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

SCHOOL OF ELECTRICAL SCIENCES

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS)

- *With amendments as approved from 26th ACM to 32nd ACM (07.08.2021).*
- *Applicable for the students admitted from 2018-19.*

Curriculum and syllabus

"TO MAKE EVERY MAN A SUCCESS AND NO MAN A FAILURE"

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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 ELECTRICAL AND ELECTRONICS ENGINEERING

Vision:

To educate the students in the recent developments of emerging fields in Electrical and Electronics Engineering, to encourage research activities, innovative techniques and to develop managerial abilities so as to make them excel globally with ethical values.

Mission:

- *To empower students with state-of-art knowledge and technological skills in Electrical and Electronics Engineering.*
- *To keep pace with changing industrial requirement and to imbibe the students with new technology.*
- *To mould students for research, innovation and entrepreneurship.*
- *To inculcate managerial and professional capabilities with ethics and human values.*

B. Tech. ELECTRICAL AND ELECTRONICS ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

The program is expected to enable the students to

PEO1: Graduates will be capable of modelling, designing and developing innovative solutions for critical Electrical and Electronics Engineering problems using advanced techniques.

PEO2: Graduates will demonstrate professional competence, practical and innovative skills in integrating various electrical and electronics components enabling them to have successful careers in Electrical and Power, Electric Vehicle or allied industry.

PEO3: Graduates will be able to pursue higher studies, involve in research and development activities in interdisciplinary topics by applying recent technological developments in electronics and embedded systems.

PROGRAM OUTCOMES (ALIGNED WITH GRADUATE ATTRIBUTES) (PO)

1. **A knowledge base for engineering:** Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.

2. **Problem analysis:** An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions

3**. Investigation:** An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions.

4. **Design:** An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.

5. **Use of engineering tools:** An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.

6. **Individual and teamwork:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.

7. **Communication skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing,

speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.

8.**Professionalism:** An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.

9. **Impact of engineering on society and the environment:** An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.

10. **Ethics and equity:** An ability to apply professional ethics, accountability, and equity.

11. **Economics and project management:** An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.

12. **Life-long learning:** An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge

. PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1: Use logical & technical skills to model, simulate, analyze and develop electrical components and systems.

PSO2: Integrate the knowledge of fundamental electronics, power electronics control system and embedded systems for designing industrial control systems.

PSO3: Contribute for the development of smart power grid, electric vehicle and integrating green energy to meet the increasing demand of the society.

B.TECH –ELECTRICAL AND ELECTRONICS ENGINEERING									
(165 CREDIT STRUCTURE)									
SEMESTER - I									
S. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	BS	MEB4101/ ELA4101	Engineering Graphics and Computer Aided Design / Professional English and soft skills	1	1	2	3	1	4
2	BS	MAA4101	Matrices and Calculus	3	0	2	4	1	5
3	BS	PHA4102/ CYA4101	Engineering Physics / Engineering Materials	3	0	0	3	1	3
4	PC	CSA4101/ GEA4102	Problem solving using C* / Sustainable Engineering Systems	2	0	2*	3/2	1	4/3
5	PC	EEB4101 / EEB4118	Introduction to Digital Systems / Engineering And Design	3	0	0	3	1	3
6	BS	EEA4131	Engineering Immersion Lab	0	0	2	0.5	2	2
7	BS	PHA4131/ CYA4131	Engineering Physics / Materials Chemistry Lab	0	0	2	1	0	2
Total				**12**	**1**	**10**	**17.5/ 16.5**	**7**	**23/ 22**

***Project based learning**

SEMESTER - II									
S. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	BS	MAA4117	Analytical Mathematics	3	0	2	4	1	5
2	BS	PHA4102/ CYA4101	Engineering Physics / Engineering Materials	3	0	0	3	1	3
3	BS	MEB4101/ ELA4101	Engineering Graphics And Computer Aided Design / Professional English and soft skills	1	1	2	3	1	4
4	PC	CSA4101/ GEA4102	Problem solving using C* / Sustainable Engineering Systems	2	0	2*	2/3	1	3/4
5	PC	EEB4101 / EEB4118	Introduction to Digital Systems / Engineering And Design	3	0	0	3	1	3

6	PC	EEB4116	Electromagnetic Theory	3	1	0	4	1	4
7	PC	EEB4117	Circuits and Networks	3	1	0	4	1	4
8	PC	EEB4141	Circuits and Networks laboratory	0	0	2	1	1	2
9	BS	EEA4131	Engineering Immersion Lab	0	0	2	0.5	2	2
10	BS	PHA4131/ CYA4131	Engineering Physics / Materials Chemistry Lab	0	0	2	1	1	2
Total				**18**	**3**	**10/ 12**	**25.5 /26.5**	**8**	**32/33**

SEMESTER - III									
S. 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	0	5
2	PC	EEB4201	Electrical machines	3	1	0	4	1	4
3	PC	EEB4202	Analog Electronics	3	1	0	4	0	4
4	BS	GEA4216	Professional Ethics and Life Skills	2	0	0	2	0	2
5	DE		Department Elective-I	3	0	0	3	0	3
6	NE		Non Department Elective- I	2	0	0	2	0	2
7	PC	EEB4231	Electrical machines laboratory	0	0	3	1		3
8	PC	EEB4232	Analog Electronics laboratory	0	0	3	1		3
9	PC	EEB4233	Design Project I	0	0	2	1	0	2
Total				**16**	**2**	**10**	**22**	**1**	**28**

SEMESTER - IV									
S. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**

1	PC	MAA4217	Numerical Methods	3	0	2	4	0	5
2	PC	EEB4216	Signals and Systems	3	1	0	4	1	4
3	PC	EEB4217	Control Systems	3	1	0	4	1	4
4	PC	EEB4218	Transmission & Distribution	3	1	0	4	1	4
5	DE		Department Elective-II	3	0	0	3	0	3
6	NE		Non Department Elective–II	2	0	0	2	0	2
7	PC	EEB4241	Electrical Simulation laboratory	0	0	2	1	0	2
8	PC	EEB4242	Control Systems Laboratory	0	0	2	1	0	2
9	PC	EEB4243	Design Project II	0	0	2	1	0	2
Total				**17**	**3**	**8**	**24**	**3**	**28**

SEMESTER - V									
S. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	BS	MAA4301	Optimization Techniques	3	1	0	4	0	4
2	PC	EEB4301	Power Electronics	3	1	0	4	2	4
3	PC	EEB4302	Microcontroller and Embedded Systems	3	0	2	4	1	5
4	PC	EEB4303	Measurement and Instrumentation	2	0	2	3	1	4
5	DE		Department Elective-III	3	0	0	3	0	3
6	NE		Non Department Elective–III	2	0	0	2	0	2
7	PC	EEB4331	Power Electronics laboratory	0	0	3	1	0	3
8	PC	EEB4332	Electrical Machine Design laboratory	0	0	2	1	0	2
9	PC	EEB4333	Design Project III	0	0	2	1	0	2
Total				**16**	**2**	**11**	**23**	**5**	**29**

SEMESTER - VI									
S. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	PC	EEB4316	Power System protection and control	3	1	0	4	1	4

2	PC	EEB4317	Solid State Drives	3	0	2	4	1	5
3	PC	EEB4318	Power System Analysis	3	1	0	4	1	4
4	BS	GEA4304	Business Economics	2	0	0	2	1	3
5	DE		Department Elective-IV	3	0	0	3	0	3
6	NE		Non Department Elective–IV	2	0	0	2	0	2
7	PC	EEB4341	Power System Protection laboratory	0	0	2	1	0	2
8	PC	EEB4342	Comprehension	1	0	0	1	0	1
9	PC	EEB4343	Design Project IV	0	0	2	1	0	2
Total				**18**	**2**	**6**	**22**	**4**	**27**

SEMESTER - VII									
S. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	PC	EEB4401	Electrical Energy Utilization and Conservation	3	1	0	4	1	4
2	PC	EEB4402	Energy and Environment	3	0	0	3	3	3
3	PC	EEB4403	Industry Standards and Specifications	2	0	2	3	1	4
4	PC	EEB4404	Artificial intelligence for Electrical Engineers	3	0	0	3	1	3
5	NE		Non Department Elective–V	2	0	0	2	0	2
6	DE		Department Elective-V	3	0	0	3	0	3
7	PC	EEB4431	Illumination laboratory	0	0	2	1	0	1
8	PC	EEB4432	Power System Simulation laboratory	0	0	2	1	0	1
9	PC	EEB4434	Renewable Energy Lab	0	0	2	1	0	2
10	PC	EEB4433	Design Project V	0	0	2	1	0	2
Total				**16**	**1**	**10**	**22**	**6**	**25**
SEMESTER - VIII									

S. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	PC	EEB4441	Project & Viva – voce	0	0	16	8	0	16
2	PC	EEB4442	Internship	0	0	0	1	0	0
Total				0	0	16	9	0	**16**
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	EEC4251	Solar Energy System and Regulation[1]	3	0	0	3	0	3
3	DE	EEC4252	Electrical Safety	3	0	0	3	0	3
3	DE	EEC4253	Basic Python Programming[2]	3	0	0	3	0	3
4	DE	EEC4266	Wind Energy Systems[1]	3	0	0	3	0	3
4	DE	EEC4267	High Voltage Engineering	3	0	0	3	0	3
4	DE	EEC4268	Power Plant Engineering	3	0	0	3	0	3
4	DE	EEC4269	Internet of Things[2]	3	0	0	3	0	3
5	DE	EEC4351	Alternative Sources of Energy	3	0	0	3	0	3
5	DE	EEC4352	Power Quality	3	0	0	3	0	3
5	DE	EEC4353	Advanced Control Theory	3	0	0	3	0	3
5	DE	EEC4354	Renewable Power Generation Technologies[1]	3	0	0	3	0	3
5	DE	EEC4355	Embedded IoT[2]	3	0	0	3	0	3
6	DE	EEC4366	Energy Conversion and Storage Technologies[1]	3	0	0	3	0	3
6	DE	EEC4367	Electrical System Design	3	0	0	3	0	3
6	DE	EEC4368	Special Electrical Machines	3	0	0	3	0	3
6	DE	EEC4370	Industrial Internet Of Things[2]	3	0	0	3	0	3
6	DE	EEC4371	IoT Application development using Mobile phone[2]	3	0	0	3	0	3
7	DE	EEC4451	Power Electronics for Renewable Energy Systems[1]	3	0	0	3	0	3
7	DE	EEC4452	Power System and Smart grid	3	0	0	3	0	3
7	DE	EEC4453	Industrial Automation	3	0	0	3	0	3
7	DE	EEC4454	Distributed Generation And Micro-Grids[1]	3	0	0	3	0	3
7	DE	EEC4455	Smart Grid Technologies & IOT[2]	3	0	0	3	0	3
7	DE	EEC4456	Embedded system for Electric and Hybrid Vehicles[2]	3	0	0	3	0	3

COURSE TITLE	ENGINEERING GRAPHICS AND COMPUTER AIDED DESIGN			CREDITS	3
COURSE CODE	MEB4101	COURSE CATEGORY	BS	L-T-P-S	1-1-2-1
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 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 practice 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	PSO 3
CO-1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2	-	-	2	-	3	-	-	-	-	-	-	-	1	-	-
CO-3	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-
CO-4	-	-	-	-	3	-	-	-	-	-	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:	**CO-1 BTL-2**

Basics of drafting and dimensioning	
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.

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		**PROFESSIONAL ENGLISH AND SOFT SKILLS**			**CREDITS**	**3**
COURSE CODE		**ELA4101**	**COURSE CATEGORY**	**HS**	**L-T-P-S**	**1-1-2-1**
Version	**1.0**	**Approval Details**	**24 ACM30th 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	PSO 3
CO-1	-	-	-	-	-	-	-	-	-	3	-	-	1	-	-
CO-2	-	-	-	-	-	-	-	2	2	3	-	-	1	-	-
CO-3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO-4	-	-	-	-	-	-	2	-	-	3	2	-	1	-	-
CO-5	-	-	-	-	-	-	-	-	2	3	2	3	-	-	-

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

MODULE 1: FUNCTIONAL GRAMMAR AND VOCABULARY	**(6L+3P=9)**
Introduction to communication skills –Self Introduction - Basic grammar (tenses, subject verb agreement) - Basic vocabulary (prefixes , suffixes, roots, phrasal verbs and idioms)- Topic sentences , paragraph writing **Practical Component:** 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.	**CO-1** **BTL-2**
MODULE 2 – LISTENING AND SPEAKING SKILLS	**(6L+3P=9)**
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 **Practical Component:** 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	**CO-2** **BTL-3**
MODULE – 3 : FUNCTIONAL READING AND WRITING	**(6L+3P=9)**
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 **Practical Component:** 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	**CO-4** **BTL-2**
MODULE – 4 : BUSINESS CORRESPONDENCE	**(6L+3P=9)**
Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives -	**CO-3**

Cause and effect **Practical Component:** Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect exercises - Presentation in the language lab (Technical or Non-technical topic) **Suggested Reading:** IELTS Academic Writing 1, New Insights into IELTS, CUP	**BTL-3**
MODULE 5 – PRESENTATION SKILLS AND INTERVIEW SKILLS	**(6L+6L=12)**
Presentation Skills - Reading and Interpreting Advertisements—Job Application- Covering Letter - Curriculum Vitae –E-mail - Project proposal –Interview skills (HR questions) – Group Discussion **Practical Component:** Presentation in the language lab (Technical or Non-technical topic) Group Discussion (Tutorial Classes)	**CO-5** **BTL-2**
TEXT BOOKS	
1.	Dr. Bikram K. Das et al.(2009),*An Introduction to Professional English and Soft Skills* (with audio CD) , Cambridge University Press.
2	Dolly John (2014),*English for Life and the Workplace Through LSRW&T skills*, Pearson Publications
REFERENCE BOOKS	
1.	Sabina Pillai and Agna Fernandez (2018), *Soft Skills & Employability Skills*, Cambridge University.
2.	Steve Hart et al (2016), *Embark, English for Undergraduates*, Cambridge University Press.
4.	Jeff Butterfield, (2010), *Soft Skills for Everyone*, Cengage Learning,
5.	Aruna Koneru (2015), *Professional Speaking Skills*, Oxford Publications.
E BOOKS	
1	https://www.britishcouncil.in/english/courses-business
2	http://www.bbc.co.uk/learningenglish/english/features/pronunciation
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		**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**	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 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 diagonalize 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	PSO 3
CO-1	3	3	2	-	-	-	-	-	-	-	-	-	3	1	1
CO-2	3	3	2	-	-	-	-	-	-	-	-	-	3	1	1
CO-3	3	3	2	2	-	-	-	-	-	-	-	-	3	1	1
CO-4	3	3	-	-	2	2	2	-	-	-	-	-	3	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-1,2,3,4**
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-1,2,3,4**
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:	**CO-3 BTL-**

Area, Surface and Volume. Suggested Reading: Basicsof Integrations **Lab3: Applications of Integral Calculus: Area, Surface area and Volume.**	**1,2,3**
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-1,2,3**

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 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: XII standard 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	PSO 3
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	2	-	-
CO-5	3	2	-	-	3	-	-	-	-	-	-	3	2	-	-

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

MODULE 1 –PROPERTIES OF MATTER& HEAT	**(9L)**
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.	P.Mani (2011), *Engineering Physics Vol.I and II*, Dhanam Publications, Chennai.
2.	Gaur R.K. and Gupta S.L. (2010), *Engineering Physics*, Dhanpat Rai Publications (P) Ltd., New Delhi, 8th Edition.

