar. Introduction of the Radar Equation – Detection of Signals in Noise – Receiver Noise and the Signal to Noise Ratio- Probability Density Functions-Probabilities of Detection and False Alarm – Integration of Radar Pulses – Radar Cross Section of Targets – Radar Cross Section Fluctuations- Transmitter Power – Pulse Repletion Frequency-Antenna Parameters – System Losses **Suggested Reading:** Other Radar Equation Considerations	**CO-1** **BTL-2**
MODULE 2: MTI and PULSE DOPPLER RADAR & TRACKING RADAR	**(9L)**
Introduction to Doppler & MTI Radar- Delay Line Cancelers- Staggered Pulse Repetition Frequencies Doppler Filter Banks – Digital MTI Processing –Moving Target Detector-Limitations to MTI Performance- MTI from a Moving Platform (AMTI) – Pulse Doppler Radar-Other Doppler Radar Topics. Tracking with Radar-Monopulse Tracking – Conical Scan and Sequential Lobbing- Limitations to Tracking Accuracy- Low-Angle Tracking- Tracking in Range- Other Tracking Radar Topics Comparison of Trackers **Suggested Reading:** Automatic Tracking with Surveillance Radars (ADT)	**CO-2** **BTL-2**
MODULE 3: THE RADAR ANTENNA & RADAR TRANSMITTERS	**(9L)**
Functions of the Radar Antenna – Antenna Parameters – Antenna Radiation Pattern and Aperture Illumination – Reflector Antennas – Electronically Steered Phased Array Antennas – Phase Shifters –Frequency Scan Arrays – Radiators for Phased Arrays – Architectures for Phased Arrays –Mechanically Steered Planar Array Antennas. Introduction to Radar Transmitters – Linear – Beam Power Tubes – Solid State RF Power Sources – Magnetron – Crossed Field Amplifiers **Suggested Reading:** Other RF Power Sources.	**CO-3** **BTL-3**
MODULE 4: RADAR RECEIVERS	**(9L)**
Noise Figure and Noise Temperature. Displays – types. Duplexer – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas- Basic Concepts, Radiation Pattern. Beam Steering and Beam Width changes, Series versus Parallel Feeds. **Suggested Reading:** Applications, Advantages and Limitations.	**CO-4** **BTL-2**
MODULE 5: PROPAGATION AND DETECTION OF RADAR SIGNALS	**(9L)**
Introduction to Propagation of Radar Waves – Forward Scattering from a Flat Earth– Scattering from the Round Earth's Surface – Atmospheric Refraction – Standard Propagation– Nonstandard Propagation – Diffraction. Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, **Suggested Reading:** Efficiency of Non-matched Filters, Matched Filter with Non-white Noise.	**CO-5** **BTL-2**
TEXT BOOKS	

1.	Introduction to Radar Systems, MERILL I SKOLNIK – Tata McGraw Hill – 3rd edition 2001
2.	Introduction to Radar System, K.K. Sharma - S K Kataria & Sons – 2015 Edition - 2012
REFERENCE BOOKS	
1	Radar Hand Book- MERILL I SKOLNIK- Tata McGraw Hill,2001
2	Radar Principals, Technology, Applications – Byron Edde, Pearson Education, 2004.
3	Radar Principles – Peebles, Jr., P.Z.Wiley, NweYork, 1998.
MOOC	
1	Introduction to Radar Systems | MIT OpenCourseWare
2	NPTEL :: Aerospace Engineering - Navigation, Guidance, And Control

COURSE TITLE	**SATELLITE COMMUNICATION**			**CREDITS**	**3**
COURSE CODE	**ECC4372**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 introduces to the basic concept in the field of satellite communication. This will enable the students to know the historical perspective, orbital mechanics and constellations, choice of orbital parameters, propagation considerations, link budgets, interference issues and				

	existing and proposed mobile satellite systems. It also describe the various applications of satellite system.
Course Objective	1. To familiarize with the basic concepts related to satellite Communication and different satellite communication orbits. 2. To provide an in-depth understanding of satellite Sub-Systems operation and launching techniques, satellite link design and earth station technology 3. To design the Earth Station antennas Link budgets & planning. 4. To analyze the various methods of satellite access. 5. To review the state of the art in Satellite System Performance and learn the Digital audio/video broadcasting using satellites understand the applications of satellites.
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the orbital and functional principles of satellite communication systems in relation to other terrestrial systems with the definitions of parameters associated with it. 2. Describe the concepts of Architect and the working of a Satellite communication system and its other subsystems in the Geostationary Orbit and Space Segment. 3. Analyze and evaluate the satellite link and suggest enhancements to improve the link performance of earth segment and space links. 4. Select an appropriate multiple access schemes for the given satellite communication link. 5. Apply knowledge of existing satellite systems and state of the art technology to the design of future systems and describe the various applications of satellite system.

Prerequisites: Basic concepts of Analog and Digital Communication

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

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

MODULE 1 – BASICS OF SATELLITE SYSTEMS AND ORBITS (9L)

Introduction – Frequency Allocations for Satellite Services – Intelsat – U.S. Domsats – Polar Orbiting Satellites – Kepler's Laws –Definitions of Terms for Earth-orbiting Satellites – Orbital Elements – Apogee and Perigee Heights – Orbital Perturbations – Effects of a Nonspherical	**CO-1 BTL-2**

Earth – Atmospheric Drag – Inclined Orbits –Calendars – Universal Time – Julian Dates – Sidereal Time – The Orbital Plane – The Geocentric- Equatorial Coordinate System – Earth Station Referred to the IJK Frame – The Topcentric-Horizon Co-ordinate System – The Sub-satellite Point – Predicting Satellite Position.	
MODULE 2 - GEOSTATIONARY ORBIT AND SPACE SEGMENT	**(9L)**
Antenna Look Angels – The Polar Mount Antenna – Limits of Visibility – Near Geostationary Orbits – Earth Eclipse of Satellite – Sun Transit Outage – Launching Orbits – Problems – Power Supply – Attitude Control – Station Keeping – Thermal Control – TT&C Subsystem – Transponders – Antenna Subsystem – Morelos – Anik-E – Advanced Tiros-N Spacecraft	**CO-2 BTL-2**
MODULE 3 – EARTH SEGMENT & SPACE LINK	**(9L)**
Introduction – Receive-Only Home TV Systems –– Master Antenna TV System – Community Antenna TV System – Transmit-Receive Earth Stations – Problems – Equivalent Isotropic Radiated Power – Transmission Losses –Link Power Budget Equation – System Noise –Carrier-to-Noise Ratio – Uplink – Downlink – Effects of Rain –– Combined Uplink and Downlink C/N Ratio – Intermodulation Noise.	**CO-3 BTL-3**
MODULE 4 – SATELLITE ACCESS	**(9L)**
Single Access – Preassigned FDMA, Demand-Assigned FDMA, SPADE System, TDMA , On-board signal Processing for TDMA / FDMA operation, Satellite switched TDMA, Code-Division Multiple Access –Problems .	**CO-4 BTL-3**
MODULE 5 – DIRECT BROADCAST SATELLITE SERVICES	**(9L)**
Introduction – Orbital Spacing – Power Rating and Number of Transponders – Frequencies and Polarization – Transponder Capacity – Bit Rates for Digital Television – MPEG Compression Standards – Forward Error Correction – Home Receiver Outdoor Unit (ODU) – Home Receiver Indoor Unit (IDU) – Downlink Analysis – Uplink - Satellite Mobile Services – VSATs – Radarsat – Global Positioning Satellite System – Orbcomm.	**CO-5 BTL-4**
TEXT BOOKS	
1.	Dennis Roddy, Satellite Communications, McGraw-Hill Publication Fourth edition 2006
2.	Timothy Pratt – Charles Bostian & Jeremy Allmuti, Satellite Communications, John Willy & Sons (Asia) Pvt. Ltd. 2004
REFERENCE BOOKS	
1	Wilbur L. Pritchars Henri G.Suyder Hond Robert A.Nelson, Satellite Communication Systems Engineering, Pearson Education Ltd., Second edition 2003.
2	Text book companionhttp://www.scilab.in/Completed_Books#2
E BOOKS	
1.	http://www.freebookcentre.net/electronics_communication_books/satellite_communication_systems_ebooks.html
2.	https://www.accessengineeringlibrary.com/browse/rf-and-microwave-power-amplifier-design-second-edition#fullDetails
MOOC	
1	http://nptel.ac.in/syllabus/syllabus_pdf/117105131.pdf/38

2	http://ggn.dronacharya.info/ECEDept/Downloads/QuestionBank/VIIsem/NPTEL_LINKS_SATELLITE_COMM.pdf

COURSE TITLE	**NEURAL NETWORKS AND FUZZY LOGIC**			**CREDITS**	**3**
COURSE CODE	**ECC4373**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 gives a basic introduction to neural networks and fuzzy logic systems. It is a very active research area and finds applications in fast developing areas such as biometrics, bioinformatics, multimedia data analysis, medicine and most recently data science. The course gives an insight about the backpropagation algorithms, associative memories, concepts of fuzzy logic and components of fuzzy logic systems.
Course Objective	1. To understand the concepts of neural networks 2. To know the functioning of the backpropagation networks 3. To comprehend the networks based on associative memories 4. To describe the fundamentals of fuzzy systems 5. To explain the various components of fuzzy systems
Course Outcome	Upon completion of this course, the students will be able to 1. Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines 2. Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems. 3. Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem

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
CO-1	2	2	-	2	-	1	-	-	-	-	-	2	-	2
CO-2	3	2	3	2	-	-	-	-	-	-	-	2	-	2
CO-3	3	2	3	3	-	-	-	-	-	-	-	2	-	2

1: Weakly related, 2: Moderately related and 3: Strongly related	
MODULE 1 – FUNDAMENTALS OF NEURAL NETWORKS	**(9L)**
Basic concepts of neural networks, Human Brain, Model of an artificial neuron, Neural network architectures, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, characteristics of neural networks, learning methods, taxonomy of neural network architectures. Broad application areas in Electronics Engineering **Suggested Readings:** Regression	**CO-1** **BTL-2**
MODULE 2: BACKPROPAGATION NETWORKS	**(9L)**
Architecture of a Backpropagation network, backpropagation Learning, Illustration, Applications, Effect of tuning parameters of the backpropagation neural network, selection of various parameters in BPN **Suggested Readings:** Perceptron Networks	**CO-2** **BTL-3**
MODULE 3: ASSOCIATIVE MEMORIES	**(9L)**
Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network **Suggested Readings:** Self Organizing Maps	**CO-2** **BTL-3**
MODULE 4: CLASSICAL AND FUZZY SETS	**(9L)**
Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions. **Suggested Readings:** Fuzzy Inference Systems	**CO-1** **BTL-3**
MODULE 5: FUZZY LOGIC SYSTEMS COMPONENTS	**(9L)**
Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods **Suggested Readings:** Applications of fuzzy logic	**CO-3** **BTL-3**
TEXT BOOKS	

1.	Ross, Timothy J, (2009) “Fuzzy logic with engineering applications”. John Wiley & Sons, 3 rd edition, pp. 1-585.
2	Yegnanarayana, B (2004), “Artificial neural networks”. PHI Learning Pvt. Ltd., pp.1-476
3.	Haykin, Simon (1994) “Neural networks: a comprehensive foundation”. Prentice Hall PTR, pp.1-823
REFERENCE BOOKS	
1	Zurada, Jacek M. (1992) “Introduction to artificial neural systems”, Jaico Publishing House,pp1-790.
2	Hagan, Martin T., Howard B. Demuth, and Mark H. Beale. (1996) ,”Neural network design”. Boston: Pws Pub..
3	Passino, Kevin M., and Stephen Yurkovich. (1998) “Fuzzy control”. Vol. 42. Menlo Park, CA: Addison-Wesley.
E BOOKS	
1.	https://drive.google.com/file/d/0B2iRDvP8jUuAUnpfaDBnQTBWLUU/edit
MOOC	
1	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ge07/

COURSE TITLE	**PYTHON PROGRAMMING FOR REAL-WORLD TASK**			**CREDITS**	**3**
COURSE CODE	**ECC4374**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**32nd ACM, 07.08.2021**	**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 developing the python programming to do a variety of programming tasks where the students are encouraged to develop application. At the end of the course the student will be developing adequate skills in programming and will be known to understand the implementation of various applications using python.
Course Objective	1. To acquire programming skills in core Python. 2. To acquire Object Oriented Skills in Python. 3. To develop the ability to write database applications in Python 4. To develop the skill of to solve real world task using python

Course Outcome	Upon completion of this course, the students will be able to 1. Identify core aspects of programming and features of the Python language 2. apply core programming concepts like data structures, conditionals, loops, variables, and functions design and analyze the function of specified sequential logic circuits 3. Write fully-functional Python programs using commonly used data structures, custom functions, and reading and writing to files 4. use Python external libraries to create and modify documents, images, and messages 5. use Application Programming Interfaces (APIs) to interact with web 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
CO-1	2	3	2	-	3	1	-	-	-	-	-	1	1	1
CO-2	2	2	2	-	3	1	-	-	-	-	-	1	1	1
CO-3	2	2	2	-	3	1	-	-	-	-	-	1	-	1
CO-4	2	2	2	-	3	1	1	-	-	-	-	1	-	1
CO-5	3	2	2	-	3	1	1	-	-	-	-	1	1	2

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

MODULE 1 – INTROUCTION TO PROGRAMMING AND PYTHON	**(9L)**
programming basics - Client-side vs. server-side programming - Introduction to core programming concepts: Data structures, Conditionals, Variables, Functions, and Loops Python basics - Downloading & installing Python - Basic Data Types - Arithmetic operators – Strings – Casting - IDLE shell - Running a Python script – simple program Exercise : • Simple arithmetic program • Program using if . . .else and multiple if **Suggested Readings:** Simple programming application using python	**CO-1** **BTL-3**
MODULE 2 – LISTS, LOOPS AND FUNCTIONS	**(9L)**
creating a list - Updating a list - Types of Loops - Iterating over a list - Iterating over strings - 'for' loops - loop using break and continue - Nested loops Function - Built-in functions - User-defined functions – Docstrings – function Execution order Exercise : • Find minimum value • Program using strings • Program for average, multiplication tables, Word reversal, comparison operation, Vowel/word counter **Suggested Readings:** Python programming for arithmetic's using loops and fuction	**CO-2** **BTL-3**
MODULE 3 – Lists, Strings, Tuples, Sets, and PyCharm	**(9L)**
About PyCharm - Downloading & installing PyCharm - Running code - More list operations - List functions - Slicing lists - Strings vs. lists - Slicing strings - Split and join - Creating a tuple - Creating a set - Iterating over and updating a set	**CO-3** **BTL-3**

Exercise : • Name Substring • Max and min function • Tuples & Sets **Suggested Readings:** Python programming with strings and PyCharm	
MODULE 4 – Dictionaries and Files	**(9L)**
Creating a dictionary - Updating a dictionary - Opening a file - Basics of file open method modes - Reading a file - Newline characters - Writing to a file - Closing a file Exercise : • Grade/attendance book • Open, read, and write to new file • Open, read, and append to file **Suggested Readings:** Advanced python programming	**CO-4** **BTL-3**
MODULE 5– Real-World Tasks with Python	**(9L)**
Introduction - Built-In Libraries vs. External Libraries- API - How to Make Sense of an API - How to Use PIL for Working With Images Python Email Library - Adding Attachments - Sending the Email Through an SMTP Server - Generating PDFs - Adding Tables to our PDFs - Adding Graphics to our PDFs Exercise : • Real-World Tasks Program **Suggested Readings:** Application programming using python	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Al Sweigart , ”Automate the Boring Stuff with Python”, 2nd Edition: Practical Programming for Total Beginners, pp.1-504 ,2019
2.	Mark Lutz , ”Learning Python: Powerful Object-Oriented Programming”, O’Reilly, fifth edition, pp.1-1648 ,2013
3.	PovelSolin, Martin Novak, “Introduction to Python Programming”, pp.1-197 ,2012
4.	John C. Lusth, “An Introduction to Python”, pp.1-135,2011
REFERENCE BOOKS	
1.	Y. Daniel Liang, “Introduction to Programming using Python”, Pearson, 2012
2.	Jacob Fredslund, Introduction to Python Programming, 2007
E BOOKS	
1	https://users-cs.au.dk/chili/PBI/python_tutorial_jakobfredslund.pdf
MOOC	
1	Introduction to Python Programming -from Coursera platform
2	Crash Course on Python - from Coursera platform

SEMESTER VII

COURSE TITLE	WIRELESS NETWORKS			CREDITS	3
COURSE CODE	ECC4451	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	24th ACM, 30.05.2018	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 will provide the principles of Wireless networking with emphasis on the essential concept delivery of radio frequency (RF) communication, the MAC layer, Mesh Networking as well as distributed algorithms for medium access. Furthermore, exposure to current and emerging Mobile IP for efficient packet delivery and handover were addressed in detail. Added to it, the MANETs which are attributed to their characteristics such as ability for infrastructure-less setup, and self-configured were covered.
Course Objective	1. To enumerate the protocol architecture of Infrastructure GSM network and WLAN in terms of channel access and localization. 2. To compare the various Channel access protocols of GSM and WLAN and select appropriate methods for specified applications. 3. To analyze the Mobile IP network layer and Transport layer for packet delivery and Handover 4. To elucidate data management techniques in mobile computing 5. To enumerate the application of MANET and its routing algorithms
Course Outcome	Upon completion of this course, the students will be able to 1.Develop the concept of protocol architecture in the context of mobile and wireless systems 2. Differentiate the application of medium access control in mobile and wireless systems. 3. Interpret the functionality of the mobile IP in the mobile network and transport layer. 4. Conceptualize the data management of the mobile databases in mobile computing. 5. Interpret the operation of various routing algorithms in MANETs.