REFERENCE BOOKS

3.	P.Charles, Poople and Frank J. Owens (2017), *Introduction to Nanotechnology*, Wiley India.
4.	Arthur Beiser, (2017),*Concepts of Modern Physics* , Tata Mc Graw – Hill Publications, 7th Edition.
5.	Neeraj Mehta (2011), *Applied Physics for engineers*, Prentice Hall India Learning Pvt. Ltd.

MOOC

1.	http://nptel.ac.in/courses/115106061/
2.	http://nptel.ac.in/courses/117101054/12

COURSE TITLE	ENGINEERING MATERIALS (Common to ALL Branches of Engineering)			CREDITS	3
COURSE CODE	CYA4101	COURSE CATEGORY	BS	L-T-P-S	3-0-0-0
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	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	PSO 3
CO-1	3	1	1	-	-	-	1	-	-	-	-	1	1	-	-
CO-2	3	2	1	1	-	-	2	-	-	-	-	2	1	-	-
CO-3	3	1	1	-	-	-	1	-	-	-	-	2	1	-	-
CO-4	3	1	1	1	-	-	1	-	-	-	-	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 (9 L)

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 CA TEGORY		PC	L-T-P-S	2-0-2-1
Version	1.0	Approval Details	23 ACM, 06.02.2021		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 introduce computers and programming in C and also explore the power of computational techniques that are currently used by engineers and scientists and to develop programming skills with reasonable complexity.
Course Objective	1.To acquire the basic knowledge in computer hardware, programming languages and Problem-solving techniques. 2.To learn the fundamentals of C programming. 3.To gain knowledge in Functions, arrays and strings in C programming. 4.To understand the pointers, Structures and Union in C programming 5.To gain Knowledge on Embedded Programming
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the basics of digital computer and programming languages. 2. Demonstrate problem solving techniques using flowchart, algorithm/pseudo code to solve the given problem. 3. Design and Implement C program using Control Statements and Functions. 4. Design and Implement C program using Pointers and File operations. 5. Identify the need for embedded C in real-time applications.

Prerequisites: Nil

CO, PO AND PSO MAPPING

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

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

MODULE 1: INTRODUCTION TO CYBER SECURITY (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-2**

MODULE 2: SECURITY ATTACKS, PRINCIPLES AND MANAGEMENT (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: SECURITY PLANS, POLICIES AND PROCEDURES (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-3**
MODULE 4: OVERVIEW OF SECURITY COUNTERMEASURE TOOLS (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: TESTING, DIGITAL FORENSICS AND NEXT GENERATION SECURITY (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 (2015), *Fundamentals of Computing and Programming in C*, Vikas Publishing house.
2.	Mark Siegesmund (2014), *Embedded C Programming*, first edition, Elsevier publications.
REFERENCE BOOKS	
1.	Ashok Kamthane (2017), *Computer Programming*, Pearson Education, 7th Edition, Inc.
2.	Yashavant Kanetkar (2016), *Let us C*, 15th edition, BPP publication.
3.	S.Sathyalakshmi, S.Dinakar (2013), *Computer Programming Practicals – Computer Lab Manual*, Dhanam Publication, First Edition.
E BOOKS	
1.	https://en.wikibooks.org/wiki/C_Programming
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc18-cs10/preview
2.	http://nptel.ac.in/courses/106105085/2
3.	https://www.udemy.com/c-programming-for-beginners/
4.	https://www.coursera.org/specializations/c-programming

COURSE TITLE		**SUSTAINABLE ENGINEERING SYSTEMS (COMMON TO ALL BRANCHES OF ENGINEERING)**			**CREDITS**	**2**
COURSE CODE		**GEA4102**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**2-0-2-1**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**		**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	Sustainable Engineering will be an essential sub-discipline in engineering in the future. The course is designed for those students with a basic background in science and maths who wish to develop the interdisciplinary skills need to design, improve and assess renewable energy systems.
Course Objective	1. To develop an increased awareness among students on issues in areas of sustainability 2. To make students understand the role of engineering and technology within sustainable development 3. To give students some familiarity with the methods and tools used for sustainable product-service system development 4. To establish in students an understanding of the role and impact of engineering activities and engineering decisions on environmental, societal, and economic well-being
Course Outcome	Upon completion of this course, the students will be able to 1. describe the principles of sustainability with case studies. 2. assess technologies and their impact on environment. 3.describe the concept of Green Engineering and to apply in their projects at higher semesters.

	4. familiarize with the management of natural resources and waste management from various types of industries. 5.examine water technology and behavioural aspects of humans.

Prerequisites: Knowledge in fundamentals of chemistry at higher secondary level.

CO, PO AND PSO MAPPING

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

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.	**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.	**CO-2 BTL-3**
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.	**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.	**CO-4 BTL-3**
MODULE 5: SUSTAINABLE WATER AND WASTEWATER SYSTEMS	**(5L)**
Water cycle - Water conservation and protection technologies - Water treatment systemsMetrics for assessment of water management technologies - Summary & Activities.	**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.	

TEXT BOOKS

1.	Vanek, F.M., and L.D. Albright (2018), *Energy Systems Engineering. Evaluation and Implementation*, McGraw Hill.
2.	C.U. Becker (2017), *Sustainability Ethics and Sustainability Research*, Springer.

REFERENCE BOOKS

1	J.B. Guinee et al. (2011), *Life Cycle Assessment: Past, Present, and Future*, Environ. Sci. Technol. 45, 90-96.
2	Anastas, P.T., Zimmerman, J.B. (2016), *Innovations in Green Chemistry and Green Engineering*, Springer.
3	*Christensen, T(2010),Solid Waste Technology & Management*, Volume 1 & 2, Wiley and Sons.
4.	Weinstein, M.P. and Turner, R.E. (Eds.), (2012), *Sustainability Science: The Emerging*

	Paradigm and Urban Environment , Springer Science+Business Media, LLC.
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		**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**	**23 ACM, 06.02.2021**		**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	An introduction to digital system design, with an emphasis on practical design techniques and circuit implementation.
Course Objective	1. To Utilize binary and hexadecimal numbers. 2. Solve problems involving digital codes, operations, and number systems 3. To analyze and design combinational logic circuits
Course Outcome	Upon completion of this course, the students will be able to 1. assess basic operation in digital systems and instruments. 2. Choose appropriate sensors and display units. 3. Apply the concepts of signal processing and converting elements. 4. describe and apply concepts of microcontrollers, programmable logic controller and PID controller 5. examine the concepts of consumer electronics and communication devices.

Prerequisites: Nil

CO, PO AND PSO MAPPING

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

Number systems: - Binary, Hexadecimal - Logic gates - Boolean algebra (Identities and Properties) - Digital controllers (ON-OFF). **Practical Component:** Lab: - (*To be done in Simulation environment*) 1. Logic gates simulation 2. Boolean Identities and Property verification 3. Digital controller design **Suggested Reading:** Basics of number systems,All digital systems in consumer and industrial electronics.	**BTL-3**
MODULE 2 –Sensors and Displays (12L)	
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. **Practical Component**: - (To be done in Simulation environment) 1. Simulation of Sensor characteristics- potentiometer 2. Simulation of Sensor Characteristics-Strain Gauge 3. Simulation of Sensor characteristics-LVDT 4. Simulation of Sensor characteristics-RTD 5. Simulation of Sensor Characteristics-Thermocouple **Suggested Reading**:Primary sensing elements, introduction to displays.	**CO-2 BTL-4**
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. **Practical Component:** - (*To be done in Simulation environment*) 1. Simulation of DC bridges 2. Operational amplifier applications 3. Active filter simulation 4. ADC- DAC simulation. **Suggested Reading:** Basic network theorems.	**CO-3 BTL-4**
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. **Practical Component:** - (*To be done in Simulation environment*) 1. PLC Ladder logic simulation. 2. Proportional controller simulation. 3. Proportional + Integral controller simulation. 4. Proportional + Derivative controller simulation.	**CO-4 BTL-3**

5. Proportional +Integral + Derivative controller simulation. **Suggested Reading:** Hobby electronics with Microcontroller interface.	
MODULE 5 – Consumer Electronics and Communication System (6L)	
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-3**
TEXT BOOKS	
1.	Thomas l. Floyd (2018),*Digital Fundamentals*, , Pearson,11th edition .
2.	Ramakant A. Gayakwad (2017),*Op-amps and Linear Integrated Circuits*, Prentice Hall,4th edition.
3.	David A. Bell(2018) ,*Electronic Instrumentation and Measurements*, Oxford University Press.
4.	SepehrNaimi, SarmadNaimi, Muhammad Ali Mazidi (2017), *The 8051 Microcontroller And Embedded Systems Using Assembly And C*, Pearson,Second edition.
5.	Frank D. Petruzella (2016), *Programmable Logic Controllers*, , McGraw-Hill Education.
REFERENCE BOOKS	
1.	M. Morris Mano (2016), *Digital Logic and Computer Design*, Prentice-Hall.
2.	Roy Choudhury (2018), *Linear Integrated Circuits*, New Age International Publishers, 4th edition, 2018
3.	Thomas W. Schultz, Thomas W. (2018), *C and 8051*, Schultz Publishers, 4th edition.
4.	S.P Bali (2008), *Consumer Electronics*, Pearson Education Asia Pvt., Ltd.,
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://www.nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/pdf/Teacher_Slides/mod3/M3L6.pdf
4.	http://nptel.ac.in/courses/108105063/pdf/L-09(SS)(IA&C)%20((EE)NPTEL).pdf
5.	http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/micro/ui/Course_home2_5.html

COURSE TITLE		**ENGINEERING AND DESIGN**			**CREDITS**	**3**
COURSE CODE		**EEB4118**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**		**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 exposes students to the design process, research and analysis, teamwork, communication methods, global and human impacts, engineering standards, and technical documentation. Students will employ engineering and scientific concepts in the solution of engineering design problems.
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.Describe the different elements involved in good designs and to apply them in practice when called for. 2. Identify the product oriented and user oriented aspects that make the design a success. 3. Describe 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.

Prerequisites: Nil

CO, PO AND PSO MAPPING

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

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

Module I: INTRODUCTION TO ENGINEERING	**(9L)**
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 II: PROBLEM SOLVING (9L)	
Design process- Different stages in design and their significance; Defining the design space; Analbgies	**CO-2 BTL-4**

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	
MODULE III: ENERGY AND SOURCE (9L)	
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 IV: INTRODUCTION TO ENGINEERING DESIGN (9L)	
Design for "X"; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc. 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.	**CO-4 BTL-4**
Module V: DESIGN STEPS AND PROJECT REPORT (9L)	
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.	Philip Kosky, Robert Balmer, William Keat (2020), *Explore Engineering*, 4th Edition, Academic Press, Elsevier.

REFERENCE BOOKS

1.	Saeed Moaveni (2015), *Engineering Fundamentals: An Introduction to Engineering*, Cengage Learning.
2.	Andrew Samuel and John Weir (2017), *Introduction to Engineering Design*,Elsevier.
4.	Dym, C. L., Little, P. and Orwin, E. J.(2017), *Engineering Design - A Project based introduction* - Wiley, ISBN-978-1-118-32458-5.
5.	Eastman, C. M. (Ed.)(2018), *Design for X Concurrent engineering imperatives*, Springer 489 p. ISBN 978-94-011-3985-4.
6.	Haik, Y. And Shahin, M. T.(2016), *Engineering Design Process, Cengage Learning*, ISBN-13: 978-0-495-66816-9.

E BOOKS	
1.	https://www.elsevier.com/books/introduction-to-engineering-design/samuel/978-0-7506-4282-8
MOOC	
1.	https://www.mooc-list.com/tags/engineering-design

COURSE TITLE		ENGINEERING IMMERSION LAB			CREDITS	1
COURSE CODE		EEA4131	COURSE CATEGORY	BS	L-T-P-S	0-0-2-2
Version	1.0	Approval Details	23 ACM, 06.02.2021		LEARNING LEVEL	BTL-3

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

Course Description	This course focuses on interconnecting various engineering disciplines basics.
Course Objective	1.To train students on welding arc 2.to train students on gasoline engine 3.To train students on Aircraft Model 4. to understand about electrical tools and basics of computer application
Course Outcome	Upon completion of this course, the students will be able to 1 Identify and use tools, Types of joints used in welding, carpentry and plumbing operations. 2 Dismantle and assemble four stroke gasoline engine 3. Fabricate simple electrical and electronics circuit and apply basics of computer 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	PSO 3
CO-1	1	2	3	-	3	-	-	-	-	-	-	3	-	-	-
CO-2	1	2	3	-	-	-	-	-	-	-	-	-	-	2	2
CO-3	1	2	3	-	-	-	-	-	-	-	-	-	-	2	2

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

SLOT X - LIST OF EXPERIMENTS

I. MECHANICAL ENGINEERING WORKSHOP 1. Welding: Arc welding: Butt joints	**CO1/BTL3**

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 Construction of a 50 cm height brick wall without mortar using English Bond	
SLOT X - LIST OF EXPERIMENTS	
V.ELECTRICAL ENGINEERING 1. Study of tools and accessories. 2. Study of cables. 3. Staircase wiring, Tube light and Fan connection. 4. Measurement of energy using single phase energy meter. **VI. ELECTRONICS ENGINEERING** 1. Study of Active and Passive Components. 2. Study of Logic Circuits. 3. Making simple circuit using Electronic Components. 4. Measuring of parameters for signal using CRO. **VII. COMPUTER SCIENCE** 1. Troubleshooting different parts of the computer peripherals, Monitor, Keyboard & CPU. 2. Installation of various operating systems, their capabilities, Windows, Unix, Linux. 3. Installation of commonly used software like MS Office 4. Assembling digital computer. **VIII. MECHATRONICS ENGINEERING** 1. Study of Key Elements of Mechatronics Systems 2. Sensors – Load Cell, Thermocouple 3. Actuators – Linear & Rotary Actuators 4. Interfacing & Measurements – Virtual Instrumentation	**CO2 & CO3/BTL3**
REFERENCE BOOKS	
1.	Jeyapoovan T and Saravanapandian M. (2015), *Engineering practices lab manual*, 4th Edition, Vikas publishing House, New Delhi.
2.	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K. (2010), "*Elements of Workshop Technology*", Media promoters and publishers private limited, Mumbai.
3.	Ibrahim Zeid (2011), *CAD/CAM Theory and Practice*, Tata McGraw-Hill Publishing Company