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
CO-1	2	2	1	2	-	-	-	-	-	-	-	2	2	-
CO-2	3	3	3	2	-	-	2	2	-	-	2	-	3	-

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

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

MODULE 1: Introduction to Network Technologies and Cellular Communications HIPERLAN	**9L**
Protocol Architecture, Physical Layer, Channel Access Control Sub-layer, MAC Sub-layer, Information Bases and Networking. **WLAN:** Infrared vs Radio Transmission, Infrastructure and Ad Hoc Networks, IEEE 802.11. **GSM**: Mobile Services, System Architecture, Radio Interface, Protocols, Localization and calling, Handover, Security, and New Data Services. **Suggested Readings:** IEEE 802 standards and Protocols	**CO-1** **BTL-2**
MODULE 2: (Wireless) Medium Access Control (MAC)	**9L**
Motivation for a Specialized MAC (Hidden and Exposed Terminals, Near and Far Terminals), SDMA, FDMA, TDMA, CDMA. MAC Protocols for GSM, Wireless LAN (IEEE8O2.11), Collision Avoidance (MACA, MACAW) Protocols. **Suggested Readings:** Advances in Wireless MAC: Principles, Techniques, and Applications	**CO-2** **BTL-3**
MODULE 3: Mobile IP Network Layer	**9L**
lP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route Optimization, DHCP. Mobile Transport Layer: Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks **Suggested Readings:** Best practices of latest version of Mobile IPs	**CO-3** **BTL-3**
MODULE 4: Database Issues	**9L**
Database Hoarding & Caching Techniques, Client—Server Computing & Adaptation, Transactional Models, Query processing, Data Recovery Process & QoS Dissemination and Synchronization. Communications Asymmetry, Classification of Data Delivery Mechanisms, Data Dissemination Broadcast Models, Selective Tuning and Indexing Methods, Digital Audio and Video Broadcasting (DAB & DVB). **Suggested Readings:** Database management in Mobile Computing	**CO-4** **BTL-2**
MODULE 5: Mobile Ad hoc Networks (MANETs)	**9L**
Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc. , Mobile Agents, Service Discovery. **Suggested Readings:** Vehicular Adhoc Networks and Intelligent Systems	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Raj Kamal, “Mobile Computing”, Oxford University Press, 2007, ISBN: 0195686772.
2	Jochen Schiller, “Mobile Communications”, Addison-Wesley, Second Edition, 2004
REFERENCE BOOKS	
1	Stojmenovic and Cacute, “Handbook of Wireless Networks and Mobile Computing”, Wiley, 2002, ISBN 0471419028.
2	Reza Behravanfar, “Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML”, ISBN: 0521817331, Cambridge University Press, Oct 2004.
E BOOKS	
1.	https://uomustansiriyah.edu.iq/media/lectures/6/6_2019_03_05!08_15_51_PM.pdf
2.	https://india.oup.com/product/mobile-computing-9780199455416
3.	http://pws.npru.ac.th/sartthong/data/files/Wireless_Networks_and_Mobile_Computing.pdf
MOOC	
1	https://www.coursera.org/learn/wireless-communications
2	https://onlinecourses.nptel.ac.in/noc19_ee48/preview
3	https://nptel.ac.in/courses/106/105/106105160/

COURSE TITLE	**SOFTWARE DEFINED RADIO**			**CREDITS**	**3**
COURSE CODE	**ECC4452**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-5**
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 provides knowledge to evolution of software defined radio and its different types of architectures. It also covers the transmitter & receiver architectures and base band processing along with reconfigurable antenna requirement. It gives concepts of GNU radio using Python.				
Course Objective	1. To understand about of evolution of SDR concepts & its benefits. 2. To classify the different types of Architectures and partitioning concepts. 3. To identify the front End technology for Software Defined Radio. 4. To know about base band processing and reconfiguring the antenna. 5. To write the Python code for GNU radio.				

Course Outcome	Upon completion of this course, the students will be able 1. Summarize the basic and design principles of SDR 2. Analyze the SDR architecture and its functions 3. Recognize the challenges in the implementation of SDR 4. Analyze the performance of transmitter and receiver architectures in SDR 5. Develop the GNU radio using python

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

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

MODULE 1: INTRODUCTION OF SDR	**(9L)**
Software Radio aspects, The Need for Software Radios, Characteristics and Benefits of a Software Radio, Design Principles of a Software Radio. SDR concepts & history, Benefits of SDR, SDR Forum, Ideal SDR architecture, SDR Based End to- End Communication, Worldwide frequency band plans- Future of Software Defined Radio- Introduction to Cognitive Radio. **Suggested Readings:** Evolution of SDR and its applications	**CO-1** **BTL-4**
MODULE 2: ARCHITECTURE	**(9L)**
Introduction – 2G Radio Architectures Hybrid Radio Architecture- Basic Software Defined Radio Block Diagram- System Level Functioning Partitioning-Digital Frequency Conversion Partitioning., Functional View, Networking Overview-Core Framework- Operating Environment (OE)- SCA architecture, specification structure- General requirements and services, devices and Certification **Suggested Readings:** Block diagram of SDR and its architecture.	**CO-2** **BTL-5**
MODULE 3: FRONT END TECHNOLOGY	**(9L)**
Radio Frequency translation, Transmitter specifications, Architecture, Design considerations- Receiver specifications, Architecture, considerations- Front end Implementation-Data conversions-Zero IF receivers, Preselect Filters. **Suggested Readings:** Transmitter and Receiver sections of communication.	**CO-3** **BTL-5**
MODULE 4: BASEBAND PROCESSING AND RECONFIGURATION	**(9L)**

Base band component technologies, Design tools, Methodologies- Antenna Requirements- Reconfiguration of network elements- user requirement of SDR terminals- Reconfiguration strategies, requirements and management techniques. **Suggested Readings:** Basic of Base Band and reconfiguration technique.	**CO-4** **BTL-5**
MODULE 5: GNU RADIO PLATFORM	**(9L)**
Software Radio platforms: Low Cost SDR Platform- GNU radio- Python introduction, developing GNU Radio, signal processing blocks, scheduler, Basic GR development flow, Universal Software radio peripherals (USRP). **Suggested Readings:** Concepts of GNU radio.	**CO-5** **BTL-5**

TEXT BOOKS	
1.	Bard, Kovarik: Software Defined Radio, The Software Communications Architecture, Wiley 2007, 3rd Edition.
2	Dillinger, Madani, Alonistioti (Eds.): Software Defined Radio, Architectures, Systems and Functions, Wiley 2003
3	Dr. Walter Tuttlebee: Software Defined Radio-Enabling Technologies, Wiley 2002
4	Tafazolli (Ed.): Technologies for the Wireless Future, Wiley 2005
REFERENCE BOOKS	
1	Eugene Grayver, Implementing Software Defined Radio, Springer, 2013.
2	Cory Clark, Software Defined Radio: With GNU Radio and USRP, McGraw-Hill Companies, Incorporated, 29-Nov-2008
E BOOKS	
1.	*https://en.wikipedia.org/wiki/Software-defined_radio*
2.	*http://www.scielo.org.co/pdf/rfing/v24n38/v24n38a07.pdf*
MOOC	
1	https://onlinecourses.nptel.ac.in/noc18_ec01/preview
2	https://onlinecourses.nptel.ac.in/

COURSE TITLE	**HIGH SPEED NETWORKS**			**CREDITS**	**3**
COURSE CODE	**ECC4453**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 provides an introduction to circuit switched and packet switched networks. The learners will be introduced to ATM networks, architecture and its various applications and will get to know about the LAN architecture, requirements and different topologies. The concept of Queue and queuing analysis and the effects of congestion and traffic management are dealt in detail. The learner will get to know the techniques involved to support real time traffic and congestion control in TCP and ATM networks. An insight to different protocols for QoS support, Integrated and differentiated services and the queuing discipline are also discussed.
Course Objective	1. To study the ATM and Frame Relay networks 2. To study the effects of congestion and Traffic management in high speed networks. 3. To study the concepts of congestion control in TCP and ATM networks 4. To understand the concepts of Integrated and differentiated services 5. To study the various protocol for QoS.
Course Outcome	Upon completion of this course, the students will be able to 1. Summarize the concepts of ATM and Frame relay 2. Describe the effects of congestion and Traffic management in high speed networks. 3. Compare the techniques involved to support real-time traffic and congestion control in TCP and ATM networks. 4. Elaborate the Integrated and differentiated services and compare the queuing disciplines. 5. Interpret the different levels of Quality of Service (QoS) in various applications.

Prerequisites: 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
CO-1	2	2	1	2	-	-	-	-	-	-	1	1	2	1
CO-2	2	2	1	2	-	-	-	-	-	-	1	1	2	1
CO-3	2	2	1	2	-	-	-	-	-	-	1	1	2	1
CO-4	2	2	1	2	-	-	-	-	-	-	1	1	2	1
CO-5	2	2	1	2	-	-	-	-	-	-	1	1	2	1

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

MODULE 1 – High Speed Networks (9L)

Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL. High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel – Wireless LANs: applications, requirements – Architecture of 802.11. **Suggested Reading:** IEEE Standards and Specifications.	**CO-1** **BTL-3**
MODULE 2 – Congestion and Traffic Management	**(9L)**
Queuing Analysis- Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks– Frame Relay Congestion Control. **Suggested Reading:** Queuing Theory Applications.	**CO-2** **BTL-3**
MODULE 3 – TCP And ATM Congestion Control	**(9L)**
TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control, RM cell formats, ABR Capacity allocations – GFR traffic management. **Suggested Reading:** Internet Traffic Management.	**CO-3** **BTL-3**
MODULE 4 – Integrated and Differentiated Services	**(9L)**
Integrated Services Architecture – Approach, Components, Services- Queuing Discipline, FQ,PS, BRFQ, GPS, WFQ – Random Early Detection, Differentiated Services **Suggested Reading:** Applications of different architectures.	**CO-4** **BTL-3**
MODULE 5 – Protocols for QoS Support	**(9L)**
RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, Protocol details – RTP – Protocol Architecture, Data Transfer Protocol, RTCP. **Suggested Reading:** Network Routing Protocol.	**CO-5** **BTL-3**
TEXT BOOKS	
1.	William Stallings, "High Speed Networks and Internet", Pearson Education, Second Edition, 2014.
REFERENCE BOOKS	
1	Warland and Pravin Varaiya, "High Performance Communication Networks", Jean Harcourt Asia Pvt. Ltd., II Edition, 2001.
2	IrvanPepelnjk, Jim Guichard and Jeff Apcar, "MPLS and VPN architecture", Cisco Press,Volume 1 and 2, 2003.
MOOC	
1	http://nptel.ac.in/courses/106105082/30
2	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-263j-data-communication-networks-fall-2002/

3	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-976-high-speed-communication-circuits-and-systems-spring-2003/

COURSE TITLE	**REMOTE SENSING**			**CREDITS**	**3**
COURSE CODE	**ECC4454**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 students to the basics of remote sensing, characteristics of remote sensors, Thermal Remote Sensing and remote sensing applications in academic disciplines and professional industries. Emphasis is placed on image acquisition and data collection in the electromagnetic spectrum and data set manipulations. This course also emphasizes the understanding of the remote sensing foundations and the use of remote sensor data for environmental applications .Specifically the course will cover concepts and foundations of remote sensing, visual image interpretation and characteristic of various sensing systems.				
Course Objective	1. To congregate the basic concepts and fundamentals of physical principles of remote sensing. 2. To create a firm basis for successful integration of remote sensing in any field of application. 3. To acquire skills in advance techniques such as Thermal and scanning for mapping, modelling and monitoring. 4. To provide exposure to students in gaining knowledge on concept and applications leading to modelling of earth resources management using Remote Sensing. 5. To enhance students capacity to interpret images and extract information on the earth surface from multi resolution imagery at multi scale level.				

Course Outcome	Upon completion of this course, the students will be able to 1. Describe the concepts, components, methodologies and applications of Remote Sensing Technology. 2. Express optical and microwave remote sensing classification, characteristics and application. 3. Demonstrate thermal remote sensing application. 4. Select and process the appropriate satellite images for specific applications. 5. Integrate the satellite data with GIS for solving societal issues.

PREREQUISITES: BASIC PHYSICS

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

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

MODULE 1:- INTRODUCTION TO REMOTE SENSING	**(9L)**
Definition – Components of Remote Sensing – Energy, Sensor, Interacting Body - Active and Passive Remote Sensing – Platforms – Aerial and Space Platforms – Balloons, Helicopters, Aircraft and Satellites – Synoptivity and Repetivity – Electro Magnetic Radiation (EMR) – EMR spectrum – Visible, InfraRed (IR), Near IR, Middle IR, Thermal IR and Microwave – Black Body Radiation - Planck's law – Stefan-Boltzman law	**CO-1 BTL-2**
MODULE 2:- MICROWAVE AND OPTICAL REMOTE SENSING	**(9L)**
Optical Remote Sensing: Satellites - Classification – Based on Orbits and Purpose – Satellite Sensors - Resolution – Description of Multi Spectral Scanning – Along and Across Track Scanners – Description of Sensors in Landsat, SPOT, IRS series – Current Satellites. **Microwave Remote Sensing**: The RADAR principle-Radar Wavebands-Side Looking Airborne Radar (SLAR) systems-Synthetic Aperture Radar (SAR)-Interaction Between Microwaves and Earth's Surface-Speckle Noise, Backscattered Radar Intensity-Interpreting SAR Images-Geometrical Characteristics-Slope Foreshortening, Layover, Aspect, Radar Shadow	**CO-2 BTL-2**
MODULE 3:- THERMAL REMOTE SENSING	**(9L)**
Introduction-Principles of Thermal Remote Sensing-The physical laws, Black bodies and emissivity, Radiant and kinetic temperatures-Processing Thermal Data-Band Ratios and Transformations, Determining Kinetic Surface temperatures-Thermal Applications-Rock Emissivity Mapping, Thermal hotspot Detection	**CO-3 BTL-3**

MODULE 4:- IMAGE INTERPRETATION	(9L)
Introduction- Image interpretation strategy-Levels of Interpretation Keys-Process of Image Interpretation-Interpretation of Aerial Photo-General procedure for photo interpretation-Preliminary Stage, Detailed Examination, Interpretation Stage, Compilation Stage-Three dimensional interpretation Method-Stereoscopic Depth Perception, Stereo Scope-Basic elements of Image Interpretation-Application of Aerial Photo Interpretation-Interpretation of Satellite Imagery-Key Elements of Visual Image Interpretation-Visual Interpretation of Topographic Features Based on Reflection Characteristics of Images.	**CO-4 BTL-2**
MODULE 5:- GIS AND APPLICATIONS OF REMOTE SENSING	**(9L)**
GIS – Components of GIS – Hardware, Software and Organizational Context – Data – Spatial and Non-Spatial – Maps – Types of Maps – Projection – Types of Projection - Data Input – Digitizer, Scanner – Editing – Raster and Vector data structures – Comparison of Raster and Vector data structure – Analysis using Raster and Vector data – Retrieval, Reclassification, Overlaying, Buffering – Data Output – Printers and Plotters- Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS – Water resources – Urban Analysis – Watershed Management – Resources Information Systems.	**CO-5 BTL-2**

TEXT BOOKS

1	M.G. Srinivas, Remote Sensing Applications, Narosa Publishing House, 2001. (Units 1).
2	Anji Reddy, Remote Sensing and Geographical Information Systems, BS Publications 2001 (Units 2,4 and 5).
3	W.H.Baker, Principles of remote sensing : an introductory textbook, Published by:The International Institute for Geo-Information Science and Earth Observation (ITC),2009.(Unit-3).

REFERENCE BOOKS

1	Jensen, J.R., Remote sensing of the environment, Prentice Hall, 2000.
2	Kang-Tsung Chang,‖ Introduction to Geographic Information Systems‖, TMH, 2002
3	Lillesand T.M. and Kiefer R.W., —Remote Sensing and Image Interpretation‖, John Wiley and Sons, Inc, New York, 1987.
4	Janza.F.J., Blue, H.M., and Johnston, J.E., "Manual of Remote Sensing Vol. I., American Society of Photogrammetry, Virginia, U.S.A, 1975.
5	Burrough P A, —Principle of GIS for land resource assessment‖, Oxford, 2008.
6	Mischael Hord, "Remote Sensing Methods and Applications", John Wiley & Sons, New York, 1986.
7	Singal, "Remote Sening", Tata McGraw-Hill, New Delhi, 1990.
8	Floyd F. Sabins, Remote sensing, —Principles and interpretation‖, W H Freeman and Company 1996.

E BOOKS

1.	https://www.researchgate.net/publication/233793637_Principles_of_remote sensing_an_introductory_textbook
2	https://www.gisresources.com/wp-content/uploads/2013/09/anji-reddy_GIS.pdf

COURSE TITLE	**OPTO ELECTRONICS DEVICES**			**CREDITS**	**3**
COURSE CODE	**ECC4455**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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	Optoelectronics is a field of study and application of physics of light with electricity. It encompasses the study, design and manufacture of hardware device and convert electrical signal into photon signal and vice versa. Course is based on the quantum mechanical effects of light on electronic materials, especially semiconductors, sometimes in the presence of electric fields. This is a relatively new and technologically very advance sector.				
Course Objective	1. To understand the basics of solid-state physics 2. To understand the basics of display devices 3. To understand the optical detection devices. 4. To understand about optical modulators. 5. To understand the design of optoelectronic integrated circuits				
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the wave nature of light and the quantum mechanical treatment of light. 2. Distinguish between Electro Luminescence, photo Luminescence, Cathode Luminescence, and Injection Luminescence and recognize various features of optical laser. 3. Analyze mechanism of operation of photo detector, Thermal Detector, Photo device, Photo Conductors, Photo Diodes by studying their performance characteristics. 4. Categorize Analog and Digital Modulation, Electro-optic modulators and solve problem related to optical Switching and Logic devices. 5. Appraise the development of Optical Integrated Circuit (OIC) and Integrated Transmitter and Receiver.				

Prerequisites: ECB4202 - Electronic Devices 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
CO-1	3	3	3	-	-	-	-	-	-	-	-	2	2	2
CO-2	3	2	3	-	-	-	-	-	-	-	-	2	2	2
CO-3	3	2	3	-	-	-	-	-	-	-	-	2	2	2
CO-4	3	2	3	-	-	-	-	-	-	-	-	2	2	2
CO-5	3	2	3	-	-	-	-	-	-	-	-	2	2	2

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

MODULE 1: ELEMENTS OF LIGHT AND SOLID STATE PHYSICS	**(9L)**
Wave nature of light, Polarization, Interference, Diffraction, Light Source, review of Quantum Mechanical concept, Review of Solid-State Physics, Review of Semiconductor Physics and Semiconductor Junction Device **Suggested Reading:** Pallab Bhattacharya "Semiconductor Opto Electronic Devices", Prentice Hall of India Pvt., Ltd.New Delhi, 2006.	**CO-1** **BTL-4**
MODULE 2: DISPLAY DEVICES AND LASERS	**(9L)**
Introduction, Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, LED, Plasma Display, Liquid Crystal Displays, Numeric Displays, Laser Emission, Absorption, Radiation, Population Inversion, Optical Feedback, Threshold condition, Laser Modes, Classes of Lasers, Mode Locking, laser applications **Suggested Reading:** Jasprit Singh, "Opto Electronics – As Introduction to Materials and Devices", Mc Graw- Hill International Edition, 1998	**CO-2** **BTL-4**
MODULE 3: OPTICAL DETECTION DEVICES	**(9L)**
Photo detector, Thermal detector, Photo Devices, Photo Conductors, Photo diodes, Detector Performance **Suggested Reading:** J. Wilson and J.Haukes, "Opto Electronics – An Introduction", Prentice Hall	**CO-3** **BTL-4**
MODULE 4: OPTOELECTRONIC MODULATOR	**(9L)**
Introduction, Analog and Digital Modulation, Electro-optic modulators, Magneto Optic Devices, Acousto-Optic devices, Optical, Switching and Logic Devices **Suggested Reading:** S C Gupta, Opto Electronic Devices and Systems, Prentice Hal of India, 2005	**CO-4** **BTL-4**
MODULE 5: OPTOELECTRONIC INTEGRATED CIRCUITS	**(9L)**
Introduction, hybrid and Monolithic Integration, Application of Opto Electronic Integrated Circuits, Integrated transmitters and Receivers, Guided wave devices **Suggested Reading:** S C Gupta, Opto Electronic Devices and Systems, Prentice Hal of India, 2005	**CO-5** **BTL-4**

TEXT BOOKS	
1.	J Wilson and JFB Hawkes, Optoelectronics – an Intro duction, PHI, 3/e, 2010
2.	Pallab Bhattacharya, Semiconductor Optoelectronic Devices, PHI, 2/e, 2009
REFERENCE BOOKS	
1	John M Senior, Optical Fiber Communication – principle and practices, PHI, 3/e, 2010.
2	Djafar K Manbaev, Fiber-Optic Communication technology, Pearson Education, 6th Reprint, 2012
E BOOKS	
1	https://www.free-ebooks.net/internet-technology/All-Optical-Signal-Processing-with Semiconductor-Optical-Amplifiers-and-Tunable-Filters
2	https://www.free-ebooks.net/internet-technology/Optoelectronic-Devices-and-Properties
3	https://onlinelibrary.wiley.com/doi/book/10.1002/9781118688977
MOOC	
1	https://onlinecourses.nptel.ac.in/noc16_mm01/announcements
2	https://nptel.ac.in/courses/117/108/117108142/
3	https://nptel.ac.in/courses/115/102/115102026/
4	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-974-fundamentals-of-photonics-quantum-electronics-spring-2006/download-course-materials/

COURSE TITLE	**INDUSTRIAL ELECTRONICS**			**CREDITS**	**3**
COURSE CODE	**ECC4456**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-2**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	Industrial electronics have the objective of studying the various power electronic devices. This course focuses on discussing the concepts and principles related to the performance of thyristor, Rectifier and choppers.				

Course Objective	1. To study the dynamic and switching characteristics of power semiconductor devices.(BJT,MOSFET,IGBT,THYRISTORS) 2. To determine the performance parameters of controlled rectifiers and AC voltage controller. 3. To design Inverters, Choppers and Switching Regulators
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the fundamental concept and working of power devices. 2. Discuss the principles of thyristors and its applications. 3. Summarize the concepts of rectifier components. 4. Outline the concept of regulator circuits. 5. Use standard concepts of Inverters and choppers

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

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

MODULE 1 – INTRODUCTION	**(9L)**
Applications of power electronics, Power semiconductor devices, Control characteristics, Types of power electronics circuits, Peripheral effects. Power Transistors: Power BJT's, switching characteristics, switching limits, Power MOSFET's, Switching characteristics, IGBT's.	**CO-1 BTL-2**
MODULE 2 – INTRODUCTION TO THYRISTORS	**(9L)**
Principle of operation, anode-cathode characteristics, Two transistor model. Turn-on Methods, Dynamic Turn-on and turn-off characteristics, Gate characteristics, Gate trigger circuits, di / dt and dv / dt protection, Thyristor firing circuits. UJT characteristics, applications	**CO-2 BTL-2**
MODULE 3 –CONTROLLED RECTIFIERS	**(9L)**
Introduction, Principles of phase controlled converter operation, 1ϕ fully controlled converters, Duel converters, 1 ϕ semi converters (all converters with R & RL load). Thyristor turn off methods. Natural and forced commutation, self-commutation, class A and class B types.	**CO-3 BTL-3**
MODULE 4 –AC VOLTAGE CONTROLLERS	**(9L)**
Introduction, Principles of on and off control, Principles of phase control, Single phase controllers with restive loads and Inductive loads, numerical problems	**CO-4 BTL-2**

MODULE 5 – DC CHOPPERS	(9L)
Introduction, Principles of step down and step up choppers, Step down chopper with RL loads, Chopper classification, Switch mode regulators – buck, boost and buck – boost regulators. **Invertors:** Introduction, Principles of operation, Performance parameters. Solar Heating Systems, Microwave Oven	**CO-5** **BTL-2**

TEXT BOOKS	
1.	M. H. Rashid "Power Electronics" - 3rd edition, PHI / Pearson publisher 2004.

REFERENCE BOOKS	
1	M. D. Singh and Kanchandani K.B. "Power Electronics" - TMH publisher, 2nd Ed. 2007
2	V Natarasu and R.S. Anandamurhty, "Power Electronics ", V Natarasu and RS anandamurhty, Pearson/Sanguine Pub. 2006

COURSE TITLE	ADVANCED MOBILE COMMUNICATION TECHNOLOGY			CREDITS	3
COURSE CODE	ECC4457	COURSE CATEGORY	PC	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	24th ACM, 30.05.2018	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 basics of OFDM and MIMO. It describes the wireless standards and their applications. This module discusses the evolution of LTE technology and explain the frequency spectrum, requirements, and applications of 5G. It deals with the Architecture and application of 5G in millimeter wave communication.
Course Objective	1. Study the basics of OFDM and MIMO. 2. Learn the role of key Wireless standards and their enhancement by applying OFDM & MIMO concepts. 3. Study 5G in a communication environment. 4. Understand the key resources (Small cell, Mobile cloud) in 5G communication. 5. Learn the requirements of 5G deployment and Millimeter wave communication

Course Outcome	Upon completion of this course, the students will be able to 1. Explain the basics of OFDM and MIMO. 2. Summarize the role of key Wireless standards and their enhancement by applying OFDMA & MIMO concepts. 3. Estimate the need and role of 5G in the communication environment. 4. Assess the application of key resources (Small cell, Mobile cloud) in 5G communication. 5. Discuss the requirements of 5G deployment and Millimeter wave communication

Prerequisites: Mobile Communications, Digital Communication.

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

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

MODULE 1 – AN INTRODUCTION TO OFDM AND MIMO	**(9L)**
Multi-Carrier Modulation – Orthogonal Frequency-Division Multiplexing, OFDM Related Issues, OFDM Transceiver Architecture – Multiple-Input Multiple-Output (MIMO) Basics, MIMO Techniques, MIMO-OFDM System Example **Suggested reading** Beamforming concepts	**CO-1** **BTL-2**
MODULE 2 – KEY WIRELESS STANDARDS	**(9L)**
3G and 4G Wireless Standards-GSM, WCDMA, LTE, LTE advanced, UWB and WiMAX. Application of OFDM and MIMIO in LTE, UWB & LTE advanced **Suggested reading** Smart antennas	**CO-2** **BTL-3**
MODULE 3 – 5G ROADMAP AND SPECTRUM	**(9L)**
Drivers for 5G – Introduction Evolution of LTE Technology to Beyond 4G.THE 5G Roadmap and Pillars – Architecture of 5G INTERNET – Internet of Things and context-Awareness – 5G spectrum –challenges –Spectrum and Bandwidth requirements **Suggested reading** Current trends of 5G Implementation in Europe, North America and Asia	**CO-3** **BTL-3**
MODULE 4 – KEY ENABLING RESOURCES FOR 5G	**(9L)**

Small Cells for 5G mobile networks- Introduction – Small Cells – Capacity limits and Achievable gains with densification – Mobile data demand – Introduction to mobile cloud– Resources– Enablers **Suggested reading** Mobility challenges in 5G	**CO-4** **BTL-3**
MODULE 5– ARCHITECTURE & APPLICATION OF 5G IN MMW COMMUNICATION	**(9L)**
5G ARCHITECTURE – Introduction – High level requirements for 5G architecture – Functional architecture and 5G flexibility – Physical Architecture and 5G deployment. Millimeter wave communication – spectrum and regulations – channel propagation – Hardware technologies for mmW systems –Architecture and mobility –Beam-forming concepts **Suggested reading** SON network architecture over LTE and its role in 5G	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Fundamentals of 5G mobile Networks, Edited by Jonathan Rodis Quez, John Wiley publication, 2015
2.	5G Mobile and Wireless Communications Technology, Edited by Asif Osseiran, Jose F. Monserrat, Patrick Marsch: Cambridge university press, June 2016.
3.	Martin Sauter, "From GSM to LTE-Advanced: An Introduction to Mobile Networks and Mobile Broadband" John Willey & Sons Ltd., 2014.
4.	Lal Chand Godara, “Smart Antennas” CRC press, 2004.
REFERENCE BOOKS	
1.	William Stallings, “Wireless Communication and Networks”, Pearson Education, 2003.
2.	Roy Blake, “Wireless Communication Technology”, India edition, Cengage learning, 2010
3.	Jiangzhou Wang, “High-Speed Wireless Communications: Ultra-wideband, 3G Long Term Evolution, and 4G Mobile Systems” Cambridge University Press, 2008
4.	EzioBiglieri and Robert Calderbank “MIMO Wireless Communications”, Cambridge University Press, 2007.
5.	David Tse and PramodViswanath, “Fundamentals of Wireless Communication”, Prentice Hall, 2003.
E BOOKS	
1	https://www.sciencedirect.com/book/9780123735805/wireless-communications-and-networking
2	https://link.springer.com/chapter/10.1007/978-981-13-1768-2_10
MOOC	
1	https://www.coursera.org/learn/wireless-communication-technologies
2	https://academy.5g-courses.com/courses/towards-5g-online-course

3	https://www.class-central.com/course/nptel-millimeter-wave-technology-7903

COURSE TITLE	EMBEDDED C FOR 8051 AND ARM USING KEIL MICROVERSION			CREDITS	3
COURSE CODE	ECC4458	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	32nd ACM, 07.08.2021	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	To familiarize the students with KEIL S/W for 8051 and ARM LPC1768 and develop the Simple programs and interfacing applications
Course Objective	1. To install the Kiel S/W and performing basic programs. 2. To study the 8051 Microcontroller Architecture and Programming and performing Basic Programming 3. To perform interfacing projects in 8051 4. To study ARM LPC1768 and Basic Programming 5. To perform interfacing projects in ARM LPC1768
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the working of Kiel S/W and executing the basic programs. 2. Explain the Architecture and Programming in 8051 and executing higher level programs in 8052 using KIEL. 3. Demonstrate the interfacing applications in 8051. 4. Interpret the architecture of ARM LPC1768 and to execute basic programs. 5. Exhibit the performance of interfacing applications with LPC1768.