	Ltd., New Delhi
4.	Robert Quesada, Jeyapoovan T. (2006), *Computer Numerical Control Machining and Turning Centers*, Pearson Education, New Delhi

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: 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	PSO 3
CO-1	3	3	-	-	-	-	-	-	3	-	-	1	**1**	-	-
CO-2	3	3	-	-	-	-	-	-	3	-	-	1	**1**	-	-
CO-3	3	3	-	-	-	-	-	-	3	-	-	1	**1**	-	-
CO-4	3	3	-	-	-	-	-	-	3	-	-	1	**1**	-	-
CO-5	3	3	-	-	-	-	-	-	3	-	-	1	**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	**(3P)**
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	**(6 P)**
6. Air – Wedge – Determination of thickness of a thin wire 7. Spectrometer – refractive index of a prism	**CO-4 BTL-3**
MODULE 5: ESTIMATION METAL ION CONTENTS IN THE SAMPLE	**(6 P)**
8. Semiconductor laser – Determination of wavelength of laser using grating 9. Semiconductor diode – VI characteristics	**CO-5 BTL-3**
TEXT BOOKS	
1.	P. Kulkarni (2015), Experiments in Engineering Physics Bachelor of Engineering and Technology
REFERENCE BOOKS	
1.	Glenn V. Lo, Jesus Urrechaga – Aituna (2015), Introductory Physics Laboratory Manual, Part-I.
E BOOKS	
1.	http://www.aurora.ac.in/images/pdf/departments/humanities-and-sciences/engg-phy-lab-manual.pdf
MOOC	
1.	https://www.coursetalk.com/providers/coursera/courses/introduction-to-chemistry-1

COURSE TITLE		**MATERIALS CHEMISTRY LABORATORY (Common to ALL branches of Engineering)**			**CREDITS**	**1**
COURSE CODE		**CYA4131**	**COURSE CATEGORY**	**BS**	**L-T-P-S**	**0-0-2-0**
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 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	PSO 3
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 - 30.5.2018	**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 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:					

CO, PO AND PSO MAPPING

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

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.	http.// nptel.ac.in/courses/122104017/28 https://www.khanacademy.org/.../double-integrals.../double-integral. nptel.ac.in/courses/115101005/downloads/lectures-doc/Lecture-1.pdf nptel.ac.in/syllabus/122104017/ nptel.ac.in/courses/111105035/22 nptel.ac.in/syllabus/111103070/
MOOC	
1.	https://www.edx.org/course/introduction-engineering-mathematics-utarlingtonx-engr3-0x

COURSE TITLE		**ELECTROMAGNETIC THEORY**			**CREDITS**	**4**
COURSE CODE		**EEB4116**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-1**
Versio	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**		**BTL-4**

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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 describes the review of static electric and magnetic fields and applications; Maxwell's equations; propagation and reflection of plane waves;
Course Objective	1.To introduce the basic mathematical concepts related to electromagnetic vector fields. 2.To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications 3.To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications. 4.To impart knowledge on the concepts of Faraday‘s law, induced emf and Maxwell‘s equations. 5.To impart knowledge on the concepts of concepts of electromagnetic waves and transmission lines.
Course Outcome	Upon completion of this course, the students will be able to 1. Apply different techniques of vector calculus to understand different concepts of electromagnetic field theory. 2. Analyze the electric field intensity from the stationary charge distributions using electromagnetic laws with the associated boundary conditions. 3. Analyze the magnetic field intensity from the steady current distributions using electromagnetic laws with the associated boundary conditions 4. Summarize the concepts of electrodynamics & to derive and discuss the Maxwell’s equations. 5. Examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering.

Prerequisites: MAA4102 – Applied Linear Algebra

CO, PO AND PSO MAPPING

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

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

MODULE 1: INTRODUCTION	**(12L)**
Sources and effects of electromagnetic fields-Vector fields-Different co-ordinate systems-Divergence theorem - Stoke's theorem. **Suggested Reading**: Vector Calculus using MATLAB	**CO-1 BTL-2**
MODULE 2: ELECTROSTATICS	**(12L)**
Coulomb's Law-Electric field intensity-Field due to point and continuous charges-Gauss's law and application-Electrical potential-Electric field and equipotential plots-Electric field in free space, conductors, dielectric-Dielectric polarization, Electric field in multiple dielectrics-boundary conditions, Poisson's and Laplace's equations Uniqueness Theorem,	**CO-2 BTL-4**

Analytical Solution in one dimension using MATLAB - Capacitance-energy density-Dielectric strength. **Suggested Reading**: Determination of Electric field intensity and Stored energy using MATLAB	
MODULE 3: MAGNETOSTATICS	**(12L)**
Lorentz Law of force, magnetic field intensity-Biot-Savart's Law-Ampere's Law-Magnetic field due to straight conductors, circular loop, infinite sheet of current - Magnetic flux density in free space, conductor, magnetic materials - Magnetization-Magnetic field in multiple media-Boundary conditions - Scalar and vector potential - Magnetic force - Torque - Inductance - Energy density -Magnetic circuits. **Suggested Reading:** Determination of Magnetic field intensity and inductance using MATLAB	**CO-3** **BTL-4**
MODULE 4: TIME VARYING FIELDS (12L)	
Faraday's laws, induced emf- Transformer and motional EMF, Maxwell's equations (differential and integral forms)-Displacement current-Relation between field theory and circuit theory. **Suggested Reading:** Solution of boundary conditions using MATLAB	**CO-4** **BTL-4**
MODULE 5: ELECTROMAGNETIC WAVES (12L)	
Generation - Electro Magnetic Wave equations - Wave parameters, velocity, intrinsic impedance, propagation constant - Waves in free space, lossy and lossless dielectrics, conductors-skin depth, Poynting vector - Plane wave reflection and refraction. **Suggested Reading:** Modeling and Simulation of an electromagnetic wave in an isotropic and anisotropic media using MATLAB	**CO-5** **BTL-4**

TEXT BOOKS	
1	Matthew Sadiku, (2014) "Elements of Electromagnetics", Sixth edition, Oxford University Press.
2	William .H.Hayt, John A.Buck, (2012) "Engineering Electromagnetics", Eighth Edition, Tata McGraw Hill.
REFERENCE BOOKS	
1.	John.D.Kraus, Daniel Fleisch, (2010) "Electomagnetics with Applications", Fifth Edition, McGrawHill.
2.	Karl E.Longren, Sava V.Savov, Randy J.Jost, (2007) "Fundamentals of Electromagnetics with MATLAB", Second Edition, Scitech Publishing.
3.	Matthew N.O. Sadiku (2009), Numerical Techniques in Electromagnetics with MATLAB, Third Edition CRC Press.
4.	Dr. M.H. Bakr (2012) , "Matlab Experiments manual for Electromagnetics".
E BOOKS	
1.	https://easyengineering.net/elements-of-electromagnetics-sadiku/
2.	https://easyengineering.net/electromagnetics-by-kraus-and-carver/
MOOC	
1.	https://www.coursera.org/learn/electrodynamics-introduction
2.	https://www.coursera.org/learn/electrodynamics-electric-magnetic-fields
3.	https://nptel.ac.in/courses/108/104/108104087/
4.	https://www.coursera.org/learn/electrodynamics-analysis-of-electric-fields

5.	https://www.coursera.org/learn/electrodynamics-solutions-maxwells-equations

COURSE TITLE		**CIRCUITS AND NETWORKS**			**CREDITS**	**4**
COURSE CODE		**EEB4117**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-1**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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	The course begins with description with circuit elements , sources. Understanding of various interesting network theorems applied to solve linear, time invariant network problems efficiently in time and s-domain
Course Objective	1. To learn a number of powerful engineering circuit analysis techniques such as nodal analysis,mesh analysis, theorems, source transformation and several methods of simplifying networks. 2. To understand the concept of graphical solution to electrical network 3. To understand frequency response in electrical circuits 4. To understand the Different types of two-port network analysis using network parameters, with different types of connections.
Course Outcome	Upon completion of this course, the students will be able to 1. Familiarize the basic laws, source transformations, theorems and the methods of analyzing electrical circuits. 2. Describe on various electrical theorems to find voltage, current and power through any element 3. Describe resonance and coupled circuits 4. Evaluate Application of Laplace transform in analyzing the circuits. 5. Analyze various parameters of TWO PORT networks and interconnection of two port networks.

Prerequisites: EEB4101-Introduction to 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	PSO 3
CO-1	3	3	2	2	2	-	-	-	-	-	-	-	1	1	1
CO-2	3	3	3	3	3	-	-	-	-	-	-	1	3	3	1
CO-3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	1
CO-4	3	3	3	3	3	-	-	-	-	-	-	1	3	3	1
CO-5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	1

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

MODULE 1: BASIC CIRCUIT ANALYSIS	**(6L+6L=12)**
Fundamental concepts of R, L and C elements, Ohm's Law - Kirchoffs laws - DC circuits, series and parallel circuits - loop and nodal analysis, A.C circuits - complex impedance -	**CO-1 BTL-2**

phasor diagram, real and reactive power - loop and nodal analysis applied to AC circuits.	
MODULE 2: NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS (6L+6L=12)	
Voltage source –current source transformations, Star-delta transformations, Various Network theorems and applications to dc and ac circuits: Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem, and Maximum power transfer theorem.	**CO-2 BTL-2**
MODULE 3: RESONANCE AND COUPLED CIRCUITS (6L+6L=12)	
Resonance in series and parallel circuits, self and mutual inductances, coefficient of coupling - dot convention - analysis of coupled circuits.	**CO-3 BTL-3**
MODULE 4: TRANSIENT RESPONSE FOR DC CIRCUITS (6L+6L=12)	
Time response of RL, RC and RLC circuits using Laplace transform for step and sinusoidal inputs.	**CO-4 BTL-2**
MODULE 5: TWO PORT NETWORKS (6L+6L=12)	
Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid(H) Parameters, Interconnection of two port networks, Symmetrical properties of T and π networks.	**CO-5 BTL-2**

TEXT BOOKS	
1.	Hayt, W. H, Kemmerly J. E. & Durbin, (2013) 'Engineering Circuit Analysis', McGraw Hill Publications, 8th Edition
2.	Charles K. Alexander, Matthew N. O. Sadiku, (2007) 'Fundamentals of Electric Circuits', McGraw-Hill Publications, 3rd Edition
REFERENCE BOOKS	
1.	Robins & Miller, 'Circuit Analysis Theory and Practice', (2012) Delmar Publishers, 5th Edition.
2.	Sudhakar A and Shyam Mohan SP, Circuits and Network Analysis and Synthesis, (2007) Tata McGraw Hill
E BOOKS	
1.	https://ia800708.us.archive.org/25/items/EngineeringCircuitAnalysis_280/HaytKemmerly-EngineeringCircuitAnalysis.pdf
2.	Solutions of Fundamentals of Electric circuits Alexander-https://docs.google.com/file/d/0B21HoBq6u9TsYUt2cW9RZEs5UEk/edit
3.	Circuit analysis,Robins miller-https://drive.google.com/file/d/0B7qpgUTOwkAdMnpFZlYyWTg3U2s/view
MOOC	
1.	https://www.mooc-list.com/course/6002x-circuits-and-electronics-edx
2.	https://www.mooc-list.com/course/linear-circuits-1-dc-analysis-coursera
3.	http://www.nptel.ac.in/courses/108102042/

COURSE TITLE		**CIRCUITS AND NETWORKS LABORATORY**			**CREDITS**	**1**
COURSE CODE		**EEB4141**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0:0:2:0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**		**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical**	**Seminar/ Assignments/**	**Surprise Test / Quiz**	**Attendance**	**ESE**

	Assessment	Project			
15%	**15%**	**10%**	**5%**	**5%**	**50%**

Course Description	Enable the students to develop the basic concepts of simple DC & AC Circuits
Course Objective	1. To design electrical systems. 2. To analyze a given network by applying various Network Theorems. 3. To measure three phase Active and Reactive power. 4. To understand the locus diagrams
Course Outcome	Upon completion of this course, the students will be able to 1. Analyze the characteristics of Electrical circuits using PSpice Simulation. 2. Analyse various network theorems. 3. Analyse the response of AC 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	PSO 3
CO-1	3	3	3	3	3	-	-	-	1	-	-	-	2	2	1
CO-2	3	3	3	3	3	-	-	-	1	-	-	-	2	2	1
CO-3	3	3	3	3	3	-	-	-	1	-	-	-	2	2	1

S.No.	EXPERIMENTS	
1	Verification of Ohm's law and Kirchhoff's laws.	**CO-1, BTL-3**
2	Verification of Mesh and Nodal analysis	
3	Verification of Thevenin's and Norton's Theorem	**CO-2, BTL-4**
4	Verification of Superposition Theorem	
5	Verification of Maximum power transfer theorem	
6	Verification of Reciprocity theorem	
7	Transient response of RL and RC circuits for DC input	**CO-3, BTL-4**
8	Frequency response of Series and Parallel resonance circuits	
9	Frequency response of Single tuned coupled circuits	
10	Electrical circuit simulation using Multisim (Additional)	

SEMESTER - III

COURSE TITLE	**PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS**			**CREDITS**	**4**
COURSE CODE	**MAA 4201**	**COURSE CATEGORY**	**BS**	**L-T-P-S**	**3-1-0-1**
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 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:

CO, PO AND PSO MAPPING

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

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

MODULE 1: PARTIAL DIFFERENTIALEQUATIONS (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-1,2,3,4**
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-2,3,4**
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-1,2,3,4**
MODULE 4: FOURIERTRANSFORM (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-1,2,3**
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	**CO-4 BTL-**

Suggested Reading: Basic calculus		**1,2,3,4**
TEXT BOOKS		
1.	P. Sivarama Krishna Das, C. VijayakumarL, "Transforms and partial differential equations", 1 Pearson Publication, 201	
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:f/www.mooc-list.com/tags/laplace-transforms	
2.	https://www.edx.o rg/course/introduction-differential-equations-bux-math226-1x-1	

COURSE TITLE		**ELECTRICAL MACHINES**			**CREDITS**	**4**
COURSE CODE		**EEB4201**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-1**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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	Electrical Machines deals with principle, performance and applications of DC and AC machines					
Course Objective	1.To learn the principle and construction of DC and AC machines 2.To derive the characteristics and performance of transformers 3.To impart knowledge about the principle, characteristics and applications of three phase induction motors and synchronous machines. 4.To analyze and select different special machines for specific applications 5. To simulate different testing using V-LABS .					
Course Outcome	Upon completion of this course, the students will be able to 1. Examine the principle, construction, classification of DC generators and motors,					

	and apply in real time application. 2. Analyze performance parameters, equivalent circuit, phasor diagram, parallel operation of transformers. 3. Describe the construction, principle, characteristics and applications of three phase induction motor. 4. Describe the principle, construction, applications of alternators and synchronous motors. 5. Analyze the principle and applications of single phase induction motors and special machines like stepper motors, reluctance motors etc.

Prerequisites: Physics and Mathematics

CO, PO AND PSO MAPPING

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

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

Module I:- DC MACHINES **(9L+3T)=12)**	
Constructional details – EMF equation – Methods of excitation – Self and separately excited generators – Characteristics of series, shunt and compound generators – Principle of operation of D.C. motor – Back emf and torque equation – Characteristics of series, shunt and compound motors - Starting of D.C. motors – Types of starters - Testing, brake test and Swinburne's test – Speed control of D.C. shunt motors. Suggested Reading: Generators used for battery charging systems, speed control of dc motor for an industrial application. SIMULATION: USING V-LAB ,MHRD	**CO-1** **BTL-2**
Module II:- TRANSFORMERS (9L+3T=12)	
Constructional details – Principle of operation – EMF equation – Transformation ratio – Transformer on no load – Parameters referred to HV/LV windings – Equivalent circuit – Transformer on load – Regulation - Testing – Load test, open circuit and short circuit tests. – All day efficiency Parallel operation of single phase transformers - Auto transformer - Three phase transformers - Vector group. **Suggested Reading**: : IEEE papers 1 compulsory by each student and give the work as PPT	**CO-2** **BTL-3**
Module III:- POLY PHASEINDUCTION MOTORS (9L+3T=12)	
Construction features, production of rotating magnetic field, phasor diagram, equivalent circuit, torque and power equations, torque slip characteristics, no load and blocked rotor tests efficiency . Induction generator. Starting and speed control (with and without e.m.f. injection in the rotor circuit), deep bar and double cage induction motors ,cogging and crawling **Suggested Reading**: Induction motor industrial application, basic simulation of induction motor by MATLAB/ related software **SIMULATION** :Speed control using V-LAB ,MHRD	**CO-3** **BTL-3**

Module IV:- SYNCHRONOUS MACHINES (9L+3T=12)	
Constructional features, E.M.F equation, winding coefficients, armature reaction, O.C. and S.C. tests, voltage regulation- Synchronous impedance method, MMF Method, Potier 's triangle method and parallel operation. Synchronous Motor - Principle of operation, starting methods, , V -curves, hunting and damping, synchronous condenser **Suggested Reading:** Application of synchronous motor,IEEE papers in this topic. **SIMULATION –**V-LAB	**CO-4** **BTL-3**
Module V:- SINGLE PHASE INDUCTION MOTOR AND SPECIAL MACHINES (9L+3T=12)	
Single Phase Induction Motor - Double revolving field theory , equivalent circuit, no load and blocked rotor tests, starting methods, repulsion motor . A.C.Commutator Motor - E.M.F .induced in commutator windings, single phase a.c. series motor , Universal motor , Reluctance motor – Hysteresis motor – Stepper motor. **Suggested Reading**: single phase motor domestic and industrial applications V-LAB ,MHRD	**CO-5** **BTL-2**

TEXT BOOKS	
1.	Vincent Del Toro.Pearson (2015), Basic electric machines, publications electric machines drives and power system,Theodore wildi

REFERENCE BOOKS	
1.	B.L Theraja and A.K .Theraja (2018), Electrical machines , ,S.Chand publications
2.	Dr.P.S Bimbra (2018), Electric machines

E BOOKS	
1.	www.freeengineeringbooks.com/Electrical/Electrical-Machines-Ebooks.php
2	https://www.studynama.com/community/threads/322-Electrical-Machine-1-pdf-download-ebook-lecture-notes-for-EE-engineers
3	http://www.uotechnology.edu.iq/dep-eee/lectures/2nd/Electrical%20machines%201/DC%20MACHINES%20(PART1).pdf

MOOC	
1.	https://www.mooc-list.com/course/fundamentals-electrical-engineering-coursera?static=true
2.	nptel.ac.in/courses/108105017

COURSE TITLE		ANALOG ELECTRONICS			CREDITS	4
COURSE CODE		EEB4202	COURSE CATEGORY	PC	L-T-P-S	3-1-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021		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 covers the design, construction, and debugging of analog electronic circuits.
Course Objective	1. To familiarize the fundamental properties of semiconductors 2. To prepare students to perform the analysis of analog electronics circuit.

	3. 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 BJT / FET amplifier circuits and analyses effect of negative feedback on different parameters of an Amplifier 2. Design and set up of inverter scale changer/adder, non-inverting amplifier, differential amplifier with one, two and three op amps. 3. Design integrator, differentiator, and comparator circuits using op amp. 4. Design Signal generator, comparator and filter circuits using op amp. 5. Design Voltage Regulator and Frequency multiplier circuits.

Prerequisites: EEB4101 Introduction to Digital System

CO, PO AND PSO MAPPING

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

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

Module I: TRANSISTORS AND FEEDBACK ANALYSIS	**(12 L)**
Biasing of BJT, Common Emitter and Emitter follower analysis and comparison using hybrid equivalent circuit – push pull amplifier. FET: Biasing a JFET and MOSFET - Small signal model - CS amplifiers. Concepts of negative and positive feedback – loop gain- advantages of negative feedback - Feedback Connection Types **Practical Component:** Transistor configurations, Characteristics of MOSFET and JFET **Suggested Reading :** Class B and Class AB - Power amplifiers using BJT ,Frequency response of BJT amplifiers, Small signal model - CD amplifiers, cascading transistor amplifiers, Practical Feedback Circuits	**CO-1** **BTL-3**
MODULE II: OP AMP BASICS AND LINEAR APPLICATIONS	**(12 L)**
Introduction Block diagram representation of a typical op-amp, Analysis op-amp IC circuits, types, designations, packages, pin configurations and power supplies. Ideal op-amp, equivalent circuit, open loop op amp configurations of differential, inverting and non-inverting amplifiers, op amp feedback amplifier analysis. Op amp parameters - offset voltages and currents, bias current, drift, PSRR, CMRR, offset nulling methods **Practical Component:** Design and set up of inverter scale changer/adder, non-inverting amplifier, differential amplifier with one, two and three op amps	**CO-2** **BTL-4**
MODULE III: AC PERFORMANCE OF OP-AMP	**(12 L)**
Bandwidth, slew rate and frequency response. Op-amp applications: DC and AC amplifiers, peaking, summing scaling and averaging amplifiers, differential input and differential, output amplifier, V to I and I to V converters, integrator, differentiator comparator, non-linear	**CO-3** **BTL-4**

amplifier, phase shift oscillator, Wien bridge oscillator, square, triangular and sawtooth wave generator, voltage controlled oscillator, zero crossing detector, window detector. **Practical Component:** integrator, differentiator, and comparator **Suggested Reading:** introduction to analog simulation, instrumentation amplifier	
MODULE IV: NON LINEAR IC APPLICATIONS USING OPAMP	**(12 L)**
Signal Generators: Square, triangle and ramp generator circuits using opamps - Effect of slew rate on waveform generation- Astable multivibrator- Principles of VCO circuits. Comparator Circuits: Zero Crossing Detector- Regenerative comparator circuits Active filters –Types- Characteristics- Frequency Response of different types of filters- Order and cut off frequency - Butterworth low pass filter – First order filter design **Practical Component:** Application of op-amp as low pass filter, high pass filter. **Suggested Reading:** Butterworth low pass filter – second order filter design - Sallen and Key second order LP filter - Butterworth high pass filters - Second order wide band and narrow band filters, Schmitt trigger circuits. monostable and bistable circuits	**CO-4** **BTL-4**
MODULE V: TIMER IC , PLL AND VOLTAGE REGULATOR	**(12 L)**
Timer IC 555: Functional diagram astable and monostable modes with applications Phase locked loops: Principles – Building blocks of PLL-Lock and Capture ranges - Capture process - Study of NE565 - Applications of PLL – Frequency multiplication. Three terminal regulator ICs: basic block schematic - 78 x x& 79 x x series , Adjustable output voltage regulator LM 317 **Practical Component:** PLL IC 565 Frequency multiplying / FSK demodulation **Suggested Reading:** Adjustable output voltage regulator LM 340 and LM 337 series power supply ICs. their use and basic design considerations for designing regulated power supplies. Applications of PLL – FSK demodulator - FM demodulation.	**CO-5** **BTL-4**

TEXT BOOKS	
1.	David A. Bell (2017),"Electronic devices and circuits", Oxford, Fifth edition.
2	V. Boylestad and Nashelsky (2013), Electronic Devices and Circuits, Prentice Hall of India.
3	D. Roy Choudhury &Shail B. Jain (2010), 'Linear Integrated Circuits', New Age International Publishers, Fourth Edition.
4	BehzadRazavi (2014),"Fundamentals of Micro Electronics ",Wiley and Sons.
5	Sedra and Smith (2016) ,"Microelectronic circuits", Oxford, Fifth edition.
REFERENCE BOOKS	
1.	Theodore F. Bogart Jr. (2014), Electronic Devices and Circuits.
2.	K. R. Botkar (2013), Integrated Circuits, Khanna Publishers.
3	Floyd (2015), Fundamentals of Analog Circuits 2e, Pearson Education.
E BOOKS	
1.	https://archive.org/details/ElectronicDevicesCircuits
2	http://www.rtna.ac.th/departments/elect/Data /EE304/Electronic%20Devices%20and%20Circuit%20Theory.pdf
3	*https://docs.google.com/file/d/0B9LJy8vattSMMHFZelktMHp5TG8/edit*
MOOC	
1.	http://nptel.ac.in/courses/117103063/ http://nptel.ac.in/courses/122106025/2 https://onlinecourses.nptel.ac.in/noc18_ee10/preview

COURSE TITLE		PROFESSIONAL ETHICS AND LIFE SKILLS			CREDITS	2
COURSE CODE		GEA4216	COURSE CATEGORY	BS	L-T-P-S	2-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	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	The study on ethics helps to know the people's beliefs, values, and morals, learn the good and bad of them, and practice them to maximize their well-being and happiness. It involves the inquiry on the existing situations, form judgments and resolve the issues.
Course Objective	1.Implement the basic relationship between "values" and "skills" with the end purpose of ensuring sustained happiness and prosperity which are the primary aspirations of all human beings. 2.Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources 3.Discuss plausible implications of such a holistic understanding in terms of ethical human conduct, trustworthy and mutually satisfying human behaviour and mutually enriching interaction.
Course Outcome	Upon completion of this course, the students will be able to 1. Implement Moral values and ethics with the end purpose of ensuring sustained happiness and prosperity 2. Apply Different Ethical theories to real time environment. 3. Apply Risk analysis and Professional rights in office 4.Implement Personal Values and Life Skills for professional development and societal progress 5. Apply Personal value and professional value of Engineers for betterment of society

Prerequisites: Nil

CO, PO AND PSO MAPPING

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

meditation for professional excellence and stress management Self-Study: Case study of Discovery failure	
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	**CO-2 BTL-2**
MODULE 3: SAFETY, REPOSIBILITIES 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	**CO-3 BTL-2**
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*	**CO-4 BTL-2**
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	**CO-5 BTL-2**

TEXT BOOKS	
1.	Subramanian R.(2015), Professional ethics, Oxford University press
REFERENCE BOOKS	
1.	Megan J. Murphy (Editor), Lorna Hecker (Editor) (2013), Ethics and Professional Issues in Couple and Family Therapy.
2.	Andrew Belsey (Editor), Ruth Chadwick (Editor) (2017), Ethical Issues in Journalism and the Media (Professional Ethics).
3.	Warwick Fox (Editor) (2018), Ethics and the Built Environment (Professional Ethics).
4	RuchikaNath (2016), Value Education, APH Publishing Corporation, New Delhi.
5	Manoharan P.K. (2015), Education and Personality Development, APH Publishing Corporation, New Delhi.
E BOOKS	
1.	https://soaneemrana.org/onewebmedia
MOOC	
1.	https://www.lifeskillsmooc.in/
2.	https://www.edx.org/course/ethics-life-sciences-healthcare-kyotoux-006x-1

COURSE TITLE	ELECTRICAL MACHINES LABORATORY			CREDITS	1
COURSE CODE	EEB4231	COURSE CATEGORY	PC	L-T-P-S	0-0-3-0
Version 1.0	Approval Details	23 ACM, 06.02.2021		LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

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

Course Description	**This course focuses on impart knowledge on Principle of operation and performance of Electrical motor.**
Course Objective	1. To perform tests on Induction Motor, synchronous machines and transformers to interpret their performances 2. To perform suitable test and analyse various characteristics of Electrical machines
Course Outcome	Upon completion of this course, the students will be able to 1. Determine characteristics of DC generator and DC motor, and implement speed control of DC motor 2. Perform testing methods of Transformer and interpret results. 3. Conduct load test on poly phase induction motor and single phase induction motor and analyse its performance 4. Plot performance characteristics of synchronous generator and synchronous motor and analyse the results

Prerequisites: Nil

CO, PO AND PSO MAPPING

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

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

Load Test and Speed Control of DC machines	
1. Open circuit and load characteristics of separately excited and self excited D.C. generator 2. Load test on D.C. shunt motor & D.C. series motor Speed Control of DC Shunt Motor 3. Swinburne's test and speed control of D.C. shunt motor	**CO1/BTL3**
Transformer test	
4. Load test on single phase transformer 5. Open circuit and short circuit test on single phase transformer	**CO2/BTL3**
Load test on Induction Motor	
6. Load test and No load & blocked rotor test on three-phase induction motor. 7.Load test and No load & blocked rotor test on single-phase induction motor	**CO3/BTL3**
V & Inverted V curves	
8.V and Inverted V curves of Three Phase Synchronous Motor. 9.Regulation of three phase alternator by emf and mmf methods	**CO4/BTL3**

REFERENCE BOOKS

1.	D. P. Kothari, I. J. Nagrath (2004) Tata McGraw-Hill Education,- Electric machinery - 834 pages

E BOOKS

1.	https://www.csun.edu/sites/default/files/ECE410_LabManual_2ndEdition.pdf
MOOC	
1.	https://www.mooc-list.com/tags/electric-machines

COURSE TITLE	**ANALOG ELECTRONICS LABORATORY**			**CREDITS**	**1**
COURSE CODE	**EEB4232**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**	**BTL-4**

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

Course Description	**This course focuses on the design and analysis of analog circuits**
Course Objective	1.Analyze amplifiers for frequency response 2. Identify, select, and handle transistors. 3. Analyze feedback circuits , amplifier circuits and oscillator circuits 4. To provide an overview of amplifiers, feedback amplifiers and oscillators. 5. Design and construct simple electronic circuits to accomplish a specific function.
Course Outcome	Upon completion of this course, the students will be able to 1. Apply transistor, power transistors and operational amplifier in different circuits. 2. Analyze analog electronic circuits using discrete components. 3. Analyze the amplitude and frequency responses of common amplification circuits. 4. Measure various parameters of analog circuits and compare experimental results in the laboratory with theoretical analysis. 5.Design and construct simple electronic circuits to accomplish a specific function, e.g., designing amplifiers, oscillators.