Prerequisites: Digital System Design and Microprocessors

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

1: Weakly related, 2: Moderately related and 3: Strongly related	
MODULE 1: Basics of Embedded C	**(9L)**
Introduction to embedded systems and microcontrollers-Embedded C program structure-Programming of Microcontroller using embedded C-Programming in KEIL IDE software-Basic Programs in KEIL	**CO-1 BTL-3**
MODULE 2: Embedded C for 8051	**(9L)**
8051 Microcontroller –Architecture – Features –Finding GCD and LCM - Generating delay for the Timer without interrupt	**CO-2 BTL-3**
MODULE 3: Interfacing of 8051	**(9L)**
Interfacing with LCD, Timer, Matrix Keyboard, Stepper Motor ,DC motor and Relay	**CO-3 BTL-3**
MODULE 4: Embedded C Programs for ARM CORTEX M3	**(9L)**
ARM CORTEX M3-Instruction set architecture of ARM microcontroller, and assembly language programming -LPC17678-KEIL µ Version for ARM – Basic Programs	**CO-4 BTL-3**
MODULE 5: Interfacing of ARM CORTEX M3	**(9L)**
Interfacing LED, Buzzer and Switches - D/A and A/D converter, sensors and actuators	**CO-5 BTL-3**
TEXT BOOKS	
1.	Ali Mazidi, Janice Gillispie Mazidi The 8051 Microcontroller and Embedded Systems: Using Assembly and C –Muhammad, 2nd Edition, *Pearson*
2.	ARM CORTEX M3 Technical Reference Manual
REFERENCE BOOKS	
1	William Hohl, Christopher Hinds. (2015). *ARM Assembly Language Fundamentals and Techniques* CRC Press , 2nd Edition
E BOOKS	
1.	ee.sharif.edu/~sakhtar3/books/The%208051%20Microcontroller%20Ayala/The%208051%20Microcontroller%20Architecture,%20Programming%20and%20Applications%201991.pdf
MOOC	
1	https://nptel.ac.in/courses/106/105/106105193/

NON DEPARTMENT ELECTIVES

SEMESTER III

COURSE TITLE	**BASICS OF COMMUNICATION SYSTEMS**			**CREDITS**	**3**
COURSE CODE	**ECD4281**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 gives strong theoretical aspects of Analog communication, Digital Communication, Network Protocols & topologies, Satellite communication, Optical fiber communication and their Application & it is suitable for all branch engineering students to understand basic of Communication.
Course Objective	1. To understand the concepts of analog communication and its applications. 2. To know the applications about digital communication. 3. To identify different types of Network Protocols and OSI layer architectures. 4. To visualize the Satellite communication system and its uses… 5. To interpret the optical fiber communication concepts and its advantages.
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the concepts of analog communication and its applications. 2. Enumerate the concepts of digital communication and its applications in communication 3. Interpret about the network protocols, architecture and their applications. 4. Explain about the concepts of satellite communication system and its applications. 5. Describe the concepts of optical fiber communication system and its applications.

Prerequisites: communication systems

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

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

MODULE 1: Analog Communication **(6L)**

Time and frequency domain representation of signals-amplitude modulation-demodulation, frequency modulation-demodulation-applications **Suggested Readings:** Amplitude modulation, demodulation, frequency modulation, demodulation and applications	**CO-1** **BTL-3**

MODULE 2: Digital Communication	(6L)
Pulse code modulation-Time division multiplexing-frequency division multiplexing- Frequency shift keying- phase shift keying – applications **Suggested Readings:** Pulse code modulation, Multiplexing, Frequency, phase shift keying and applications	**CO-2** **BTL-3**
MODULE 3: Network Protocols	**(6L)**
Network- types- LAN- MAN- WAN- Topologies- applications-ISO-OSI seven layer architecture for WAN **Suggested Readings:** Network types, Topologies and OSI Layer architecture	**CO-3** **BTL-4**
MODULE 4: Satellite Communication	**(6L)**
Satellite communication system-system elements-space segment-ground segment-uplink-down link- transmission bands- orbits- geostationary satellites- applications **Suggested Readings:** Satellite communication system, segment elements, transmission bands, geostationary satellites and applications	**CO-4** **BTL-4**
MODULE 5: Optical Fiber Communication	**(6L)**
Fiber optic communication system-transmission medium-total internal reflection-optical fiber types-losses- optical receivers- applications **Suggested Readings:** Fiber optic communication system, losses, optical receivers and applications	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Wayne Tomasi, '*Electronic Communication Systems*', Pearson Education, 3rd Edition, 2001.
2	Roy Blake, '*Electronic Communication Systems'*, Thomson Delmar, 2nd Edition, 2002.
3	Bogdan M. Wilamowski, J. David Irwin, *'The Industrial Electronics Handbook',* second edition, Taylor & Francis, 2011
REFERENCE BOOKS	
1.	William Schweber, '*Electronic Communication Systems'*, Prentice Hall of India, 2002.
2.	G. Kennedy, '*Electronic Communication Systems'*, McGraw Hill, 4th edition, 2002
3	Miller, '*Modern Electronic Communication*', Prentice Hall of India, 2003.
E BOOKS	
1.	http://www.ece.ucsb.edu/wcsl/Publications/intro_comm_systems_madhow_jan2014b.pdf
2	https://www.slideshare.net/mohsensarakbi/introduction-to-communication-systems
MOOC	
1.	http://nptel.ac.in/courses/117102059/
2.	https://www.csun.edu/~skatz/katzpage/sdr_project/sdr/comm_intro_07_01_2010.pdf
	https://www.tutorialspoint.com/principles_of_communication/

COURSE TITLE	FUNDAMENTALS OF MATLAB PROGRAMMING			CREDITS	2
COURSE CODE	ECD4282	COURSE CATEGORY	NE	L-T-P-S	2-0-0-1
Version	1.0	Approval Details	24th ACM, 30.05.2018	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	MATLAB is the most popular and widely used programming languages for engineers and scientists. The curriculum starts with the basics concepts and features and is MATLAB for Beginners then goes to Variables and assignment operations, Manipulating vectors and matrices, Linear Algebra, File Input/Output, User defined functions, Plotting and then gradually lays emphasis on all the advanced topics like advanced plotting, user controlled input and output, relational and logical functions, Loop statements & vectorising codes, String Manipulations, Data Structures, Advanced mathematics, Numerical techniques, Guided User Interface and Simulink. This course will provide a solid reference for both experienced and those who are brand-new to MATLAB. By the end of the course you can independently implement projects in MATLAB. This course will ensure that you gain skills which will help you to find a job or get promotion.
Course Objective	1. To familiarize working with matlab environment and basic operations 2. To write programs with branching and looping statements 3. To create and annotate the various plots 4. To solve polynomials and differential equations in MATLAB. 5. To work with Simulink models for different applications
Course Outcome	Upon completion of this course, the students will be able to 1. Familiarize the vector and matrix operations in MATLAB. 2. Write script and function programs in MATLAB. 3. Generate various types of plots in MATLAB. 4. Solve polynomials and differential equations in MATLAB. 5. Create Simulink models and GUIs in MATLAB.

Prerequisites: Basic of Linear Algebra, Basic Computers

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
CO-1	2	1	-	1	3	-	-	-	2	2	-	-	1	2

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

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

MODULE 1: INTRODUCTION TO MATLAB	**(6L)**
Introduction: The MATLAB Environment, Help feature, Type of files in MATLAB, Uses of MATLAB. **Constants, Variables and Expressions:** Character set, Data Types, Constants and Variables, Operators: arithmetic, relational and logical, Hierarchy of Operations, Built-in Functions. **Vectors & Matrices:** Creating Vectors and Matrices, Operations on Vectors, Element-by-Element Array Operations, Binary Matrix Operations, Unary Matrix Operations, Multidimensional Array, Structure arrays, cell arrays, String handling, Input & Output Statements.	**CO-1** **BTL-2**
MODULE 2: PROGRAM WRITING & CONTROL STRUCTURES	**(6L)**
Program Writing: MATLAB editor, Types of M-files, Function subprograms, errors and warnings, Debugging. Control structures: Branch control structures- if, if else, nested if, if- else if-else, switch, try & catch, break, continue, error. Loop control structures- for -while - nested for.	**CO-2** **BTL-2**
MODULE 3: PLOTS IN MATLAB	**(6L)**
Basic 2D plots- plot, figure, label, Grid, Axis, entering Text, Line style, Markers, Subplot, Multiple plots, log-log, semilog, polar, comet, fplot, ezplot, ezpolar, stem, bar, hist, pie, Graph plotting in MATLAB using data of a text file or excel file. 3D plots- plot3, bar3, pie3, stem3, mesh, surf, contour and contour3.	**CO-3** **BTL-3**
MODULE 4: POLYNOMIALS & DIFFERENTIAL EQUATIONS	**(6L)**
Polynomials: Entering A Polynomial, Polynomial Evaluation, Roots of A Polynomial, Polynomial Addition and Subtraction, Polynomial Multiplication, Polynomial Division, Formulation of Polynomial Equation, Polynomial Differentiation, Polynomial Integration, Polynomial Curve Fitting. **Differential equations:** Ordinary Differential Equation Solvers, Calculus using Symbolic Mathematics.	**CO-4** **BTL-2**
MODULE 5: SIMULINK AND GUI	**(6L)**
SIMULINK- Modelling, Simulating a model, Using variables from MATLAB, Data Import & Export, Creating subsystems. **GUI**- Creating apps with GUIDE, adding components, applications of components, writing call back for the components.	**CO-5** **BTL-2**
TEXT BOOKS	

1.	Rudra Pratap, “Getting Started with MATLAB” ,7th Edition, Oxford University Press,2016.
2.	Stephen J Chapman, “MATLAB programming for Engineers”, 5th edition, Cengage Learning,2016.
3.	R.K Bansal, Manoj Sharma, A.K. Goel, “MATLAB and Its Applications in Engineering”, Pearson Eduction,2009.
4.	Holly Moore, “MATLAB for Engineers”,4th edition, Pearson, 2012.
REFERENCE BOOKS	
1.	Stephen J Chapman, “Essentials of MATLAB Programming” ,3rd edition, Cengage Learning, 2018.
2.	William J Palm III , “Introduction to MATLAB for engineers”,3rd edition, Mc-Graw Hill Education, 2010.
3.	Agam Kumar Tyagi, Matlab and Simulink for Engineers, OUP India, 2011.
E BOOKS	
1.	https://www.goodreads.com/book/show/8503035-getting-started-with-matlab
MOOC	
1.	https://in.mathworks.com/videos.html
2.	http://www.learningmatlab.com/videos/

COURSE TITLE	**FUNDAMENTALS OF BLUETOOTH TECHNOLOGY**			**CREDITS**	**2**
COURSE CODE	**ECD4283**	**COURSE CATEGORY**	**NE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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	Bluetooth is a cable-replacement technology designed to wirelessly connect peripherals, such as mice and mobile phones, to desktop or laptop computer and to each other. It is an inexpensive, low-power, short-range radio-based technology. All the basics, protocols and layers of this technology is explained in this course.				
Course Objective	1. To study the fundamental concepts of Bluetooth module 2. To analyze the protocol operation 3. To gain knowledge on Bluetooth host 4. To understand the layer functions available 5. To understand Zigbee Mac Series				

Course Outcome	Upon completion of this course, the students will be able to 1. Know about the fundamental concepts of Bluetooth module 2. Analyze the protocol operation in bluetooth module 3. Understand and analyze the Bluetooth host 4. Analyze the various layer functions avilable 5. Comprehend on Zigbee Mac Series

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

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

MODULE I THE BLUETOOTH MODULE	**(6 L)**
Introduction-overview - the Bluetooth module-antennas- Base band - Introduction-Bluetooth device address –Masters, slaves, and Pico nets-system timing-physical links-Bluetooth packet structure-logical channels-frequency hopping.	**CO-1 BTL-2**
MODULE II THE LINK CONTROLLER	**(6 L)**
The link controller-link control protocol-link controller operation-Pico net, scatter net operation-master/slave role switching-base band/link controller architectural overview - link manager-the host controller interface.	**CO-2 BTL-2**
MODULE III THE BLUETOOTH HOST	**(6 L)**
The bluetooth host-logical link control and adaptation protocol –RFCOMM- the service discovery protocol	**CO-3 BTL-3**
MODULE IV LAYER FUNCTIONS	**(6 L)**
Cross layer functions-Encryption and security-low power operations-controlling low power modes-hold mode-sniff mode-park mode-quality of service-managing Bluetooth devices.	**CO-4 BTL-2**
MODULE V ZIGBEE NETOWRKS	**(6 L)**
Zigbee communication basics – Zigbee network layers and their functions – Zigbee MAC series	**CO-5 BTL-2**
TEXT BOOKS	

1.	Jennifer Bray and Charles F Sturman, “Bluetooth: Connect Without Cables”, Pearson Education, 2002.
2.	Stahun Farahani, “Zigbee Wireless Networks and Transceivers”, Elsevier Ltd, 2003.
REFERENCE BOOKS	
1.	Jennifer Bray, Brain Senese, Gordon McNutt and Bill Munday, “Bluetooth Application Developer’s Guide”, Syngress Media, 2001
2.	Micheal Mille, “Discovering Bluetooth”, Sybex Incorporation, 2001.
E BOOKS	
1.	https://www.novelbits.io/introduction-to-bluetooth-low-energy-book/
MOOC	
1.	https://www.coursera.org/learn/smart-device-mobile-emerging-technologies
2.	https://www.edx.org/course/real-time-bluetooth-networks-shape-the-world

COURSE TITLE	**BASICS OF NEURAL NETWORKS AND FUZZY LOGIC**			**CREDITS**	**2**
COURSE CODE	**ECD4284**	**COURSE CATEGORY**	**NDE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 objective of this course is to present sufficient background in both fuzzy and neural network so that students in future can pursue advanced soft computing methodologies. This course combines knowledge, techniques, and methodologies from various sources, using techniques from neural networks and fuzzy set theory, As an extension, the course uses the Neuro Fuzzy models for the complex engineering problems.
Course Objective	1. Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory. 2. To introduce the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks. 3. Discuss neural networks and fuzzy systems, architectures, algorithms and applications, including Back-propagation, BAM, Hopfield network, Competitive Learning, ART, SOFM, Fuzzy inference methods and expert systems. 4. Introduce the theory and applications of artificial neural network and fuzzy systems to engineering applications with emphasis on image processing and control 5. Reveal different applications of these models to solve engineering and other problems.