Prerequisites: EEB4101 – Introduction to 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**	**PSO 3**
CO-1	3	3	3	1	2	-	-	-	-	-	-	1	3	2	1
CO-2	3	3	3	2	2	-	-	-	-	-	-	1	3	2	-
CO-3	3	3	3	2	2	-	-	-	-	-	-	1	3	2	1
CO-4	3	3	3	2	1	-	-	-	-	-	-	1	3	2	-
CO-5	3	3	3	2	2	-	-	-	-	-	-	1	3	2	1

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

List of Experiments

1. Study the different parameters of op-amp. 2. Comparison between different transistor configurations.	**CO-1 BTL-4**
3. Study of op-amp as inverting amplifier and non-inverting amplifier. 4.OPAMP circuits – Design and set up of inverter scale changer/adder ,non-inverting amplifier.	**CO-2 BTL-4**
5. OPAMP circuits –integrator, differentiator, and comparator. 6.Phase shift and Wein's Bridge oscillator with amplitude stabilization using OPAMPs.	**CO-3 BTL-4**
7. Waveform generation – Square, triangular and saw tooth wave form generation	**CO-4**

using OPAMPs. 8. Application of op-amp as low pass filter, high pass filter	**BTL-4**
9. IC 555 Applications as monostable and astable multi-vibrator. 10. PLL IC 565 Frequency multiplying / FSK demodulation	**CO-5** **BTL-4**

TEXT BOOKS	
1.	David A. Bell (2017),"Electronic devices and circuits", Oxford, Fifth edition.
2	V. Boylestad and Nashelsky (2013), Electronic Devices and Circuits, Prentice Hall of India.
3	D. Roy Choudhury &Shail B. Jain (2010), 'Linear Integrated Circuits', New Age International Publishers, Fourth Edition.
4	BehzadRazavi (2014),"Fundamentals of Micro Electronics ",Wiley and Sons.
5	Sedra and Smith (2016) ,"Microelectronic circuits", Oxford, Fifth edition.
REFERENCE BOOKS	
1.	Theodore F. Bogart Jr. (2014), Electronic Devices and Circuits.
2.	K. R. Botkar (2013), Integrated Circuits, Khanna Publishers.
3	Floyd (2015), Fundamentals of Analog Circuits 2e, Pearson Education.
E BOOKS	
1.	https://archive.org/details/ElectronicDevicesCircuits
2	http://www.rtna.ac.th/departments/elect/Data /EE304/Electronic%20Devices%20and%20Circuit%20Theory.pdf
3	*https://docs.google.com/file/d/0B9LJy8vattSMMHFZelktMHp5TG8/edit*
MOOC	
1.	http://nptel.ac.in/courses/117103063/ http://nptel.ac.in/courses/122106025/2 https://onlinecourses.nptel.ac.in/noc18_ee10/preview

COURSE TITLE		**DESIGN PROJECT-I**			**CREDITS**	**1**
COURSE CODE		**EEB4233**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**		**LEARNING LEVEL**	**BTL-6**

ASSESSMENT SCHEME			
Review 1	**Review 2**	**Review 3**	**Final Review**
10%	**20%**	**20%**	**50%**

Course Description	This course provides a solid foundation in core electrical engineering disciplines, critical thinking and problem-solving skills. Through the academic program students also develop excellent written and oral communication skills, learn to work as a team and project management.
Course Objective	1.To investigate the students' ability in identifying and problem formulation 2.To provide the database in the respective discipline and also enable them to know the scale of the project that should be carried on. 3.Develop excellent written and oral communication skills

Course Outcome	Upon completion of this course, the students will be able to 1. Develop simple electrical and electronic models based on the knowledge gained. 2. Propose a project and defend it as a team. 3. Develop coding for embedded System

Prerequisites: Basic Electrical 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	PSO 3
CO-1	3	2	3	2	1	1	1	-	3	-	3	3	3	3	1
CO-2	3	2	3	1	-	-	-	-	3	-	3	3	3	3	1
CO-3	3	2	3	2	3	1	1	-	3	-	3	3	3	3	2

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

To carry out a Design project and simple prototype in the area of interest based on the knowledge gained in Electrical and Electronics Engineering from previous semesters.

The students will carry out a project in one of the following Electrical and Electronics Engineering areas but with substantial multidisciplinary components:

- Transmission and Distribution
- Electrical Machines.
- Operating Systems

Student groups will be formed (3/4 in a group) and a faculty member will be allocated to guide them. There will be three major reviews which will be carried out as listed below.

Review #	Requirement	Mark Weightage	
		Internal	External
0	Area / Title selection	-	-
1	Literature review / Proposal for the Project	10%	-
2	Mathematical modelling/Circuit Design	20%	-
3	Final simulation / Hardware presentation	20%	-
End Semester Exam	Final Viva-Voce and project demonstration	-	50%

SEMESTER - IV

COURSE TITLE		NUMERICAL METHODS			CREDITS	4
COURSE CODE		MAA 4217	COURSE CATEGORY	BS	L-T-P-S	3-1-0-1
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL		BTL-1-4

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 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 solve system of linear equations by substitution and elimination 2. To define interpolation and prove the order of the polynomial is unique. 3. To develop own numerical differentiation and experience computational limitation 4. To identify the suitable methods to solve ordinary differential equations 5. To identify suitable method to solve partial differential equations
Course Outcome	Upon completion of this course, the students will be able to 1. Apply the techniques for solving the algebraic and transcendental equations, system of equations and Eigenvalue problems. 2. Construct an approximate polynomial to represent the given data and know to find the intermediate values. 3. Obtain the differentiation and integration when the functions are in analytical form. 4. Solve ordinary differential equation using an appropriate numerical method. 5. Solve partial differential equation using an appropriate numerical method.

Prerequisites:

CO, PO AND PSO MAPPING

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

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

MODULE 1: SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS (9L+3T=12)

Solution of algebraic and transcendental equations: Method of false position – Newton's method –Fixed point iteration method – Solution of linear system of Gaussian elimination and Gauss-Jordan methods – Iterative methods: Gauss Jacobi and Gauss – Seidel methods- Inverse of a matrix by Gauss-Jordan method. Eigenvalue of a matrix by power method. Suggested Reading: System of equations	**CO-1 BTL-1,2,3,4**

MODULE 2: INTERPOLATION AND APPROXIMATION (9L+3T=12)

Lagrangian Polynomials – Divided difference – Newton forward and backward difference method – Cubic Spline interpolation. Suggested Reading: Relations and functions	**CO-2 BTL-1,2,3,4**

MODULE 3: NUMERICAL DIFFERENTIATION AND INTEGRATION (9L+3T=12)

Derivatives from difference table – Divided difference and finite difference – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two and three point Gaussian quadrature formula – Double integrals using trapezoidal and Simpson's rules. Suggested Reading: Basic differentiation and integration	**CO-3 BTL-1,2,3,4**

MODULE 4: NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS (9L+3T=12)

Single step Methods: Taylor Series method –Euler and Modified Euler method – Fourth order Runge-Kutta method for solving first and second order differential equations - Multistep method: Milne's and Adam's predictor and corrector methods. Suggested Reading: Ordinary Differential Equations	**CO-4 BTL-1,2,3,4**
MODULE 5: BOUNDARY VALUE PROBLEMS (9L+3T=12)	
Finite difference solution for the second order ordinary differential equations. Finite difference solution for one dimensional heat equation by implicit and explicit methods – one dimensional wave equation and two dimensional Laplace and Poisson equations. Suggested Reading: Partial Differential Equations	**CO-5 BTL-1, 2, 3, 4**

TEXT BOOKS	
1.	Numerical Methods 3rd Edition by K. Gunavathi, P. Kandasamy, K. Thilagavathy, 2006
2.	Gerald, C.F, and Wheatley, P.O, "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2002.
3.	Grewal. B.S., and Grewal. J.S., " Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 9th Edition, 2007.
4.	Raj Kumar Bansal,Ashok Kumar Goel, Manoj Kumar Sharma, "MATLAB and its Applications in Engineering", Pearson Publication, Second Edition, 2016.
REFERENCE BOOKS	
1.	Chapra. S.C., and Canale. R.P, "Numerical Methods for Engineers", 5th Edition, Tata McGraw Hill, New Delhi, 2007
2.	Gerald. C.F., and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.
3.	Jaankiusalaas, Numerical methods with engineering with Python 3, January 2013 Edition, Cambridge Press
	Dean G. Duffy., "Advanced Engineering Mathematics with MATLAB", CRC Press, Third Edition 2013.
E BOOKS	
1.	http://nptel.ac.in/courses/112106061/Module_2/Lecture_2.2.pdf
2.	http://www.nptel.ac.in/courses/122104018/node109.html
3.	http://nptel.ac.in/courses/122107036/35
MOOC	
1.	https://www.mooc-list.com/course/numerical-methods-engineers-saylororg

COURSE TITLE		**SIGNALS AND SYSTEMS**			**CREDITS**	**4**
COURSE CODE		**EEB4216**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-1**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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	Signals and systems covers the fundamentals of signal and system analysis, focusing on representations of discrete-time and continuous-time signals using various mathematical transforms
Course Objective	1. Understand concepts, continuous-time signals and discrete-time signals 2. Apply linear time-invariant systems theory and applications

	3. Student can perform mathematical and graphical convolution of signals and systems 4. Gain knowledge about the application and use of mathematical transforms and state-variables in order to solve electrical engineering problems
Course Outcome	Upon completion of this course, the students will be able to 1. Apply continuous time & discrete time signals to systems. 2. Analyze time and frequency domain techniques to different signals. 3. Apply Laplace transform for Frequency Domain Analysis of Continuous Time System 4. Apply Z- Transform for Frequency Domain Analysis of Discrete Time System 5. Apply Fourier series and transform to Continuous Time System and Discrete Time System

Prerequisites: MAA4117-Analytical Mathematics, MAA4201-Partial Differential Equations and 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	PSO -3
CO-1	3	3	3	3	2	-	-	-	-	-	-	1	1	1	3
CO-2	3	3	3	3	2	-	-	-	-	-	-	1	1	1	3
CO-3	3	3	3	3	2	-	-	-	-	-	-	1	1	1	3
CO-4	3	3	3	3	2	-	-	-	-	-	-	1	1	2	3
CO-5	3	3	3	3	2	-	-	-	-	-	-	1	1	2	3

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

Module I:- Continuous and Discrete Time Signals and Systems (12 L)	
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.	**CO-1 BTL-4**
Module II:- Time Domain Analysis of Continuous and Discrete Time Signals And Systems (12 L)	
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.	**CO-2 BTL-4**
Module III:- Frequency Domain Analysis of Continuous Time System Using Laplace Transform (12 L)	
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.	**CO-3 BTL-4**
Module IV:- Frequency Domain Analysis of Discrete Time System Using Z- Transform (12 L)	
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.	**CO-4 BTL-4**
Module V:- Frequency Domain Analysis of Continuous and Discrete Signals using Fourier (12 L)	
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	**CO-5 BTL-4**

Fourier transform, Properties, Frequency sampling, Discrete Fourier transform, Properties.	
TEXT BOOKS	
1.	Allan V.Oppenheim, S.Wilsky and S.H. Nawab, (2014) "Signals and Systems", Pearsons.
2	Edward W Kamen & Bonnie's Heck, (2015) "Fundamentals of Signals and Systems", Pearson Education.
REFERENCE BOOKS	
1.	John G.Proakis and DimitrisG.Manolakis (2017), Digital Signal Processing, Principles, Algorithms and Applications, 4th Edition, PHI.
2.	B. P. Lathi (2018), "Principles of Linear Systems and Signals", Second Edition, Oxford.
3	R.E.Zeimer, W.H.Tranter and R.D.Fannin (2018), "Signals & Systems - Continuous and Discrete", Pearson.
4	John Alan Stuller (2018), "An Introduction to Signals and Systems", Thomson.
5	M.J.Roberts (2016), "Signals & Systems Analysis using Transform Methods & MATLAB", Tata McGraw Hill.
E BOOKS	
1.	http://bookboon.com/en/introduction-to-digital-signal-and-system-analysis-ebook
2	Text book companionhttp://www.scilab.in/Completed_Books#2
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		**CONTROL SYSTEMS**			**CREDITS**	**4**
COURSE CODE		**EEB4217**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1 -0-1**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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 provides an introduction to linear systems, transfer functions, and Laplace transforms. It covers stability and feedback, and provides basic design tools for specifications of transient response
Course Objective	1. To introduce different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis. 2. To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system 3. Formulate different types of analysis in frequency domain to explain the nature of stability of the system
Course Outcome	Upon completion of this course, the students will be able to 1. Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form. 2.Characterize any system in Laplace domain to illustrate different specification of the system using transfer function concept. 3. Interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis. 4. Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions. 5. Formulate different types of analysis in frequency domain to explain the nature of stability of the system.