Course Outcome	Upon completion of this course, the students will be able to 1. Comprehend the concepts of feed forward neural networks 2. Analyze the various feedback networks. 3. Understand the concept of fuzziness involved in various systems and fuzzy set theory. 4. Comprehend the fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm. 5. Analyze the application of fuzzy logic control to real time systems

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

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

MODULE 1: ARCHITECTURE OF NEURAL NETWORKS	**(6L)**
Introduction –Biological neuron-Artificial neuron-Neuron modeling Learning rules-Single layer-Multi layer feed forward network-Back propagation-Learning factors	**CO-1** **BTL-2**
MODULE 2: BASIC NEURAL NETWORK TECHNIQUES	**(6L)**
Back propagation neural net:standard back propagation-architecture algorithm- derivation of learning rules- number of hidden layers--associative and other neural networks- hetro associative memory neural net, auto associative net- Bidirectional associative memory-applications-Hopfield nets-Boltzman machine	**CO-2** **BTL-3**
MODULE 3: FUNDAMENTALS OF FUZZY LOGIC	**(6L)**
Basic concepts: fuzzy set theory- basic concept of crisp sets and fuzzy sets- complements-union intersection- combination of operation- general aggregation operations- fuzzy relations-compatibility relations-orderings- morphisms- fuzzy relational equations-fuzzy set and systems	**CO-3** **BTL-3**
MODULE 4: FUZZY LOGIC CONTROL	**(6L)**
Membership function – Knowledge base-Decision –making logic – Optimizations of membership function using neural networks-Adaptive fuzzy systems-Introduction to generate to genetic algorithm	**CO-4** **BTL-3**
MODULE 5: APPLICATION OF FLC	**(6L)**

Fuzzy logic control-Inverted pendulum-Image processing-Home Heating system-Blood pressure during anesthesia-Introduction to neuro fuzzy controller		**CO-5 BTL-2**
TEXT BOOKS		
1	Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", PrenticeHall, NewDelhi, 2004.	
2	Timothy J Ross, "Fuzzy Logic with Engineering Applications",John Willey and Sons, West Sussex, England, 2005.	
3	T1. Kliryvan- Fuzzy System & Fuzzy logic Prentice Hall of India, First Edition.	
REFERENCE BOOKS		
1	Jack M. Zurada, "Introduction to Artificial Neural Systems", PWS Publishing Co., Boston, 2002.	
2	Klir G.J. &Folger T.A., "Fuzzy sets, Uncertainty and Information", Prentice –Hall of India Pvt. Ltd., New Delhi, 2008	
3	Zimmerman H.J., "Fuzzy set theory and its Applications", Kluwer Academic Publishers Dordrecht, 2001.	
4	J.M.Zurada, —Introduction to artificial neural systems-Jaico Publication house,Delhi 1994.	
5	VallusuRao and HayagvnaRao , —C++ Neural network and fuzzy logic-BPB and Publication, New Delhi,1996.	
E BOOKS		
1	https://dl.acm.org/doi/10.5555/550087	
2	http://boente.eti.br/fuzzy/ebook-fuzzy-kazabov.pdf	
MOOC		
1	https://onlinecourses.nptel.ac.in/noc20_ge09/preview	
2	https://freevideolectures.com/course/4246/nptel-fuzzy-logic-neural-networks	

SEMESTER IV

COURSE TITLE	**NEURAL NETWORKS AND FUZZY LOGIC**			**CREDITS**	**2**
COURSE CODE	**ECD4291**	**COURSE CATEGORY**	**NE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 will start with a brief introduction to fuzzy sets. The differences between fuzzy sets and crisp sets will be identified. Various terms used in the fuzzy sets and the grammar of fuzzy sets will be discussed, in detail, with the help of some numerical examples. The working principles of two most popular applications of fuzzy sets, namely fuzzy reasoning and fuzzy clustering will be explained, and numerical examples will be solved. Fundamentals of neural networks and various learning methods will then be discussed. The method of evolving optimized fuzzy reasoning tools, neural networks will be discussed with the help of some numerical examples.
Course Objective	1. To expose the students to the concepts of feed forward neural networks. 2. To provide adequate knowledge about feedback neural networks. 3. To teach about the concept of fuzziness involved in various systems. To provide adequate knowledge about fuzzy set theory. 4. To provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm. 5. To provide adequate knowledge of application of fuzzy logic control to real time systems.
Course Outcome	Upon completion of this course, the students will be able to 1. Comprehend the concepts of feed forward neural networks. 2. Analyze the various feedback networks. 3. Understand the concept of fuzziness involved in various systems and fuzzy set theory. 4. Comprehend the fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm 5. Analyze the application of fuzzy logic control to real time systems.

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

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

MODULE I ARCHITECTURE (6 L)

Introduction – Biological neuron – Artificial neuron – Neuron modeling – Learning rules – Single layer – Multi layer feed forward network – Back propagation – Learning factors.	**CO-1** **BTL-2**

MODULE II NEURAL NETWORKS FOR CONTROL (6L)

Feedback networks – Discrete time hop field networks – Transient response of continuous time networks – Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum.	**CO-2 BTL-2**
MODULE III FUZZY SYSTEMS	**(6 L)**
Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules.	**CO-3 BTL-3**
MODULE IV FUZZY LOGIC CONTROL	**(6 L)**
Membership function – Knowledge base – Decision-making logic – Optimization of membership function using neural networks – Adaptive fuzzy system – Introduction to genetic algorithm.	**CO-4 BTL-2**
MODULE V APPLICATION OF FLC	**(6 L)**
Fuzzy logic control – Inverted pendulum – Image processing – Home heating system – Blood pressure during anesthesia – Introduction to neuro fuzzy controller.	**CO-5 BTL-2**

TEXT BOOKS	
1.	Jacek M. Zurada, 'Introduction to Artificial Neural Systems', Jaico Publishing home, 2002.
2.	Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 1997.
REFERENCE BOOKS	
1.	Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, 1992.
2.	H.J. Zimmermann, 'Fuzzy Set Theory & its Applications', Allied Publication Ltd., 1996.
3.	Simon Haykin, 'Neural Networks', Pearson Education, 2003.
4.	John Yen & Reza Langari, 'Fuzzy Logic – Intelligence Control & Information', Pearson Education, New Delhi, 2003.
E BOOKS	
1.	http://neuralnetworksanddeeplearning.com/

COURSE TITLE	**FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS**			**CREDITS**	**2**
COURSE CODE	**ECD4292**	**COURSE CATEGORY**	**NE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 module provides the basic foundation about the architecture, instruction set and addressing modes of 8086 microprocessor and 8051 microcontroller. It covers the C programming for basic interfacing module using 8051. The later part of the module covers features and interfacing techniques using Arduino and Raspberry Pi system design.
Course Objective	1. To illustrate the 8086 architecture and explain the 8086 instruction set. 2. To illustrate the 8086 architecture and explain the 8086 instruction set. 3. To write C Programs for 8051 Microcontroller. 4. To familiarize the functionality of Arduino Uno and Interfacing. 5. To explain the functionality of Raspberry Pi and its real time audio and video streaming application.
Course Outcome	Upon completion of this course, the students will be able to 1. Articulate the architecture, instruction set of 8086 Microprocessor. 2. Explain the architecture and instruction set of 8051 Microcontroller. 3. Develop C programs for 8051 Microcontroller arithmetic, logical operations and its interfacing. 4. Examine the functionality of Arduino Uno and Interfacing. 5. Examine the functionality of Raspberry Pi and its real time audio and video streaming application.

Prerequisites: - Digital Systems

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

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

MODULE 1: 8086 Microprocessor	**(6L)**
Microprocessor-8086 Functional block diagram –Interrupts – Instruction set- Addressing Modes **Suggested Readings:** 8086 pin diagram and Timing Diagram	**CO-1** **BTL-2**
MODULE 2: 8051 Microcontroller	**(6L)**

Differences between Microprocessor and Microcontroller-8051 Functional block diagram – Instruction set- addressing modes **Suggested Readings:** 8086 Machine Cycle and Timing Diagram	**CO-2** **BTL-2**
MODULE 3: Programming and Interfacing	**(6L)**
C programming-8051 arithmetic- logical operations- Interfacing- Keyboard-LCD-Stepper motor **Suggested Readings:** ADC and DAC Interface	**CO-3** **BTL-4**
MODULE 4: Arduino System design	**(6L)**
Arduino Uno-Features-Signals-IDE-Interfacing-Keyboard -LED-LCD-Sensors **Suggested Readings:** Arduino Uno signals, IDE and interfacing	**CO-4** **BTL-4**
MODULE 5: Raspberry Pi System design	**(6L)**
Raspberry Pi Features-Signals-IDE- Real time audio Streaming- Real time Video Streaming **Suggested Readings:** Raspberry Pi signals, Audio and Video streaming	**CO-5** **BTL-4**
TEXT BOOKS	
1.	M.A.Mazidi, J.C.Mazidi "Microcontroller and Embedded systems using Assembly & C", Second Edition Pearson Education, 2007
REFERENCE BOOKS	
1	Embedded Systems: An integrated approach by. Lyla Das, Pearson publication, 2013.
2	Arduino Workshop: A hands on introduction with 65 projects by John Boxall, 2013.
E BOOKS	
1.	https://www.jntubook.com/microprocessors-and-microcontrollers-textbook-free-download/
MOOC	
1	http://nptel.ac.in/courses/106108100/
2	http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/New_index1.html

COURSE TITLE	**IOT BASED HEALTHCARE SYSTEMS**			**CREDITS**	**2**
COURSE CODE	**ECD4293**	**COURSE CATEGORY**	**NE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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	Healthcare facilities in modern age are key challenge especially in developing countries where remote areas face lack of high-quality hospitals and medical experts. This course facilitates novel and intelligent healthcare systems that are based on modern technologies like Internet of things (IoT) and machine learning.
Course Objective	1. To familiarize the smart health system 2. To learn different protocol architectures and service model 3. To adopt the health care services as per societal demand 4. To address the security and confidentiality threads 5. To develop a Patient monitoring system
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the concepts and scope of internet of things 2. Illustrate IoT healthcare networks topology and architecture 3. Classify IoT Healthcare Services and Applications. 4. Present IoT Healthcare security requirements and challenges 5. Develop a case study of IoT based patient monitoring system

Prerequisites: CSB231 - Cryptography and Network Security

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

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

MODULE 1:- IoT Technology	**(6L)**
Internet of things- vision-definition-scope- machine to entity-Smart-X Applications-Smart health system **Suggested Reading:** Machine to entity, Smart-X applications and Smart health system	**CO-1** **BTL-2**

MODULE 2:- Healthcare Networks **(6L)**

Health care networks-network topology- intelligent healthcare gateway-network architecture- protocol stack of WPAN-network platform- framework of a health information service model. **Suggested Reading:** Health care Network topology, architecture and platform	**CO-2** **BTL-2**
MODULE 3:- Services and Applications	**(6L)**
Healthcare services - ambient assisted living - miot - adverse drug reaction - community healthcare - wearable device access - embedded gateway configuration- healthcare applications - glucose level sensing - electrocardiogram monitoring- blood pressure monitoring - body temperature monitoring - oxygen saturation monitoring - rehabilitation system - medication management – wheel chair management **Suggested Reading:** Healthcare services and applications	**CO-3** **BTL-3**
MODULE 4:- Security issues	**(6L)**
Security requirements- confidentiality- integrity- authentication- authorization- fault tolerance- computational limitations- mobility- scalability- dynamic network topology- intelligent collaborative security model. **Suggested Reading:** Security requirements, dynamic network topology and intelligent collaborative security model.	**CO-4** **BTL-3**
MODULE 5:- TeleHealth system	**(6L)**
Telehealth-services- Telemedicine-Telemonitoring-Telesurgery-remote medical education- benefits –case study of IoT based patient monitoring system **Suggested Reading:** Telehealth services, benefits and case study of IoT based patient monitoring system	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Arshdeep Bhagya, “Internet of things-a hands on approach”, universities press, 2015.
2.	Peter Friess, “Internet of things”, River Publishers, 2014.
3.	David Hanes,”IoT Fundamentals”, 1st , Kindle Edition, 2014.
REFERENCE BOOKS	
1.	Agus Kurniawan,”Smart Internet of Things Projects”, Packt publications, 2016.
2.	David Niewolny, ‘Healthcare Implementations of the Internet of Things’, Freescale technology forum, 2014.
E BOOKS	
1.	http://www.oreilly.com/iot/free/
2.	http://www.qorvo.com/design-hub/ebooks/internet-of-things-for-dummies
MOOC	
1.	http://www.oreilly.com/iot/free/
2.	http://www.qorvo.com/design-hub/ebooks/internet-of-things-for-dummies
3.	http://www.oreilly.com/iot/free/

SEMESTER V

COURSE TITLE	MOBILE COMMUNICATION ENGINEERING			CREDITS	2
COURSE CODE	ECD4381	COURSE CATEGORY	NE	L-T-P-S	2-0-0-1
Version	1.0	Approval Details	24th ACM, 30.05.2018	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	Traditional mobile service was structured in a fashion similar to television broadcasting: One very powerful transmitter located at the highest spot in an area would broadcast in a radius of up to 50 kilometers. The cellular concept structured the mobile telephone network in a different way increasing the coverage and connectivity. Each mobile uses a separate, temporary radio channel to talk to the cell site. The cell site talks to many mobiles at once, using one channel per mobile. The basic structure of mobile networks includes telephone systems and radio services. The course provides an insight of the different generations of mobile communication and techniques involved in transmission.
Course Objective	1. To study the evolution of mobile communication and cellular concept. 2. To study the modulation techniques 3. To familiarize with coding and multiple access techniques. 4. To understand the wireless networking standards 5. To study the architecture and features of advanced 3G systems
Course Outcome	Upon completion of this course, the students will be able to 1. Summarize the evolution of mobile communication and cellular concepts. 2. Elaborate the concept of Bit error rate in Different modulation Techniques. 3. Compare the different types of coding and reduction of the bit rate. 4. Compare the concepts of various wireless Networks. 5. Illustrate the architecture and features of advanced 3G systems

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
CO-1	2	2	-	-	-	1	-	-	-	-	-	-	2	1

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

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

MODULE 1 – Overview of Cellular mobile communication and cellular concept	**(6L)**
Overview to wireless communication: Evolution & Generation of mobile communication. Existing mobile communication technology and current Status. Cellular Concept: Frequency reuse, channel assignment, hand off, Interference and system Capacity, tracking and grade of service, Improving Coverage and capacity in Cellular systems **Suggested Readings:** Evolution of wireless communication	**CO-1** **BTL-2**
MODULE 2: Modulation Techniques	**(6L)**
Modulation Techniques: Minimum Shift Keying, Gauss ion MSK, M-ary QAM, M-ary FSK,MIMO-OFDM **Suggested Readings:** Analog modulation, Digital modulation techniques.	**CO-2** **BTL-3**
MODULE 3: Coding and Multiple Access schemes	**(6L)**
Coding: Vocoders, Linear Predictive Coders, Selection of Speech Coders for Mobile Communication, GSM Codec, RS codes for CDPD. Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Capacity of Cellular CDMA and SDMA. **Suggested Readings:** Coding techniques	**CO-3** **BTL-3**
MODULE 4: Wireless Networks and Standards	**(6L)**
Second and Third Generation Wireless Networks and Standards, WLL, Bluetooth, AMPS, GSM, VoIP service for Mobile Networks, GPRS,IS-95 and DECT. **Suggested Readings:** First generation mobile communication networks	**CO-4** **BTL-3**
MODULE 5: Beyond 3G Mobile Communication	**(6L)**
Architectures, Operations, Features and application of Wi-Fi, Wi-Max, LTE **Suggested Readings:** Architecture of wireless networks	**CO-5** **BTL-3**

TEXT BOOKS	
1.	T.S.Rappaport, "Wireless Communications: Principles and Practice", Second Edition, Pearson Education/ Prentice Hall of India, Second Edition 2013
2	Jochen Schiller, "Mobile Communications", Person Education – 2003, 2nd Edition
REFERENCE BOOKS	

1.	R. Blake, “Wireless Communication Technology”, Thomson Delmar, 2003.
2.	W.C.Y.Lee, "Mobile Communications Engineering: Theory and applications”, Second Edition, McGraw-Hill International, 1998.
3.	Stephen G. Wilson, “Digital Modulation and Coding”, Pearson Education, 1995.
E BOOKS	
1.	http://www.freebookcentre.net/mobile-technology/mobile-technology-books.html
2.	Text book companion http://www.scilab.in/Completed_Books#2
MOOC	
1.	nptel.ac.in/courses/117102062/38

COURSE TITLE	**INTRODUCTION TO DATA COMMUNICATION**			**CREDITS**	**2**
COURSE CODE	**ECD4382**	**COURSE CATEGORY**	**NE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24 th ACM, 30.05.2018**	**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 teaches the design and implementation techniques essential for engineering robust networks. Topics include networking principles, Transmission Control Protocol/Internet Protocol, naming and addressing (Domain Name System), data encoding/decoding techniques, link layer protocols, routing protocols, transport layer services, congestion control, quality of service, network services, programmable routers and overlay networks, wireless and mobile networking, security in computer networks, multimedia networking, and network management.				
Course Objective	The students will be able to 1. Build an understanding of the fundamental concepts of data communication and computer networking. 2. Understand how errors detected and corrected that occur in transmission 3. Know about routing mechanisms and different routing protocols 4. Understand transport layer functions 5. Know about different application layer protocols				

Course Outcome	Upon completion of this course, the students will be able to 1. To describe the basic concept of communications and its paradigms. 2. To identify a suitable transmission media through an error free Communication network for the given specifications 3. To discuss the suitable protocol suite for a network based data communication for the specified functions. 4. To analyze the characteristics of routing and process delivery mechanisms with the concerned QoS parameters. 5. To describe the popular application layer protocols in the Internet.