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

CO, PO AND PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	2	2	2	-	-	-	-	-	-	-	1	3	1
CO-2	3	3	2	2	3	-	-	-	-	-	-	-	1	3	1
CO-3	3	3	2	2	3	-	-	-	-	-	-	-	1	3	1
CO-4	3	3	2	2	3	-	-	-	-	-	-	-	1	3	1
CO-5	3	3	3	2	3	-	-	-	-	-	-	-	1	3	1

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

Module I:- SYSTEM REPRESENTATION **(9L+3T)**

Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – AC and DC servo motors – Block diagram reduction techniques – Signal flow graphs.	**CO-1 BTL-3**

Module II:- TIME RESPONSE **(9L+3T)**

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, Creating Continuous Time Models, Discrete Time Models, PID Controller Tuning in Simulink	**CO-2** **BTL-4**
Module III:- FREQUENCY RESPONSE (9L+3T)	
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 IV:-STABILITY OF CONTROL SYSTE (9L+3T)	
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 V:-COMPENSATOR DESIGN (9L+3T)	
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. Practical Component: Design of compensators Suggested Reading:- Compensator Design, SISO, MISO.	**CO-5** **BTL-4**
TEXT BOOKS	
1.	Ogata.K (2015), *Modern Control System Engineering Fifth Edition* –Pearsons.
2	I.J. Nagrath& M. Gopal (2018), *Control Systems Engineering*, New Age International Publishers, Sixth edition.
3	B.C. Kuo (2017), "Automatic Control Systems"Tenth Edition, McGraw-Hill Education.
4	G.F. Franklin, J.D. Powell and A. Emami-Naeini (2015), "Feedback Control of Dynamic Systems" Seventh edition,Pearson education Ltd.
5	Norman S. Nise (2013), "Control Systems Engineering" by Seventh Edition, John Wiley & Sons, Incorporated.
6	Jairath AK (2017), "Problems and Solutions of Control Systems: With Essential Theory" fourth edition, CBS Publishers & Distributors.
REFERENCE BOOKS	
1.	M. Gopal (2012), *Control Systems, Principles & Design*, Fourth edition, Tata McGraw Hill, New Delhi.
2.	M.N. Bandyopadhyay (2017), *Control Engineering Theory and Practice*, Prentice Hall of India.
3	Norman S. Nise (2015),"Control Systems Engineering: Analysis and Design " seventh edition,Wiley sons.
E BOOKS	
1.	http://engineeronadisk.com/book_modeling/
2.	Text book companionhttp://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/
4	http://www.nptelvideos.in/2012/11/control-engineering.html
5	Virtual Lab:- http://iitb.vlab.co.in/?sub=8&brch=117&sim=959&cnt=2017
6	http://vlcsd.virtual-laboratories.com/html/index.html

COURSE TITLE	**TRANSMISSION AND DISTRIBUTION**			**CREDITS**	**4**
COURSE CODE	**EEB4218**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-1**
Version **1.0**	**Approval Details**	**23 ACM, 06.02.2021**		**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	The course describes the journey of electricity from the power plant to customers. Various parameters of transmission and distribution systems is derived. Modeling and analysis of transmission lines and insulation coordination of transmission system is included.
Course Objective	1.To gain knowledge of transmission and distribution systems that deliver power from a power plant to customers. 2.To identify the basic components of a transmission and distribution system and explain their functions. 3. To gain knowledge of how power grids help in continuous flow of power to customers 4.To model the transmission line with compensators. 5.To design proper grounding and insulation coordination of transmission
Course Outcome	Upon completion of this course, the students will be able to 1.describe the various stages of power system , merits and demerits of high voltage transmission 2.Evaluate the parameters of transmission line and analyze the effect of corona, electrostatic field of EHVAC lines. 3.Model and analyze the performance of a transmission line. 4.Select a particular insulator based on the operating voltage and explain the characteristics and features of Underground cables. 5.Design proper grounding in a substation and analyse different ac and dc distribution systems.

Prerequisites: ESB4201 Electromagnetic Theory

CO, PO AND PSO MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO-1	3	3	2	2	2	-	-	-	-	-	-	1	1	-	1
CO-2	3	3	2	2	3	-	-	-	-	-	-	1	1	-	1

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

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

MODULE 1: INTRODUCTION	**(12 L)**
Structure of electric power system- generation, transmission and distribution-advantages of high voltage transmission-introduction to EHV AC transmission, HVDC transmission and FACTS devices.-Mechanical design of transmission line between towers – sag and tension calculations using approximate equations taking into account the effect of ice and wind. **Suggested Readings:** 1. Modelling and Simulation of a Monopolar / Bipolar / Homopolar HVDC Transmission system with a suitable controller using MATLAB. 2. Simulation of FACTS Devices as Reactive Power Compensators and Voltage Controllers using MATLAB.	**CO-1** **BTL-3**
MODULE 2: TRANSMISSION LINE PARAMETERS	**(12 L)**
Parameters of single and three phase transmission lines -resistance, inductance and capacitance calculations - single and double circuits - solid, stranded and bundled conductors - symmetrical and unsymmetrical spacing – transposition of lines - concepts of GMR and GMD - skin and proximity effects - interference with neighbouring communication circuits. Corona discharge characteristics – critical voltage and loss. **Suggested Readings** 1. Analysis of Radio Interference on Performance of Transmission Line using MATLAB 2.Determining Transmission Line Parameters using MATLAB.	**CO-2** **BTL-4**
MODULE 3: MODELLING AND PERFORMANCE OF TRANSMISSION LINES	**(12 L)**
Transmission line classifications: Short line, medium line and long line-equivalent circuits-ferranti effect- surge impedance -attenuation constant and phase constant- voltage regulation and transmission efficiency -real and reactive power flow in lines: Power-angle diagram- surge impedance loading- loadability limits based on thermal loading, angle and voltage stability considerations; shunt and series compensation **Suggested Readings:** 1. Modelling and Analysis of transmission line using MATLAB. 2. Verification of Ferranti Effect for Different Length Transmission Lines Using MATLAB Simulation.	**CO-3** **BTL-4**
MODULE 4: INSULATORS AND CABLES	**(12 L)**
Classification of insulators- voltage distribution in insulator string and grading-improvement of string efficiency. Underground cables-Constructional features of LT and HT cables, capacitance, dielectric stress and grading, thermal characteristics. **Suggested Readings:** The Analysis and Simulation of Voltage Distribution over String Insulators Using Matlab/Simulink.	**CO-4** **BTL-4**
MODULE 5: SUBSTATION, GROUNDING AND DISTRIBUTION SYSTEM	**(12 L)**
Classification and functions of major components of substations-Bus-bar arrangements-	**CO-5**

substation bus schemes: single bus, double bus with double breaker and single breaker, main and transfer bus, ring bus, double bus-bar with bypass isolators. Importance of earthing in a substation -Qualitative treatment to neutral grounding and Earthing practices . Feeders, distributors and service mains. DC distributor – 2-wire and 3-wire, radial and ring main distribution. AC distribution – single phase and three phase 4-wire distribution. **Suggested Readings:** 1. Design and Calculation of Earth Electrode. 2.Grounding Design Calculations.	**BTL-4**

TEXT BOOKS	
1.	V. K. Mehta & Rohit Mehta M. (2018). *Principles of Power System*, S.Chand; 4th edition , pp. 127-386.
REFERENCE BOOKS	
1.	J. Duncan Glover. (2017). *Power System Analysis and Design*, Cengage Learning, 6th Edition.
2.	A.S. Pabla. (2015). *Electric Power Distribution*, McGraw Hill, 6th Edition.
E BOOKS	
1.	http://www.eenotes.com/2017/09/principles-of-power-system-by-v-k.html
2.	https://books.google.co.in/books/about/Electrical_power.html?id=IIvZrQEACAAJ&redir_esc=y
MOOC	
1.	https://www.mooc-list.com/course/electric-industry-operations-and-markets-coursera

COURSE TITLE		**ELECTRICAL SIMULATION LABORATORY**			**CREDITS**	**1**
COURSE CODE		**EEB4241**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**		**BTL-4**
ASSESSMENT SCHEME						
Internal Assessment					**Attendance**	**ESE**
75%					**5%**	**20%**
Course Description	To develop the skill for using different simulation on software MATLAB tool for the analysis and processing of signals and to generate various continuous and discrete time signals.					
Course Objective	1. To train the students on MATLAB tool. 2. To impart knowledge on signal transmission through linear systems, convolution and correlation of signals and sampling. 3. To understand the concept and importance of Fourier and Z-Transforms. 4. To introduce Digital logic design software for constructing various types of Digital circuit used in real time application.					
Course Outcome	Upon completion of this course, the students will be able to 1. Familiarize with Analyze Various Signals and Sequences in MATLAB, including the operations on Signals and Sequences. 2. Verify of Sampling Theorem, Linearity and Time Invariance Properties of a given Signals/ Systems 3. Analyze the Fourier Transform of a given signal and plotting its magnitude and					

	phase spectrum and also plot Pole-Zero Maps in Z-Plane

Prerequisites: Basic of renewable energy concepts

CO, PO AND PSO MAPPING

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

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

LIST OF EXPERIMENTS	**(9L)**
1. Basic Operations on Matrices	**CO-1 BTL-2,4**
2. Permanent Magnet Brushless DC motor simulation using Matlab/Simulink.	
3. Permanent Magnet DC motor simulation using Matlab/Simulink	
4. Design and simulate the characteristics of first and second order circuits in time and frequency domain using Pspice	
5. Simulation of three phase bridge rectifier using Matlab	
6. Performance evaluation of medium and long transmission lines using Matlab	**CO-2 BTL-4**
7. Symmetrical component analysis using Matlab	**CO-3 BTL-4**
8. Design and analyse the performance of feedback control system	
9. DC Motor Armature control using Matlab/Simulink	
10. Simulate and tune parameters of a PID controller for a given system	**CO-4 BTL-4**

TEXT BOOKS

1.	Basic Electrical Engineering- By M.S.Naidu and S. Kamakshiah – TMH.
2.	Basic Electrical Engineering –By T.K.Nagasarkar and M.S. Sukhija Oxford.

REFERENCE BOOKS

1.	Theory and Problems of Basic Electrical Engineering by D.P.Kothari & I.J.Nagrath PHI.
2.	Principles of Electrical Engineering by V.K Mehta, S.Chand Publications.

E BOOKS

1.	https://www.technicalsymposium.com/Lecturenotes_EE8261_Unit1.html
2.	https://www.technicalsymposium.com/Lecturenotes_BE8261_Unit1.html

MOOC

1.	https://nptel.ac.in/courses/108/104/108104139/
2.	https://nptel.ac.in/courses/108/107/108107115/
3.	https://nptel.ac.in/courses/108/107/108107115/
4.	https://swayam.gov.in/courses/1352-design-and-simulation-of-dc-dc-conver...

COURSE TITLE	**CONTROL SYSTEM LABORATORY**			**CREDITS**	**1**
COURSE CODE	**EEB4242**	**COURSE**	**LAB**	**L-T-P-S**	**0-0-3-0**

			CATEGORY			
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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 control parameters of different systems. A control system manages, commands, directs, or regulates the behavior of other devices or systems using control loops.
Course Objective	1. To familiarize the students with MATLAB software and simulink 2. To help the students understand and practice the modeling and simulation, 3. To study the effects of poles and zeros location in the s-plane on the transient and steady state behavior
Course Outcome	Upon completion of this course, the students will be able to 1.Describe various input/output models of dynamic system. 2.Determine the time response of a control system for various test inputs. 3.Determine the frequency response using various plots. 4.Analyse the concept of stability using various stability criteria. 5.Apply Bode plot to design phase lead-lag compensation.

Prerequisites: Nil

CO, PO AND PSO MAPPING

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

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

Open and closed loop	**(6P)**
❖ To simulate basic open and closed loop system. ❖ To plot torque-speed characteristics of A.C servo motor. ❖ To Generate and plot characteristics of Test Inputs (Pulse, Step, Ramp, Parabola). ❖ To plot the Time domain response and analyse the parameters of the System (First & Second order Systems).	**CO1/BTL3**
Frequency Domain Response	**(8P)**
❖ To plot the Frequency domain response and parameters of with Bode plot (First & Second order Systems). ❖ To study the system characteristics using Polar plot. ❖ To study the system characteristics using Constant M and N Circles.	**CO2/BTL3**
Stability Analysis	**(8P)**
❖ To analyze the system using Nichols chart.	**CO3/BTL3**

❖ To plot the poles and zeros in complex S plane. ❖ To find the stability of the system using Routh Hurwitz criterion. ❖ To find the stability of the system using Root locus method. ❖ To analyze the effect of pole & zero addition in system. To analyze the system and design a Compensator for a given Mathematical Model	
Application	**(8P)**
➢ Deriving the Mathematical Model of a control system based on given time domain specifications. ➢ Deriving the Mathematical Model of a control system based on given frequency domain specifications. ➢ Controlling the direction of rotation of stepper motor. Controlling the speed of DC motor by varying armature current.	**CO4/BTL3**

REFERENCE BOOKS	
1.	Ogata.K (2017), *Modern Control System Engineering Fifth Edition* –Pearsons.
2.	I.J. Nagrath& M. Gopal (2015), *Control Systems Engineering*, New Age International Publishers, Sixth edition.
3.	B.C. Kuo (2017), *Automatic Control Systems,* Tenth Edition, McGraw-Hill Education.
4.	G.F. Franklin, J.D. Powell and A. Emami-Naeini (2017) *Feedback Control of Dynamic Systems*"
5.	Norman S. Nise (2013) *Control Systems Engineering*, Seventh Edition, John Wiley & Sons, Incorporated.
6.	Jairath AK (2017), *Problems and Solutions of Control Systems: With Essential Theory,* fourth edition, CBS Publishers & Distributors.
E BOOKS	
1.	http://engineeronadisk.com/book_modeling/
	Text book companionhttp://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/
4.	http://www.nptelvideos.in/2012/11/control-engineering.html
5.	Virtual Lab:- http://iitb.vlab.co.in/?sub=8&brch=117&sim=959&cnt=2017
6.	http://vlcsd.virtual-laboratories.com/html/index.html

COURSE TITLE	**DESIGN PROJECT-II**	**CREDITS**	**1**

COURSE CODE	EEB4243	COURSE CATEGORY	PC	L-T-P-S	0-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-6

ASSESSMENT SCHEME

Review 1	Review 2	Review 3	Final Review
10%	20%	20%	50%

Course Description	This course provides a solid foundation in core electrical engineering disciplines, critical thinking and problem-solving skills. Through the academic program students also develop excellent written and oral communication skills, learn to work as a team and project management.
Course Objective	1.To investigate the students' ability in identifying and problem formulation 2.To provide the database in the respective discipline and also enable them to know the scale of the project that should be carried on. 3.Develop excellent written and oral communication skills
Course Outcome	Upon completion of this course, the students will be able to 1. Develop simple electrical and electronic models based on the knowledge gained. 2. Propose a project and defend it as a team. 3. Develop coding for embedded System

Prerequisites: Basic Electrical 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	PSO 3
CO-1	3	2	3	2	1	1	1	-	3	-	3	3	3	3	1
CO-2	3	2	3	1	-	-	-	-	3	-	3	3	3	3	1
CO-3	3	2	3	2	3	1	1	-	3	-	3	3	3	3	2

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

To carry out a Design project and simple prototype in the area of interest based on the knowledge gained in Electrical and Electronics Engineering from previous semesters.

The students will carry out a project in one of the following Electrical and Electronics Engineering areas but with substantial multidisciplinary components:

- Transmission and Distribution
- Electrical Machines.
- Operating Systems

Student groups will be formed (3/4 in a group) and a faculty member will be allocated to guide them. There will be three major reviews which will be carried out as listed below.