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

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

MODULE 1 – FUNDAMENTALS OF DATA COMMUNICATION	**(6L)**
Data Representation – Direction of Data flow – Networks – Categories of Network – Topologies – Basics of Packet switching and Circuit switching. Type of services- Virtual circuit and Datagrams approach Suggested reading- Broadband services	**CO-1** **BTL-2**
MODULE 2 – TRANSMISSION MEDIA AND ERROR DETECTION CONCEPTS	**(6L)**
Transmission Media- basic Guided (Twisted Pair, Co-axial, Fibre optics) & Wireless Media types and their characteristics. RS 232/ EIA 232 / USB Interfaces. Bandwidth utilization: Multiplexing and Spreading. Transmission error -Redundancy – Detection and Correction mechanisms– Parity – CRC – Hamming code. Suggested reading- Error control mechanisms	**CO-2** **BTL-2**
MODULE 3 – PROTOCOLS AND STANDARDS	**(6L)**
Standards – Layer Architecture – ISO/OSI reference model – Overview of TCP/IP stack architecture, LAN: Ethernet IEEE Standards- IEEE 802.3, IEEE 802.5- Wireless LAN IEEE 802.11, IEEE 802.15. Suggested reading- Comparative performance analysis of Wired and Wireless Transmission	**CO-3** **BTL-3**
MODULE 4 – IP NETWORK & TRANSPORT FUNCTIONS	**(6L)**

IP addressing methods– Sub-netting – Routing – Distance Vector and Link State Routing concepts – Process delivery protocols- User Datagram Protocol (UDP) and Transmission Control Protocol (TCP) – QOS Suggested reading- QOS improvement techniques	**CO-4** **BTL-2**
MODULE 5 – PRACTICAL NETWORK APPLICATIONS	**(6L)**
Domain Name Space (DNS) – Services provided –Simple Mail Transfer Protocol (SMTP) – Hyper Text Transfer Protocol (HTTP) –World Wide Web (WWW) – Client Server Architecture. Suggested reading- Socket Programming	**CO-5** **BTL-2**

TEXT BOOKS	
1.	Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw-Hill, 4th Edition, 2006
2.	Larry L. Peterson & Bruce S. Davie, "Computer Networks, A systems approach", Morgan Kaufmann Publication, 5th Edition, 2011
REFERENCE BOOKS	
1.	Data and Computer Communications,G.S.Hura and M.Singhal,CRC Press,Taylor and Francis Group, 2004.
2.	An Engineering Approach to Computer Networks-S.Keshav,2nd Edition,Pearson Education, 2001
3.	Computer Networks,A.S.Tanenbaum,4th edition,Pearson education, 2011
4.	Understanding communications and Networks,3rd Edition, W.A.Shay,Cengage Learning, 2003.
E BOOKS	
1.	http://www.mhhe.com/engcs/compsci/forouzan/frontmatter.pdf
2.	http://dpcvqz.chatrm.ru/imge?key=free+download+data+communication+and+networking+forouzan+5th+edition
MOOC	
1.	http://nptel.ac.in/courses/106105082/
2.	https://edurev.in/courses/14_Computer-Networks-and-Communication-by-NPTEL

COURSE TITLE	**INTRODUCTION TO ARDUINO AND ITS APPLICATIONS**			**CREDITS**	**2**
COURSE CODE	**ECD4383**	**COURSE CATEGORY**	**NDE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 module enables the students to design and implement real word applications. Arduino receives the information from sensors and can control the world around it by adjusting lights, motors and other actuators. This module describes the digital and analog Input/output devices and how to interface them with Arduino. This also introduces the use of software libraries with an Arduino sketch.
Course Objective	1. To provide knowledge of different Smart system applications 2. To familiarize students with Arduino as IDE, Programming language and platform 3. To provide knowledge of Arduino boards and basic components. 4. To develop skills to design and implement various smart system application.
Course Outcome	Upon completion of this course, the students will be able to 1. Summarize the embedded system characteristics and illustrate some embedded system applications. 2. Classify and compare different types of 8-bit Microcontroller 3. Demonstrate the Arduino development board and its functions. 4. Analyze the interfacing of Digital and Analog I/O devices with Arduino 5. Develop different control and automation systems with Arduino

Prerequisites: Basics of C and C++, Microcontroller and Electronic 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
CO-1	2	1	2	1	1	-	1	-	-	-	-	-	2	-
CO-2	3	1	2	1	1	-	1	-	-	-	-	-	2	-
CO-3	3	2	3	2	3	-	3	-	-	3	-	-	2	1
CO-4	3	2	3	2	3	-	3	-	-	3	3	3	3	1
CO-5	3	2	3	2	3	-	3	-	-	3	3	3	3	1

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

MODULE 1: OVERVIEW OF EMBEDDED SYSTEM	**(6L)**
Embedded System Characteristics, Examples: Washing Machine, Chocolate Vending Machine, Room Temperature Controller, Characteristics of Real Time Operating System	**CO-1 BTL-2**
MODULE 2: 8-BIT MICROCONTROLLERS ARCHITECTURE (ATMEGA 8,AVR)	**(6L)**
Microcontroller Types: PIC, AVR, ARM: features and applications, AVR microcontroller: Types , Architecture, Internal Architectural ,Block diagram of controller (At mega 8), Functions of each pins of AT mega, 6-channel ADC Working, Boot loader Circuit.	**CO-2 BTL-2**
MODULE 3: OPEN SOURCE EMBEDDED DEVELOPMENT BOARD (ARDUINO)	**(6L)**

Arduino: Birth, Open Source community, Functional Block Diagram of Arduino, Functions of each Pin of Arduino, Arduino Development Board diagram (including different blocks only): IDE, I/O Functions, Looping Techniques, Decision Making Techniques, Programming of an Arduino (Arduino ISP), Basic Circuit for Arduino.	**CO-3 BTL-3**
MODULE 4: INTERFACE DIGITAL AND ANALOG I/O DEVICES (ARDUINO INTERFACING)	**(6L)**
Basic Interfacing and I/O Concept, Interfacing LED,Switch,7seg LED its and Code, Interfacing POT,LM35,Acelerometer (ADXL3C5C) and its Code, Interfacing DC motor and its Code ,Interfacing 16x2 LCD and its code.	**CO-4 BTL-4**
MODULE 5: EMBEDDED SYSTEM APPLICATIONS (ARDUINO)	**(6L)**
Motor Driver L293D, IR Sensor, Code for Line Follower Robot, Interfacing Accelerometer with Arduino, Record Gestures, Code For Accelerometer based Robot, Interfacing of RF Tx/RF Rx with Arduino, Interfacing of Relay Driver ULN2803 with Arduino, Code for Home automation and its Control, Interfacing of USB-UART.	**CO-5 BTL-4**

TEXT BOOKS	
1.	Simon Monk, "30 Arduino Projects for Evil Genius "McGraw-Hill Professional.
2.	Michael McRoberts, Beginning Arduino, "Technology in Action ,2010
REFERENCE BOOKS	
1.	Dale Wheat, "Arduino Internas", Technology in Action, 2012
2.	John-david, Warren Josh Adams, Harald Molle, "Arduino Robotics, Technology in Action, 2008
E BOOKS	
1.	http://www.introtoarduino.com/downloads/IntroArduinoBook.pdf
2.	http://phylab.fudan.edu.cn/lib/exe/fetch.php?media=yuandi:arduino: getting_started_with_arduino_v2.pdf
MOOC	
1.	https://www.coursera.org/learn/arduino
2.	https://www.coursera.org/learn/arduino-platform

COURSE TITLE	**MACHNE LEARNING**			**CREDITS**	**2**
COURSE CODE	**ECD4384**	**COURSE CATEGORY**	**NE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 understand the importance of different types of Machine learning algorithms, data dimensionality reduction techniques and neural networks.
Course Objective	1. To comprehend the concept of supervised and unsupervised learning techniques 2. To apply different dimensionality reduction techniques 3. To understand the concepts of different data cross validation and Bay's classifier 4. To analyze the performance of various machine learning techniques features for training machine learning algorithms 5. To implement different Markov models and basic problems of HMMs
Course Outcome	Upon completion of this course, the students will be able to 1. Differentiate various learning approaches, and to interpret the concepts of supervised learning. 2. Compare the different dimensionality reduction techniques. 3. Apply theoretical foundations of decision trees to identify best split and Bayesian classifier to label data points. 4. Illustrate the working of classifier models like SVM, Neural Networks and identify classifier model for typical machine learning applications. 5. Identify the state sequence and evaluate a sequence emission probability from a given HMM.

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

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

MODULE 1: INTRODUCTION **(6L)**

Introduction to Machine Learning, Examples of Machine Learning applications - Learning associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning. Supervised learning- Input representation, Hypothesis class, Version space, Vapnik-Chervonenkis (VC) Dimension. **Suggested Readings:** Evaluation of Machine learning.	**CO-1** **BTL-3**

MODULE 2: REDUCTION TECHNIQUES **(6L)**

Probably Approximately Learning (PAC), Noise, Learning Multiple classes, Model Selection and Generalization, Dimensionality reduction- Subset selection, Principle Component Analysis. **Suggested Readings:** Data dimensionality reduction and advantages.	**CO-2** **BTL-3**
MODULE 3: INDUCTIVE CLASSIFICATION	**(6L)**
Classification- Cross validation and re-sampling methods- Kfold cross validation, Boot strapping, Measuring classifier performance- Precision, recall, ROC curves. Bayes Theorem, Bayesian classifier, Maximum Likelihood estimation, Density functions, Regression. **Suggested Readings:** Cross validation and Bay's theorem	**CO-3** **BTL-4**
MODULE 4: TREE AND PROBABILISTIC MODELS	**(6L)**
Decision Trees- Entropy, Information Gain, Tree construction, ID3, Issues in Decision Tree learning- Avoiding Over-fitting, Reduced Error Pruning, The problem of Missing Attributes, Gain Ratio, Classification by Regression (CART), Neural Networks- The Perceptron, Activation Functions, Training Feed Forward Network by Back Propagation. **Suggested Readings:** Decision tress, Neural network, handling of over and under fitting	**CO-4** **BTL-3**
MODULE 5: SUPPORT VECTOR MACHINES AND LANGUAGE LEARNING	**6L**
Kernel Machines - Support Vector Machine - Optimal Separating hyper plane, Softmargin hyperplane, Kernel trick, Kernel functions. Discrete Markov Processes, Hidden Markov models, Three basic problems of HMMs - Evaluation problem, finding state sequence, Learning model parameters. Combining multiple learners, Ways to achieve diversity, Model combination schemes, Voting, Bagging, Booting. **Suggested Readings:** Hyper planes, SVM and Markov models.	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
2.	Ethem Alpayidin, Introduction to Machine Learning (Adaptive Computation and machine Learning), MIT Press, 2004
3.	Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Pearson, 2006
4.	Ryszard S. Michalski, Jaime G. Carbonell, and Tom M. Mitchell, Machine Learning : An Artificial Intelligence Approach, Tioga Publishing Company
5.	Stephen Marsland, —Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
6.	Tom M Mitchell, —Machine Learning‖, First Edition, McGraw Hill Education, 2013.
REFERENCE BOOKS	
1.	Peter Flach, —Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.

2.	Jason Bell, —Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014
3.	Ethem Alpaydin, —Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)‖, Third Edition, MIT Press, 2014
E BOOKS	
1.	http://users.isr.ist.utl.pt/~wurmd/Livros/school/Bishop%20-%20Pattern%20Recognition%20And%20Machine%20Learning%20-%20Springer%20%202006.pdf
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc21_cs85/preview

COURSE TITLE	**MATLAB PROGRAMMING FOR ENGINEERS**			**CREDITS**	**3**
COURSE CODE	**ECD4387**	**COURSE CATEGORY**	**NE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**		**LEARNING LEVEL**	**BTL-5**

ASSESSMENT SCHEME

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

Course Description	Demonstrate knowledge and basic understanding of MATLAB, including popular toolboxes. Concepts covered include basic use, graphical representations and tips for designing and implementing MATLAB code.
Course Objective	This module describes the specific features of MATLAB that are useful for engineering classes. MATLAB sessions are used with one main goal: to allow students to become familiar with computer software (e.g., MATLAB) to solve application problems.
Course Outcome	Upon completion students will be able to 1. Familiarize the vector and matrix operations in MATLAB. 2. Write script and function programs in MATLAB. 3. Generate various types of plots in MATLAB. 4. Solve polynomials and differential equations in MATLAB. 5. Create Simulink models and GUIs in MATLAB.

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
CO-1	1	1	1	1	1	1	3	3	2	2	2	1	-	1

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

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

MODULE 1 – INTRODUCTION TO MATLAB	**(9 L)**
Introduction: The MATLAB Environment, Help feature, Type of files in MATLAB, Uses of MATLAB. **Constants, Variables and Expressions:** Character set, Data Types, Constants and Variables, Operators: arithmetic, relational and logical, Hierarchy of Operations, Built-in Functions. **Vectors & Matrices:** Creating Vectors and Matrices, Operations on Vectors, Element-by-Element Array Operations, Binary Matrix Operations, Unary Matrix Operations, Multidimensional Array, Structure arrays, cell arrays, String handling, Input & Output Statements.	**CO-1** **BTL-2**
MODULE 2 – PROGRAM WRITING & CONTROL STRUCTURES	**(9L)**
Program Writing: MATLAB editor, Types of M-files, Function subprograms, errors and warnings, Debugging. **Control structures:** Branch control structures- if, if else, nested if, if- else if-else, switch, try & catch, break, continue, error. Loop control structures- for -while - nested for.	**CO-2** **BTL-3**
MODULE 3 – PLOTS IN MATLAB	**(9L)**
Basic 2D plots- plot, figure, label, Grid, Axis, entering Text, Line style, Markers, Subplot, Multiple plots, log-log, semilog, polar, comet, fplot, ezplot, ezpolar, stem, bar, hist, pie, Graph plotting in MATLAB using data of a text file or excel file. **3D plots**- plot3, bar3, pie3, stem3, mesh, surf, contour and contour3.	**CO-3** **BTL-4**
MODULE 4 – POLYNOMIALS & DIFFERENTIAL EQUATIONS	**(9L)**
Polynomials: Entering A Polynomial, Polynomial Evaluation, Roots of A Polynomial, Polynomial Addition and Subtraction, Polynomial Multiplication, Polynomial Division, Formulation of Polynomial Equation, Polynomial Differentiation, Polynomial Integration, Polynomial Curve Fitting. **Differential equations:** Ordinary Differential Equation Solvers, Calculus using Symbolic Mathematics.	**CO-4** **BTL-4**
MODULE 5 – SIMULINK AND GUI	**(9L)**
SIMULINK- Modelling, Simulating a model, Using variables from MATLAB, Data Import & Export, Creating subsystems. **GUI**- Creating apps with GUIDE, adding components, applications of components, writing call back for the components.	**CO-5** **BTL-5**
TEXT BOOKS	

1	Rudra Pratap, “Getting Started with MATLAB” ,7th Edition, Oxford University Press,2016.
2	Stephen J Chapman, “MATLAB programming for Engineers”, 5th edition, Cengage Learning,2016.
3	R.K Bansal, Manoj Sharma, A.K. Goel, “MATLAB and Its Applications in Engineering”, Pearson Eduction,2009.
4	Holly Moore, “MATLAB for Engineers”,4th edition, Pearson, 2012.
REFERENCE BOOKS	
1	Stephen J Chapman, “Essentials of MATLAB Programming” ,3rd edition, Cengage Learning, 2018.
2	William J Palm III , “Introduction to MATLAB for engineers”,3rd edition, Mc-Graw Hill Education, 2010.
3	Agam Kumar Tyagi, Matlab and Simulink for Engineers, OUP India, 2011.
E BOOKS	
1	Rudra Pratap, “Getting Started with MATLAB”, Oxford University Press.
MOOC	
1	https://in.mathworks.com/videos.html
2	http://www.learningmatlab.com/videos/

SEMESTER VI

COURSE TITLE	**IMAGE PROCESSING AND PATTERN RECOGNITION**			**CREDITS**	**2**
COURSE CODE	**ECD4391**	**COURSE CATEGORY**	**NE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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	Image processing and pattern recognition subject deals with knowledge in image processing details ,segmentation process, pattern recognition tools and application				
Course Objective	1. To get adequate background knowledge about image processing. 2. To get adequate background knowledge in image pre-processing techniques. 3. To get practical knowledge and skills about image segmentation methods and morphology 4. To get basic knowledge and skills about pattern recognition tools. 5. To get an image processing and pattern recognition application.				

Course Outcome	1. Able to get adequate background knowledge about image processing 2. Able to get adequate background knowledge in image pre-processing techniques. 3. Able to get practical knowledge and skills about image segmentation methods and morphology 4. Able to get basic knowledge and skills about pattern recognition tools. 5. Able to Get necessary knowledge to design and implement a prototype of an image processing and pattern recognition application

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

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

MODULE 1:Digital Image fundamentals	**(6L)**
Elements of visual perception, steps in digital image processing, applications of image processing, image function, image representation, basic relationship between pixels, sampling, quantization, color images, image quality, noise image. **Suggested Reading:** Metrics and topological properties of digital images	**CO-1** **BTL-2**
MODULE 2: Image Preprocessing	**(6L)**
Pixel brightness transformation, position dependent brightness correction, gray scale transformation; geometric transformation, local pre-processing, spatial filtering: smoothing, sharpening filters, edge detectors, zero-crossing, various edge detection methods, parametric images, local preprocessing and adaptive neighborhood preprocessing, image restoration- in the presence of noise only spatial filtering. **Suggested Reading:** Frequency domain filters: smoothing, sharpening filters	**CO-2** **BTL-2**
MODULE 3: Image Segmentation & Mathematical Morphology	**(6L)**
Threshold detection methods, optimal thresholding, global thresholding, adaptive thresholding, edge based image segmentation- edge linking and boundary detection, region based segmentation. Basic morphological concepts, four morphological principles, binary dilation, erosion, thinning and skeleton algorithms; Morphological segmentation. **Suggested Reading:** Hit or miss transformation, opening and closing.	**CO-3** **BTL-3**
MODULE 4: Basics of Pattern Recognition & Unsupervised Learning	**(6L)**

Pattern Recognition Fundamentals Basic Concepts of pattern recognition, Fundamental problems in pattern recognition system, design concepts and methodologies. Exarrfe of automatic pattern recognition systems. a simple automatic pattern recognition model. Unsupervised learning and clustering, criterion functions for clustering, K-means and hierarchical clustering, cluster validation. **Suggested Reading:** Bayesian decision theory, classifiers, discriminant functions	**CO-4** **BTL-2**
MODULE 5: Propagation and Detection of Radar Signals	**(6L)**
Maximum likelihood estimation, expectation – maximization method, Bayesian estimation.K-nearest neighbor method, linear discriminant functions based classifiers, support vector machines. **Suggested Reading:** Gaussian mixture models	**CO-5** **BTL-2**
TEXT BOOKS	
1.	A.K. Jain, —Fundamentals of Digital Image Processing‖, PHI, 1998
REFERENCE BOOKS	
1.	Earl Gose, Richard Johnsonbaugh, —Pattern Recognition and Image Analysis‖, 1st Edition, Prentice Hall of India Private limited, 2009.
2.	Millan Sonka, Vaclav Hiavac, Roger Boyle, —Image Processing Analysis and Machine Vision‖, 3rd Edition, CL Engineering, 2013.
E BOOKS	
1.	http://www.engineeringbookspdf.com/digital-image-processing-6th-revised-and-extended-edition/
MOOC	
1.	https://www.coursera.org/courses?languages=en&query=pattern+recognition
2.	http://handbook.uts.edu.au/subjects/details/31256.html

COURSE TITLE	**RADAR AND OPTICAL COMMUNICATION**			**CREDITS**	**2**
COURSE CODE	**ECD4392**	**COURSE CATEGORY**	**NE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 module gives a introduction about various radars and their working principle. The final part deals with optical communication, optical fiber modes configuration and various signal degradation factors associated with optical fibers. It covers optical sources and receivers.
Course Objective	1.To derive the radar range equation 2.To study and categorize various tracking radars 3.To study the different structures of optical fibers 4.To calculate the quantum efficiency of optical sources and detectors 5.To design the fiber optical system
Course Outcome	Upon completion of this course, the students will be able to 1.Summarize the working principles of radar and derive the radar range equation 2. Examine the different types of radars and categorize various tracking radars 3.Analyse the different structures of optical fibers and identify the various losses 4. Examine the quantum efficiency of optical sources and detectors 5. Interpret the design considerations of fiber optical system

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

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

MODULE 1: INTRODUCTION TO RADAR	**6L**
Basic radar, Simple form of radar equation, Radar block diagram, Radar frequencies, Application of radar. **Radar Equation**- Discussion, Detection of signals in noise, Receiver noise and signal-to-noise ratio, Probability density functions, Probability of detection and false alarm, Integration of radar pulses	**CO-1** **BTL-2**
MODULE 2: DOPPLER AND MTI RADAR	**6L**
Introduction, Delay-line cancelers, Staggered pulse repetition frequencies, Doppler filter banks, Digital MTI Processing, Pulse Doppler radar	**CO-2** **BTL-2**
MODULE 3: OVERVIEW OF OPTICAL FIBER COMMUNICATIONS	**6L**
Motivations for light wave communications, Optical spectral bands, Fundamental data communication concepts, Network information rates, WDM concepts, Key elements of	**CO-3** **BTL-3**

optical fiber systems. **Optical fibers**: Structures, waveguiding- Nature of light, Basic optical laws and definition, Optical fiber modes and configurations, Mode theory for circular waveguides, Single-mode fibers, Graded-index fiber structure.	
MODULE 4: SIGNAL DEGRADATION IN OPTICAL FIBERS	**6L**
Attenuation, Signal distortion in fibers, Characteristics of single-mode fibers. Optical sources- Light-emitting diodes, Laser diodes.	**CO-4 BTL-2**
MODULE 5: OVERVIEW ON PHOTODETECTORS	**6L**
Photodetectors- Physical Principles of photodiodes, Photodetector noise, Detector response time, Avalanche multiplication noise, Structure of InGaAs APDs, Temperature effect on avalanche gain, Comparison of photodetectors.	**CO-5 BTL-2**
TEXT BOOKS	
1.	Merrill I. Skolnik, "Introduction to Radar Systems", Third Edition, McGraw-Hill, 2001.
2	G. Keiser, "Optical Fiber Communication", Fourth Edition, McGraw-Hill, 2010.
REFERENCE BOOKS	
1.	Merrill I. Skolnik, "Radar Handbook", second Edition, McGraw-Hill, 1990.
2.	G.P.Agarwal, "Fiber Optic Communiacation Systems", Third Edition, Wiley, 2002.

COURSE TITLE	**FUNDAMENTALS OF WIRELESS SENSOR NETWORKS**			**CREDITS**	**2**
COURSE CODE	**ECD4393**	**COURSE CATEGORY**	**NE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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	The course will provide students with an understanding of wireless sensors networks enable them to recognize the wide range of applicability of these networks and provide them with an understanding of the major design issues including topics such as protocol mechanisms and resource constrains. Wireless networks are set up dynamically, for a short time and limited purpose and without using any fixed network infrastructure like base station, access point etc. Important application area includes the provision of networking facilities to human operators in disaster areas or in areas with no infrastructure. Key design challenges include the need for self-organization and the support for mobility between the involved nodes.				

Course Objective	1. To Interpret the basic wireless sensor technology and its applications 2. To Explain the MAC protocols of WSN. 3. To Analyze the challenges in designing routing protocols and routing techniques in WSN 4. To summarize the operating system of WSN and its components 5. To Outline the working models and performance of a WSN
Course Outcome	Upon completion of this course, the students will be able to 1. Explain sensor networks and emerging technologies 2. Describe the node and network architecture of sensor nodes and its execution environment. 3. Elaborate the concepts of communication, MAC, routing protocols and also study about the naming and addressing in WSN 4. Comprehend topology control and clustering in networks with timing synchronization for localization services with sensor tasking and control 5. Differentiate sensor node hardware and software platforms and understand the simulation and programming 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
CO-1	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO-2	2	2	-	1	-	-	-	-	-	-	-	-	2	-
CO-3	2	2	-	1	-	-	-	-	-	-	-	-	2	-
CO-4	2	2	-	1	1	-	-	-	-	-	-	-	2	-
CO-5	2	-	-	1	1	1	-	-	-	-	-	-	2	-

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

MODULE 1: OVERVIEW OF WIRELESS SENSOR NETWORKS	**(6L)**
Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. **Suggested Readings:** Protocols And Architectures for Wireless Sensor Networks	**CO-1** **BTL-4**

MODULE 2: ARCHITECTURES	**(6L)**
Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts. **Suggested Readings:** Protocols And Architectures for Wireless Sensor Networks	**CO-2** **BTL-4**

MODULE 3: NETWORKING SENSOR (6L)	
Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing. **Suggested Readings:** Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks- Technology, Protocols, And Applications", John Wiley, 2007	**CO-3** **BTL-4**
MODULE 4: INFRASTRUCTURE ESTABLISHMENT (6L)	
Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. **Suggested Readings:** Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003	**CO-4** **BTL-4**
MODULE 5: SENSOR NETWORK PLATFORMS AND TOOLS (6L)	
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming, Case study **Suggested Readings:** Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.
2.	Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007
REFERENCE BOOKS	
1.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks- Technology, Protocols, And Applications", John Wiley, 2007.
2.	Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003
E BOOKS	
1.	http://image.sciencenet.cn/olddata/kexue.com.cn/bbs/upload/12615WSN-2007.pdf
2.	http://doktora.kirbas.com/Kitaplar/Wireless%20Sensor%20Networks%20(Akyildiz).pdf
MOOC	
1	http://nptel.ac.in/courses/106105160/21
2	http://nptel.ac.in/courses/106105160/
3	http://nptel.ac.in/courses/114106035/37

COURSE TITLE	PROJECT PLANNING AND ORGANIZATION FOR ENGINEERS			CREDITS	2
COURSE CODE	ECD4397	COURSE CATEGORY	NDE	L-T-P-S	2-0-0-1

Version	1.0	Approval Details	24th ACM, 30.05.2018	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	Project planning and organization helps an engineer to start the career in a project assigned to him and prepare for any difficult work situation that might be encountered. It's a temporary endeavor undertaken to create a unique product, service or result. This course helps the student to plan, prepare, organize and manage a project as a skillful engineer. It helps and guides the step by step procedure to formulate a problem, organize it, execute and accomplish it successfully. The course will also help the students in carrying out the final year project successfully.				
Course Objective	1. To develop project scope and methodology while considering factors such as customer requirements and internal/external goals 2. To organize the selection and initiation of individual projects by understanding the concepts of project management. 3. To construct plans relevantly to achieve the project's goals 4. To comprehend the project procurement process 5. To understand the various concepts involved in Project Consulting				
Course Outcome	Upon completion of this course, the students will be able to 1. Outline the scope, cost, timing, and quality of the project, at all times focused on project success as defined by project stakeholders 2. Demonstrate effective organizational leadership skills for managing projects, project teams, and stakeholders. 3. Make use of project planning methods to accurately forecast project costs, timelines, and quality in order to achieve the desired outcome in the project. 4. Develop a tender document for the purpose of project procurement 5. Describe the client objectives and facilitate appropriate consulting for design and production 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
CO-1	1	1	1	0	0	1	1	2	3	3	3	3	-	-
CO-2	1	1	1	0	0	2	1	2	3	3	3	3	-	-
CO-3	1	1	1	0	0	2	1	2	3	3	3	3	-	-
CO-4	1	1	1	0	0	2	1	1	3	3	3	3	-	-

CO-5	1	1	1	0	0	2	2	1	3	3	3	3	-	-

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

MODULE 1: INTRODUCTION TO PROJECTS	**(6L)**
Introduction to Projects: Project Team- Purpose and Scope of a Project- Project Work Methodology- Project Contracting Types- Characteristics and Categories of a Project- Project Structure **Suggested Readings:** Project Quality control	**CO-1** **BTL-2**
MODULE 2: PROJECT MANAGEMENT	**(6L)**
Definition of Project Management, Management Functions, Project Authority and Responsibility, Role and Responsibilities of a Project Manager, Types of Project Organization. Predictability: Definition and Concept, Predictability in a Project **Suggested Readings:** Codes and standards	**CO-2** **BTL-2**
MODULE 3: PROJECT PLANNING AND SCHEDULING	**(6L)**
Project Life Cycle: Statement of Work (SOW), Project Specifications. Project Planning. Project Scheduling: Work Breakdown Structure, Gantt Chart, Program Evaluation and Review Technique (PERT), Critical Path Method (CPM), Differentiation between PERT and CPM. **Suggested Readings:** Project Network Analysis	**CO-3** **BTL-3**
MODULE 4: PROJECT PROCUREMENT ENGINEERING	**(6L)**
Procurement Process- Preparation of Tender Documents: Tender Process- Procedure for Submisssion of Bids-Cost of the Tender. Tender Document: Content of the Tender Document- Clarification of Tender Document,-Amendment in the Tender Document.- Preparation of Bids **Suggested Readings:** Formats and Signing of Bids	**CO-4** **BTL-2**
MODULE 5: PROJECT CONSULTING	**(6L)**
Consulting-Definition-Need for Consultants-Scope of Management Consulting- Consulting Process,-Main types of Consulting Organizations-Customer Client Relationship-Defining Expectations and Roles-Client and the Consultant system- Critical Dimensions of consultant client relationship- Behavioural role of consultants- Case Study **Suggested Readings:** Managing a consulting firm	**CO-5** **BTL-2**

TEXT BOOKS	
1.	Dilip N Pawar,Dattatray K Nikam, “Fundamentals of Project Planning and Engineering”, S Penram International Publishing, Mumbai, 2017.
REFERENCE BOOKS	
1.	Gary R Heerkens, “Project Management”, McGraw Hill, 2002.