Review #	Requirement	Mark Weightage	
		Internal	External
0	Area / Title selection	-	-
1	Literature review / Proposal for the Project	10%	-
2	Mathematical modelling/Circuit Design	20%	-
3	Final simulation / Hardware presentation	20%	-
End Semester Exam	Final Viva-Voce and project demonstration	-	50%

Semester – V

COURSE TITLE	OPTIMIZATION TECHNIQUES			CREDITS	4
COURSE CODE	MAA 4301	COURSE CATEGORY	BS	L-T-P-S	3-1-0-1
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 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	PSO 3
CO-1	3	3	2	-	2	2	-	-	-	-	-	-	2	1	1
CO-2	3	3	2	-	-	2	-	-	-	-	-	-	2	1	1
CO-3	3	3	-	-	2	2	-	-	-	-	-	-	2	1	1
CO-4	3	3	2	-	2	2	-	-	-	-	-	-	2	1	1
CO-5	3	3	3	-	-	2	-	-	-	-	-	-	2	1	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-1,2**
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-1,2,3**
MODULE 3:INTEGER PROGRAMMING (9L+3T=12)	
Integer programming – Cutting plane method – Gomory's Mixed integer method – Branch and Bound method Suggested Reading: System of equations	**CO-3 BTL-1,2,3,4**
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-3 BTL-1,2,3,4**
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-4 BTL-1,2,3,4**

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	POWER ELECTRONICS			CREDITS	4
COURSE CODE	EEB4301	COURSE CATEGORY	PC	L-T-P-S	3-1-0-0

Version	1.0	Approval Details	23 ACM, 06.02.2021	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	The goal of this course is to cover the following topics, so that the person finishing this course would have the knowledge base necessary to design working power electronic systems.
Course Objective	To understand and acquire knowledge about various power semiconductor devices. To prepare the students to analyze and design different power converter circuits
Course Outcome	Upon completion of this course, the students will be able to 1. Acquire knowledge about fundamental concepts and operation of semiconductor devices 2. Analyze various single phase and three phase power converter circuits and understand their applications. 3. Analyze various DC to DC converters and its applications 4. Analyze various single phase and three phase inverter circuits and understand their applications. 5. Apply power converters in commercial and industrial applications.

Prerequisites: EEB4117 - Circuits and Networks, EEB4202 – Analog Electronics, EEB4201 - Electrical Machines

CO, PO AND PSO MAPPING

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

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

MODULE 1: POWER SEMI-CONDUCTOR DEVICES (9L+3T=12)

Structure, operation and characteristics of SCR, TRIAC, power transistor, MOSFET and IGBT.Driver and snubber circuits for MOSFET - Turn-on and turn-off characteristics and switching losses. Suggested Readings: Advanced semiconductors devices **Practical component:** Triggering circuits for SCR a. UJT Trigger circuit b. R firing circuit c. RC Firing circuit Characteristics of MOSFET and IGBT **Suggested Readings:** Advanced semiconductors devices	**CO-1** **BTL-4**

MODULE 2: PHASE-CONTROLLED CONVERTERS (9L+3T=12)	
2-pulse, 3-pulse and 6-pulse converters - Inverter operation of fully controlled converter - Effect of source inductance - Distortion and displacement factor - Ripple factor - Single phase AC voltage controllers. **Practical component:** AC to DC half and fully controlled converter Step down and step up MOSFET based choppers **Suggested Readings:** Simulation of various converters using MATLAB	**CO-2 BTL-4**
MODULE 3: DC TO DC CONVERTERS (9L+3T=12)	
Step-down and step-up choppers - Time ratio control and current limit control - Switching mode regulators: Buck, boost, buck-boost and Cukconverter . **Practical component:** Zero voltage switching resonant dc-dc converter **Suggested Readings:** Simulation of various choppers using MATLAB	**CO-3 BTL-3**
MODULE 4: INVERTERS (9L+3T=12)	
Single phase and three phase (both 120degree mode and 180 mode) inverters - PWM techniques: Sinusoidal PWM, modified sinusoidal PWM and multiple PWM - Voltage and harmonic control - Series resonant inverter - Current source inverters. **Practical component:** IGBT based single phase PWM Inverter **Suggested Readings:** Simulation of various inverters using MATLAB	**CO-4 BTL-4**
MODULE 5: : APPLICATIONS (9L+3T=12)	
Uninterrupted power supply topologies - Flexible AC transmission systems - Shunt and series static VAR compensator - Unified power flow controller- HVDC Transmission. **Suggested Readings:** Application of UPS, UPFC	**CO-5 BTL-3**

TEXT BOOKS	
1.	Muhammad H. Rashid (2004) *Power Electronics: Circuits, Devices and Applications*, Pearson Education, Third edition.
2.	P.S.Bimbhra (2014) *Power Electronics*, Khanna Publications, fifth edition.
E BOOKS	
1.	www.powerelectronics.com/learning-resources/ebooks
2.	https://www.scribd.com/document/356197939/Power-Electronics-Book
3.	www.freeengineeringbooks.com/Electrical/Power-Electronics.php
MOOC	
1.	https://www.coursera.org/learn/power-electronics
2.	https://www.mooc-list.com/tags/power-electronics

COURSE TITLE	**MICROCONTROLLER AND EMBEDDED SYSTEM**			**CREDITS**	**4**
COURSE	**EEB4302**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-2-**

CODE					1
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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	The course describes microcontroller-based system of hardware and software designed to perform dedicated functions within an electrical system. The main purpose is to control the device and to allow a user to interact with it. Programming and developing real time applications is included.
Course Objective	1. To gain knowledge of Digital Computer, microprocessors, micro controllers and its architecture. 2.To do basic program for time delay, I/O interfacing, data conversion & keyboard interfacing in 8051. 3. To identify the sensors and motor and do program for external interrupts, timer interrupts and interfacing the various types of motor control in 8051. 4. To gain knowledge and familiarize with Arduino and its installation. Interfacing with external peripheral devices. 5.To design the circuit model for interfacing the motors with PIC microcontroller and analyze the speed response.
Course Outcome	Upon completion of this course, the students will be able to 1.Describe the architecture and real time functioning of 8051 2.Develop basic program for time delay, interrupts and interfacing with external peripherals. 3.Describe the architecture and real time functioning of Arduino Microcontroller 4.Describe the architecture, functions and application of PIC microcontroller 5.Develop systems using Microcontroller

Prerequisites: EEB4101 Introduction to 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	PSO 3
CO-1	3	2	2	2	3	-	-	-	1	-	1	2	-	1	1
CO-2	3	3	2	2	3	-	-	-	2	-	1	2	2	2	1
CO-3	3	3	2	2	3	-	-	-	2	-	1	2	2	2	1
CO-4	3	3	2	2	3	-	-	-	2	-	1	2	2	2	1
CO-5	3	3	2	2	3	-	-	-	2	-	1	2	2	2	1

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

Module I:- INTRODUCTION AND 8051 MICROCONTROLLER (9L + 3 P = 12)

Introduction to Digital Computer, microprocessors, micro controllers, Van Neumann and Harvard Architecture, CISC and RISC Processors. 8051 Micro controller – Architecture - Addressing modes - Instruction set - Interfacing with real time peripherals. **Practical Component**: Generation of control signals	**CO-1 BTL-3**

Module II:- 8051 MICROCONTROLLER PROGRAMMING AND INTERFACING (9L + 3 P = 12)

8051 C programming basics and time delay in 8051 C, I/O programming in8051 C, Logic operations in 8051 C, Data conversion programs in 8051 C, Accessing code ROM space in 8051 C. ADC, DAC and Temperature Sensor interfacing with 8051 microcontroller. LCD and Matrix Keyboard interfacing with 8051microcontroller. **Practical Component** : Room Temperature Indicator, Level detection application, DC Motor control, stepper motor control, relay, DC motor and servomotor control using scilab	**CO-2 BTL-4**
Module III:- 8051 TIMER, SERIAL PORT, INTERRUPT PROGRAMMING IN C & MOTOR CONTROL (9L + 3 P = 12)	
Programming 8051 timers/Counter in C. Basics of serial communication, 8051 connection to RS232, 8051 serial port programming in C. 8051 interrupts programming in C: Timer interrupts, external hardware interrupts and serial communication interrupt. Relays and Opt-isolators, Stepper motor interfacing, DC motor interfacing and PWM using 8051. **Practical Component**:Case study: Industrial Controllers using 8051.	**CO-3 BTL-4**
Module IV:- ARDUINO MICROCONTROLLER BOARD (9L + 3 P = 12)	
Introducing the Arduino Board, Installing and familiarizing the Arduino IDE, Interfacing the Arduino Uno into Keypad, LCD, Sensors and motor **Practical Component** : Case study: Controllers using Arduino Uno.	**CO-4 BTL-4**
Module V:- PIC MICRO CONTROLLER (9L + 3 P = 12)	
PIC16F7X series- Architecture- Instruction set- Programs for pulse generation, Controllers for Motor control – stepper motor and servo motor control **Practical Component** : Case study: Industrial Controllers using PIC16F7X	**CO-5 BTL-4**

TEXT BOOKS	
1.	Muhammad Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay (2017) 'The 8051 Microcontroller and Embedded Systems using Assembly and C', Prentice Hall Publications, 2nd Edition.
REFERENCE BOOKS	
1.	MykePredko , 'Programming and Customizing the 8051 Microcontroller (2017), Tata Mcgraw Hill publishing company limited,New Delhi, Sixteenth reprint.
2.	K. J. Ayala, D. V. Gadre (2016) ,'The 8051 Microcontroller & Embedded Systems using Assembly and C', *Penram Intl. Publishing.*

COURSE TITLE	**MEASUREMENT & INSTRUMENTATION**			**CREDITS**	**3**
COURSE CODE	**EEB4303**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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 will introduce the basic measurement techniques employing electronic test equipment including the operation and usage of digital multimeters, function generators and oscilloscopes.				
Course Objective	1. To familiarize with the concepts of various measuring instruments				

	2. To understand the concept of resistance measurement 3. To understand the working principle of AC bridges 4. To recognize the functioning of waveform generators and analyzers 5. To understand the construction and working of various display and recording devices.
Course Outcome	Students will be able to 1. Describe the concepts of various meters, measurement of voltage and power. 2. Describe the measurement of various types of resistances 3. Analyze the measurement of impedance, capacitance and inductance using AC Bridges 4. Analyze the functioning of the various waveform generators and analyzers 5. Demonstrate the construction and working of various display and recording devices.

Prerequisites: Prerequisites:- Fundamental Definitions in Electrical & Electronic Measurements, basics of mathematics, Methods of differentiation,

CO, PO AND PSO MAPPING

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

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

MODULE 1: MEASUREMENT OF VOLTAGE ,CURRENT AND POWER	**(6L+3P=9)**
Galvanometers D'Arsonaval galvanometer Theory, calibration, application Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type& thermal type meter, rectifier type calibration of voltmeter and ammeter Errors and compensation- Electrodynamometer type wattmeter, Theory & its errors. **Practical component: hard ware** Lab experiments/virtual lab calibration of voltmeters, ammeters **Suggested Readings:** Concept of Damping, Types of Damping	**CO-1** **BTL-2**
MODULE 2: RESISTANCE MEASUREMENT	**(6L+3P=9)**
Measurement of low, medium & high resistance Ammeter, voltmeter method Wheatstone bridge Kelvin double bridge Series and shunt type ohmmeter High resistance measurement , Megger Direct deflection methods – Price's guard-wire method Loss of charge method - Earth resistance measurement. **Practical component:** Hardware 1. Measurement of resistance using Kelvin' bridge 2. Measurement of resistance using Anderson's bridge **Suggested Readings:** Basic electrical laws, Bridge balance conditions	**CO-2** **BTL-4**
MODULE 3: IMPEDANCE MEASUREMENT	**(6L+3P=9)**
A.C bridges Measurement of inductance, capacitance Q of coil Maxwell Bridge	**CO-3**

ay's dge Schering bridge- Anderson bridge-Campbell bridge to measure mutual inductance Errors in A.C. bridge methods and their compensation-Detectors-Excited field. A.C. galvanometer - Vibration galvanometer Introduction to cable fault and eddy current measurement. **Suggested Reading:** - Analysis of circuits, AC Bridge balance Conditions **Practicals**: Hardware 3. Measurement of resistance using Maxwell' bridge 4. Measurement of resistance using Schering's bridge	**BTL-4**
MODULE 4: SIGNAL GENERATORS AND ANALYZERS	**(6L+3P=9)**
Sine wave generator Frequency synthesized sine wave generator pulse and square wave generator Function generator Wave analyzer Applications Harmonic distortion analyzer Spectrum analyzer Applications Audio Frequency generator Noise generator. Cathode Ray Oscilloscope-Screens for CRT graticules Vertical & horizontal deflection systems Probes-Digital CRO **Suggested Reading: -**Properties and analysis of periodic waves **Practicals**: Hardware/MATLAB 1.Sinewave generation 2.Pulse width modulation	**CO-4** **BTL-2**
MODULE 5: DISPLAY AND RECORDING DEVICES	**(6L+3P=9)**
Bar graph display Segmental and dot matrix display X-Y recorders, magnetic tape recorders Digital recording Data loggers. Interference and screening- Electrostatic and electromagnetic interference & earth loops. **Suggested Reading**:- Measurement of electrical quantities, SI units of measurements **Practicals**: MATLAB 1.Digital simulation of 1st and 2nd order systems for different inputs	**CO-5** **BTL-2**

TEXT BOOKS	
1.	Alan S Morris and Reza Langari (2015) *Measurement and Instrumentation: Theory and Application*, Academic Press, Second Edition.
2.	A.K Sawhney (2012) *A course in electrical and electronic measurements and instrumentation*, Fourth Edition
3.	Bela G Lipak, Krista Vencizel (2017) *Measurement and Safety: Volume 1,* CRC Press, , Fifth Edition,
4.	Robert V Northrope (2014) *Introduction to measurement and instrumentation,* Taylor and Francis, 4th edition.
REFERENCE BOOKS	
1.	Romen Maleric(2015) *Instrumentation and measurements in electrical engineering, Universal Publishers,* Second Edition
2.	Arun G Ghosh (2012) *Introduction to measurement and instrumentation*, McGraw Hill, Fourth Edition
E BOOKS	
1.	Measuring Instruments(web), http://nptel.ac.in/courses/108105053
2.	Electrical and Electronic Measurements(video), http://nptel.ac.in/courses/108106070/
MOOC	
1.	https://www.udemy.com/course/electronic-measurements-and-instrumentation/
2.	https://www.udemy.com/course/measurements-and-instrumentation/

COURSE TITLE		POWER ELECTRONICS LABORATORY			CREDITS	1
COURSE CODE		EEB4331	COURSE CATEGORY	PC	L-T-P-S	0:0:2:0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL		BTL-4

ASSESSMENT SCHEME

First Cycle Assessment	Second Cycle Assessment	Attendance	ESE
35%	35%	10%	20%

Course Description	Power electronics lab enables the students on experimental skills towards the operation of different types of choppers, rectifiers, inverters and AC voltage controllers
Course Objectives	To understand and acquire knowledge about various power semiconductor devices. To prepare the students to analyze and design different power converter circuits
Course Outcome	Upon the completion of Power electronics laboratory course, the student will be able to 1. Design and obtain the characteristics of SCR, MOSFET and IGBT. 2. Construct single phase and three phase controlled rectifiers and their commutating circuits. 3. Construct and design different types of Choppers and inverters. 4. Design the different power electronic circuits using MATLAB

Prerequisites: - EEB4202 - 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	PSO 3
CO-1	2	3	3	-	3	-	-	-	2	-	-	-	2	1	1
CO-2	2	3	2	-	3	-	-	-	2	-	-	-	2	1	1
CO-3	2	3	3	-	3	-	-	-	2	-	-	-	2	1	1
CO-4	2	3	3	-	3	-	-	-	2	-	-	-	2	1	1

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

LIST OF EXPERIMENTS

1	**Triggering circuits for SCR** **a. UJT Trigger circuit** **b. R firing circuit** c. **RC Firing circuit**	CO1, BTL-3
2	**Characteristics of MOSFET and IGBT**	
3	**Characteristics of TRIAC**	CO2, BTL-3
4	**Characteristics of SCR**	
5	**Transient characteristics of SCR and MOSFET**	
6	**AC to DC half and fully controlled converter**	CO3, BTL-3
7	**Step down and step up MOSFET based choppers**	
8	**IGBT based single-phase PWM inverter**	
9	**Zero voltage switching resonant dc-dc converter**	CO4, BTL-3
10	**Zero current switching resonant dc-to-dc converter**	
TEXT BOOKS		
1	Muhammad H. Rashid (2017) *Power Electronics: Circuits, Devices and Applications*, Pearson Education, Third edition.	
2	P.S.Bimbhra (2018) *Power Electronics*, Khanna Publishers, fifth edition.	
REFERENCE BOOKS		
1.	Ned Mohan, Tore.M.Undeland, William.P.Robbins (2012) *Power Electronics: Converters, Applications and Design*, John Wiley and sons, third edition.	
2.	G.K. Dubey(2001) *Fundamentals of Electrical Drives*, Narosa Publishing House, New Delhi, 2nd Edition.	
3.	G.K. Dubey (2011) *Power Semi-conductor Controlled Drives*, Prentice Hall of India, Second Edition	
4.	S.K. Pillai (2012) *A First Course on Electrical Drives*, Wiley Eastern Limited, Second Edition.	