2.	Milan Kubr, "Management Consulting A Guide to the Profession", ILO Publications, Geneva,Switzerland,2002.4th Edition
E BOOKS	
1.	https://onlinelibrary.wiley.com/doi/book/10.1002/9781119197508
2.	https://bookboon.com/en/projectmanagement-ebook
MOOC	
1.	https://nptel.ac.in/courses/110104073/
2.	https://nptel.ac.in/courses/110107081/
3.	https://nptel.ac.in/courses/105106149/

SEMESTER VII

COURSE TITLE	**FUNDAMENTALS OF SOFTWARE DEFINED RADIO**			**CREDITS**	**2**
COURSE CODE	**ECD4481**	**COURSE CATEGORY**	**NE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**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 gives a strong theoretical and Practical foundation for Engineering concepts about benefits of Software Defined Radio, its hardware and software architecture, design of trans-receiver structure to understand the different types of its application in different areas of communication.
Course Objective	To provide knowledge of fundamental and state-of the art concepts in software defined radio.
Course Outcome	Student will be able to 1.Explain the Characteristics and benefits of a Software Radio 2.Comprehend the basic SDR architectures and their functions 3. Discuss the structural and behavior of both Transmitter and Receiver 4. Differentiate the function of Key Hardware devices 5. Summarize the need of smart antennas for SDR

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**

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

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

MODULE 1 – SDR INTRODUCTION	**(6L)**
Introduction to Software Defined Radio- the Need for Software Radios, Characteristics and benefits of a Software Radio- SDR concepts, history and Design principles.	**CO-1 BTL-2**
MODULE 2 – ARCHITECTURE	**(6L)**
Ideal SDR architecture- SDR Based End to- End Communication. 2G Radio Architectures Hybrid Radio Architecture- Basic SDR Block Diagram- Digital Frequency Conversion Partitioning- Operating Environment (OE).	**CO-2 BTL-2**
MODULE 3 –FRONT END TECHNOLOGY	**(6L)**
Radio Frequency translation, Transmitter and Receiver specifications & Architecture, - Architecture, considerations- Front end Implementation-Data conversions-Zero IF receivers, Preselect Filters.	**CO-3 BTL-3**
MODULE 4 – HARDWARE REQUIREMENTS	**(6L)**
Digital hardware choices- Key hardware elements, DSP processors and FPGA , Trade-offs in using DSPs, FPGAs, and ASICs and its combination, Power management issues	**CO-4 BTL-2**
MODULE 5 – SMART ANTENNA SYSTEMS FOR SDR	**(6L)**
ADC and DAC conversion Parameters of ideal data converters and its architectures, Techniques to improve data converter performance, - Antenna requirements -Benefits of smart antennas, Structures for beam forming systems.	**CO-5 BTL-2**

TEXT BOOKS	
1.	Software Radio Architecture: Object-Oriented Approaches to Wireless Systems Engineering by Joseph Mitola Wiley-Interscience; 1st edition 2000
REFERENCE BOOKS	
1.	Bard, Kovarik: Software Defined Radio, The Software Communications Architecture, Wiley2007, 3rd Edition.
2.	J H Reed, Software defined Radio, Prentice Hall,2002
E BOOKS	
1.	http://s1.downloadmienphi.net/file/downloadfile6/192/1385263.pdf
2	http://www.ac0c.com/attachments/An_Introduction_to_Software_Defined_Radios_v2a.pdf
1.	https://www.youtube.com/watch?v=5BVJmtyp7_E
2.	https://www.youtube.com/watch?v=BK9QkHxeYQI

COURSE TITLE	RADIO-FREQUENCY IDENTIFICATION (RFID) AND ITS APPLICATIONS			CREDITS	2
COURSE CODE	ECD4482	COURSE CATEGORY	NE	L-T-P-S	2-0-0-1
Version	1.0	Approval Details	24th ACM, 30.05.2018	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	Radio frequency identification system (RFID) is an automatic technology and aids machines or computers to identify objects, record metadata or control individual target through radio waves. Connecting RFID reader to the terminal of Internet, the readers can identify, track, and monitor the objects attached with tags globally, automatically, and in real time, if needed. RFID is often seen as a prerequisite for the IoT. Thus, this course introduces features and characteristics of readers and tags, typical frequencies, components, antennas, middleware, standards for electronic product coding. It also discusses the various applications using RFID.
Course Objective	1. Learn RFID evolution, systems, and classifications 2. Understand the RFID readers and tags, transceivers etc. 3. Get familiarize with RFID reader antennas and tag antennas 4. Study various RFID protocols 5. Understand various RFID based applications.
Course Outcome	Upon completion of this course, the students will be able to 1. Describe RFID evolution, systems, and classifications 2. Differentiate RFID readers and tags, transceivers etc. 3. Examine the performance of reader antennas and tag antennas 4. Classify the various RFID protocols 5. Discuss the RFID based applications.

Prerequisites: Basics of Antenna theory, Basics of communication Systems

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
CO-1	1	1	-	1	1	-	-	-	-	-	-	-	-	2
CO-2	1	1	-	1	1	-	-	-	-	2	-	-	-	2
CO-3	1	1	-	1	1	-	-	-	-	-	-	-	-	2

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

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

MODULE 1: BASICS FOR RFID	**(6L)**
Introduction, history and evolution of RFID technology, RFID systems and terminology, Types of RFID- frequency bands of RFID – Passive, Semi passive and active Tags, Communication Protocols, Electromagnetic waves. **Suggested Readings:** The Internet of Things and UHF RFID	**CO-1** **BTL-2**
MODULE 2: RFID READERS AND TAGS	**(6L)**
Radio Architecture, Radio components-Amplifiers, Mixers, Oscillators, Filters, Digital – analog Conversion, Circulators and directional couplers, RFID transmitters, RFID receivers, Power, RF to DC, Tags IC overall design challenges, Packaging. **Suggested Readings:** Packaging: No Small Matter	**CO-2** **BTL-2**
MODULE 3: READER ANTENNAS AND TAG ANTENNAS	**(6L)**
Antenna for fixed readers, Antennas for handheld and Portable Readers, Near –field antennas, Cable and connectors, Impedance matching and power transfer, Dipoles and derivatives, tags and the local environment, Near-filed and Hybrid tags antennas. **Suggested Readings:** General Antenna Theory and Practice	**CO-3** **BTL-3**
MODULE 4: RFID PROTOCOLS	**(6L)**
EPC global generation 1-Class 0, class 1 Generation 1, ISO 18000-6B, ISO 18000-6C, ISO 18000-extensions, Battery –Assisted Tags, sensors, Active Device protocols. **Suggested Readings:** RFID Protocols: The Source Docs, RFID Protocols: Security and Privacy	**CO-4** **BTL-2**
MODULE 5: RFID APPLICATIONS	**(6L)**
Aircraft identification, Railcar tracking, automobile tolling , animal tracking, Container tracking, supply chain tracking for consumer goods, RFID use in pharmaceutical. **Suggested Readings:** UWB Tags, Cold Chain Tracking	**CO-5** **BTL-2**

TEXT BOOKS	
1.	V.Daniel Hunt, Albert Pugila and Mike Pugila, “RFID- A-guide to Radio Frequency identification” A John Wiley and Sons- 2007.
2	Daniel M. Dobkin,” The RF in RFID”- second edition, Newness Pubilcation-2013
REFERENCE BOOKS	
1.	Albert Lozano-Nieto “RFID Design Fundamentals and Applications” CRC press-2010

2.	Syed A. Ahson , Mohammad Ilyas RFID Handbook: Applications, Technology, Security, and Privacy,CRC press-2008
3	Jari-Pascal Curty , Michel Declercq , Catherine Dehollain , Norbert Joehl " Design and Optimization of Passive UHF RFID Systems "Springer-2007.
E BOOKS	
1.	https://rfid.atlasrfidstore.com/basics-of-an-rfid-system-ebookText book companion
2	https://www.elektor.com/rfid-ebook
MOOC	
1.	http://nptel.ac.in/courses/105101008/524_AutoMer/point16/point.html
2.	RFID (web), https://youtu.be/15GeJRg4XR0

COURSE TITLE	**MODERN WIRELESS COMMUNICATION SYSTEMS**			**CREDITS**	**2**
COURSE CODE	**ECD4483**	**COURSE CATEGORY**	**NE**	**L-T-P-S**	**2-0-0-1**
Version	**1.0**	**Approval Details**	**24th ACM, 30.05.2018**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

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

Course Description	This course gives the fundamentals of wireless communication and explains the web of concepts underpinning these advances at a level accessible to an audience with a basic background in probability and digital communication. Topics covered include MIMO (Multiple Input Multiple Output) communication, space-time coding, opportunistic communication, OFDM and CDMA. The concepts are illustrated using many examples from wireless systems such as GSM, IS-95 (CDMA), IS-856 (1EV-DO), Flash OFDM and Array Comm SDMA systems.
Course Objective	1. To familiarize with the fundamentals of communication systems. 2. To infer the requirements of mobile communication as compared to static communication 3. To identify the requirements of communication network and mobile networks. 4. To summarize the fundamentals of mobile communication systems with their standards. 5. To identify and choose various short range wireless communication.

Course Outcome	Upon completion of this course, the students will be able to 1. Outline the evolution, types and functioning of wireless communication system and standards, fundamentals of analog and digital transmission. 2. Summarize the concepts of modern wireless network LANs and cellular network systems. 3. Explain various multiple access techniques for Wireless Communication. 4. Compare the various wireless cellphone generations and multiplexing techniques. 5. Discuss the design of short wireless networks such as bluetooth, cordless, WiMax etc.,"

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

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

MODULE 1: FUNDAMENTALS	**(6L)**
Introduction: Wireless communication systems, Applications of wireless communication systems, Types of wireless communication systems. **Transmission Fundamentals**: Time domain & Frequency domain concepts, Analog vs. Digital data transmission, channel capacity, transmission media.	**CO-1** **BTL-2**
MODULE 2: CONCEPTS OF NETWORKS	**(6L)**
Communication Networks: LANs, MANs, WANs, circuit switching, packet switching, ATM **Cellular Networks:** Cells, duplexing, multiplexing, voice coding	**CO-2** **BTL-2**
MODULE 3: MULTIPLE ACCESS TECHNIQUES	**(6L)**
FDMA, TDMA, SDMA, CDMA, Spread Spectrum, Packet Radio: ALOHA and Slotted ALOHA	**CO-3** **BTL-3**
MODULE 4: WIRELESS TECHNOLOGIES & STANDARDS	**(6L)**
Cellphone Generations: 1G, 2G, 2.5G, 3G & 4G. **Beyond 3G:** IMT-2000, W-CDMA, CDMA 2000, EDGE, OFDM.	**CO-4** **BTL-3**
MODULE 5: SHORT RANGE NETWORKS	**(6L)**
Short-Range Wireless Networks: Unlicensed spectrum, Wireless LANs, cordless systems, IrDA, Bluetooth, wireless Local Loop, WiMAX.	**CO-5** **BTL-3**

TEXT BOOKS	
1.	William Stallings, “Wireless Communications And Networks”, 2nd EDITION, Pearson Education 2005.
2.	Andy Dornan, “Essential Guide to Wireless Communications Applications”, 2nd Edition, Prentice Hall, 2002.
3.	Theodore, S. Rappaport, “Wireless Communications, Principles”, 2nd Edition., PHI, 2002.
4.	Mischa Schwartz, “Mobile Wireless Communications”, Cambridge University Press, 2013.
REFERENCE BOOKS	
1	Kaveh Pah Laven and P. Krishna Murthy , “Principles of Wireless Networks, Pearson Education, 2002.
2	Andreaws F. Molisch , “Wireless Communications” , Wiley India, 2006
MOOC	
1	http://www.nptelvideos.in/2012/12/wireless-communication.html
2	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/lecture-20-introduction-of-wireless-communication/

COURSE TITLE	INTRODUCTION TO SENSOR TECHNOLOGY			CREDITS	2
COURSE CODE	ECD4484	COURSE CATEGORY	NE	L-T-P-S	2-0-0-1
Version	1.0	Approval Details	24th ACM, 30.05.2018	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 provides good knowledge of working of different types of sensors used in various application areas. The course also provides knowledge of interfacing of electronic circuits with different sensors for it's applications in different fields.				
Course Objective	The main objective of this course is to give an introduce about various applications of sensor technology in line with advancements in technology				

Course Outcome	Upon completion of this course, the students will be able to 1. Outline the concepts and characteristics of sensors 2. Summarize the physical principles of sensors 3. Describe the interface electronic circuits 4. Classify the different types of sensors for various applications. 5. Discuss the various sensor materials and technology used in designing sensors

Prerequisites: Basic Electronics fundamentals

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

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

MODULE 1: SENSOR FUNDAMENTALS AND CHARACTERISTICS	**(6L)**
Sensors, Signals and Systems; Sensor Classification; Units of Measurements; Sensor Characteristics. **Suggested Readings:** Advanced sensors and its characteristics	**CO-1** **BTL-2**
MODULE 2: PHYSICAL PRINCIPLES OF SENSING	**(6L)**
Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material. Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material **Suggested Readings:** Heat Transfer; Light; Dynamic Models of Sensor Elements	**CO-2** **BTL-2**
MODULE 3 INTERFACING SENSORING CIRCUIT	**(6L)**
Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits **Suggested Readings:** Batteries for Low Power Sensors	**CO-3** **BTL-3**
MODULE 4: SENSORS IN DIFFERENT APPLICATION AREA	**(6L)**

Occupancy and Motion Detectors- Ultrasonic sensors, Visible and Near Infrared Light motion detectors, far infrared motion detectors. Temperature sensors- Thermistors & Optical temperature sensors. **Suggested Readings:** Sensor application in automobiles	**CO-4** **BTL-3**
MODULE 5: SENSOR MATERIAL AND TECHNOLOGY	**(6L)**
Materials, Surface Processing, Nano-Technology. **Suggested Readings:** Technology of sensors in robotics application	**CO-5** **BTL-3**
TEXT BOOKS	
1.	J. Fraden, Handbook of Modern Sensors:Physical, Designs, and Applications, AIP Press, Springer, fourth edition, 2010
2.	D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi, second edition, 2003.
REFERENCE BOOKS	
1.	Mechatronics- Ganesh S. Hegde, Published by University Science Press (An imprint of Laxmi Publication Private Limited), Second edition, 2009.
E BOOKS	
1.	https://www.springer.com/la/book/9781493900404
MOOC	
1.	http://nptel.ac.in/courses/112103174/3
2.	http://nptel.ac.in/courses/112103174/pdf/mod2.pdf