COURSE TITLE	**ELECTRICAL MACHINE DESIGN LAB**			**CREDITS**	**1**
COURSE CODE	**EEB4332**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0:0:2:0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**	**BTL-4**
ASSESSMENT SCHEME					
First Cycle Assessment	**Second Cycle Assessment**	**Attendance**			**ESE**
35%	**35%**	**10%**			**20%**
Course Objectives	The objective of electrical machine design lab is to expose the students to analyze and design parts of both DC machines and AC machines				
Course Outcome	Upon the completion of electrical machine design laboratory course, the student will be able to analyze and 1.Design a DC Machine and cylindrical pole synchronous Machine using MATLAB and obtain the results. 2. Develop a program Using MATLAB and design a Squirrel cage Induction Motor				

	for the given specifications 3. Develop a program Using MATLAB and design a single-phase transformer for the given specifications 4. Assemble the parts of both DC machines and AC machines

Prerequisites: - EEB4201 - Electrical Machines

CO, PO AND PSO MAPPING

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

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

LIST OF EXPERIMENTS

1	Design of cylindrical pole synchronous Machine	CO-1, BTL-4
2	Design of DC Machine (Series connected)	
3	Design of Squirrel cage Induction Motor	CO-2, BTL-4
4	Design of Single-phase Transformer	
5	Simple control circuit's for controlling machines using PCB	CO-3, BTL-3
6	Assembly of DC Machines	CO-4, BTL-2
7	Assembly of 3-phase induction motor	
8	Assembly of 3-phase Synchronous motor	

COURSE TITLE	**DESIGN PROJECT-III**			**CREDITS**	**1**
COURSE CODE	**EEB4333**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**	**BTL-5**

ASSESSMENT SCHEME

Review 1	**Review 2**	**Review 3**	**Final Review**
10%	**20%**	**20%**	**50%**

Course Description	This course provides a solid foundation in core electrical engineering disciplines, critical thinking and problem-solving skills. Through the academic program students also develop excellent written and oral communication skills, learn to work as a team and project management.
Course Objective	1.To investigate the students' ability in identifying and problem formulation 2.To provide the database in the respective discipline and also enable them to know the scale of the project that should be carried on. 3.To enable the coding skills. 4.Develop excellent written and oral communication skills
Course Outcome	Upon completion of this course, the students will be able to 1.Develop simple electrical and electronic models based on the knowledge gained.

	2.Propose a project and defend it as a team. 3.Implement a real time system as proposed

Prerequisites: Basic Electrical and Computer Engineering 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	PSO 3
CO-1	3	2	3	2	1	1	1	-	3	-	3	3	3	3	1
CO-2	3	2	3	1	-	-	-	-	3	-	3	3	3	3	1
CO-3	3	2	3	2	3	1	1	-	3	-	3	3	3	3	2

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

To carry out a Design project and simple prototype in the area of interest based on the knowledge gained in Electrical and Electronics Engineering from previous semesters.

The students will carry out a project in one of the following Electrical and Electronics Engineering areas but with substantial multidisciplinary components:

- Control System
- Real Time Embedded System
- OOPS

Student groups will be formed (3/4 in a group) and a faculty member will be allocated to guide them. There will be three major reviews which will be carried out as listed below.

Review #	**Requirement**	**Mark Weightage**	
		Internal	**External**
0	Area / Title selection	-	-
1	Literature review / Proposal for the Project	10%	-
2	Mathematical modelling/Circuit Design	20%	-
3	Final simulation / Hardware presentation	20%	-
End Semester Exam	Final Viva-Voce and project demonstration	-	50%

SEMESTER - VI

COURSE TITLE	POWER SYSTEM PROTECTION AND CONTROL			CREDITS	4
COURSE CODE	EEB4316	COURSE CATEGORY	DE	L-T-P-S	3-1-0-1
Version	1.0	Approval Details	23 ACM, 06.02.2021	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	The course deals with various protective schemes in power system and power system control schemes like Load frequency Control and Reactive Power Control
Course Objective	1. To familiarize various protection schemes, fault analysis and earthing. 2. To comprehend various relays and its principle. 3. Overview of various protection schemes for apparatus protection and circuit breakers 4. To familiarize real power –frequency control and underlying techniques. 5. To explain various reactive power-voltage control schemes and choose the appropriate scheme .
Course Outcome	Upon completion of this course, the students will be able to 1. Apply the Symmetrical Components techniques for fault analysis. 2. Choose appropriate protection schemes and select the necessary protective relays 3. Choose appropriate apparatus protection scheme and explain the characteristics of circuit breakers 4. Apply fundamentals of real power-frequency control, when there is a system load variation. 5. Apply different methods of voltage control.

Prerequisites: EEB4218 - Transmission and Distribution

CO, PO AND PSO MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	-	-	-	-	-	-	1	3	-	1
CO2	3	3	3	3	3	-	-	-	-	-	-	1	2	-	1
CO3	3	3	3	3	3	-	-	-	-	-	-	1	2	-	1
CO4	3	3	3	3	3	-	-	-	-	-	-	1	3	-	1
CO5	3	3	3	3	3	-	-	-	-	-	-	1	3	-	1

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

MODULE 1: INTRODUCTION (9L+3T=12)

Principles and need for protective schemes - nature and causes of faults - types of faults - fault current calculation using symmetrical components - Power system earthing - Zones of protection and essential qualities of protection - Protection scheme. **Suggested Reading:** Power System Earthing design	**CO-1** **BTL-2,3**
MODULE 2: RELAY PRINCIPLE AND TYPES (9L)	
Electromagnetic relays - Over current, directional, distance and differential, under frequency relays - static relays Microprocessor control for overcurrent relay, impedance relay, direction and mho relay, digital distance relay algorithm **Suggested Reading:** Relay current calculation	**CO-2** **BTL-2,3**
MODULE 3: APPARATUS PROTECTION AND CIRCUIT INTERRUPTION (9L+3T=12)	
Apparatus protection: transformer, generator, motor- protection of bus bars & transmission lines - CTs and PTs and their applications in protection schemes Physics of arc phenomena and arc interruption. Restriking voltage & Recovery voltage, rate of rise of recovery voltage, resistance switching, current chopping, interruption of capacitive current **Suggested Reading:** Advanced Circuit Breakers	**CO-3** **BTL-3**
MODULE 4: : REAL POWER-FREQUENCY CONTROL (9L+6T=15)	
Fundamentals of speed governing mechanism and modeling: Speed-load characteristics - Load sharing between two synchronous machines in parallel; concept of control area, LFC control of a single-area system: Static and dynamic analysis of uncontrolled and controlled cases. **Suggested Reading:** MATLAB simulation of ALFC	**CO-4** **BTL-3**
MODULE 5: REACTIVE POWER-VOLTAGE CONTROL (9L+3T=12)	
Typical excitation system, modeling, static and dynamic analysis, stability compensation; generation and absorption of reactive power: Relation between voltage, power and reactive power at a node; method of voltage control: Injection of reactive power. **Suggested Reading:** MATLAB simulation of AVR	**CO-5** **BTL-3**
TEXT BOOKS	
1.	Badri Ram & D N Vishwakarma (2017) *Power system protection & switch gear*, Tata McGraw Hill pub.
2.	P. Kundur (2008) *Power System Stability & Control*, McGraw Hill Publications, USA, 2008.
REFERENCE BOOKS	
1.	Y.G. Paithankar and S.R Bhide (2003) *Fundamentals of Power System Protection*, Prentice-Hall of India.
2.	Allen J. Wood, Bruce F. Wollenberg, Gerald B. Sheblé (2013) *Power Generation, Operation, and Control*, ISBN: 978-0-471-79055-6.
E BOOKS	

1.	https://dokumen.pub/power-system-protection-and-switchgear-2-e-2nbsped-9780071077743.html
2.	Power-system-operation-and-control-by-jeraldin-ahila.pdf
MOOC	
1.	NPTEL / Online learning materials: http://nptel.ac.in/courses/108101039/3

COURSE TITLE	**SOLID STATE DRIVES**									**CREDITS**			**4**
COURSE CODE	**EEB4317**			**COURSE CATEGORY**		**PC**				**L-T-P-S**			**3-0-2-1**
Version	**1.0**	**Approval Details**		**23 ACM, 06.02.2021**				**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 provides an introduction to the operation of electric drives controlled from a power electronic converter and also provides the design concepts of controllers**												
Course Objective	1. To understand the stable steady-state operation and transient dynamics of a motor-load system. 2. To familiarize with the operation of the converter / chopper fed dc drive and to solve simple problems. 3. To study and understand the operation of both classical and modern induction motor drives. 4. To understand the differences between synchronous motor drive and induction motor drive and to learn the basics of permanent magnet synchronous motor drives. 5. To prepare the students to understand the design of current and speed controllers for a closed loop solid-state DC motor drive												
Course Outcome	Upon completion of this course, the students will be able to 1. Describe motor load dynamics and its steady state stability with Multi quadrant dynamics in the speed torque plane 2. Analyze and design converter and chopper fed DC drive 3. Analyze different speed control methods of Induction motor drives 4. Distinguish the different control strategies of Synchronous Motor drives 5. Analyze the current and speed controllers for a closed loop solid state DC motor Drive												
Prerequisites: EEB4301- Power 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**	**PSO 3**

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

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

MODULE 1: DRIVE CHARACTERISTICS
(9L+3P=12)

Equations governing motor load dynamics - Equilibrium operating point and its steady state stability - Mathematical condition for steady state stability and problems - Multi quadrant dynamics in the speed torque plane - Basics of regenerative braking - Typical load torque characteristics - Acceleration, deceleration, starting and stopping.

Practical component:

1. Simulation of determination of steady state stability in MATLAB

Suggested Readings:

Applications involving four quadrant operation

CO-1
BTL-4

MODULE 2: CONVERTER / CHOPPER FED DC MOTOR DRIVE
(9L+3P=12)

Steady state analysis of the single and three phase fully controlled converter fed separately excited D.C motor drive: Continuous and discontinuous conduction mode - Chopper fed D.C drive: Time ratio control and current limit control - Operation of four quadrant chopper.

Practical component:

2. Single Phase half and fully controlled converter fed DC Drive in MATLAB
3. Four Quadrant Chopper in MATLAB

Suggested Readings:

Simulating simple choppers and converters using MATLAB, Boost Converter Voltage Control, First and Second Quadrant Chopper Control

CO-2
BTL-4

MODULE 3: INDUCTION MOTOR DRIVES
(9L+3P=12)

Stator voltage control - Slip-power recovery drives - Adjustable frequency drives: v/f control, constant slip-speed control and constant air-gap flux control – Basics of voltage/current fed inverters - Block diagram of closed loop drive.

Practical component:

1. Inductor Motor fed drive simulation using MATLAB
2. IGBT based single-phase PWM inverter using MATLAB

Suggested Readings:

Vector Control of Induction Motor using MATLAB

CO-3
BTL-4

MODULE 4: SYNCHRONOUS MOTOR DRIVES
(9L+3P=12)

Open loop volts/hertz control and self-control of synchronous motor: Marginal angle control and power factor control - Permanent magnet synchronous motor.

Practical component:

1. Speed control of BLDC motor fed drive in MATLAB
2. Speed control of PMSM motor fed drive in MATLAB

Suggested Readings:

Vector Control of PMSM in MATLAB

CO-4
BTL-4

MODULE 5: DESIGN OF CONTROLLERS FOR DRIVES
(9L+3P=12)

Transfer function for dc motor, load and converter – Closed loop control with current and speed feedback - Armature voltage control and field weakening mode control - Design of controllers: Current controller and speed controller - Converter selection and characteristics. **Practical component:** 1. Transfer function of separately fed DC motor using MATLAB **Suggested Readings:** Closed loop control of VSI fed Induction Motor drive in MATLAB	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Krishnan, R (2016). *Electric Motor & Drives: Modelling, Analysis and Control*, Prentice Hall of India, 2003.
2.	G.K. Dubey, *Fundamentals of Electrical Drives*, Narosa Publishing House , New Delhi 2nd Edition, 2001.
REFERENCE BOOKS	
1.	G.K. Dubey(2002) *Power Semi-conductor Controlled Drives*, Prentice Hall of India, Second Edition.
2.	S.K. Pillai(2003) *A First Course on Electrical Drives*, Wiley Eastern Limited, Third Edition.
3.	Bimal K. Bose (2002) *Modern Power Electronics and AC Drives*, Pearson Education, Second Edition.
E BOOKS	
1.	https://www.amazon.in/Electric-Motor-Drives-Modeling-Analysis/dp/0130910147
2.	http://www.academia.edu/26714897/R._Krishnan-Electric_Motor_Drives_Modeling_Analysis_and_Control_2001_
3.	https://books.google.co.in/books/about/Fundamentals_of_Electrical_Drives.html?id=2NsGKpLolsQC
MOOC	
1.	https://nptel.ac.in/courses/108/104/108104140/
2.	https://www.coursera.org/learn/motors-circuits-design
3.	https://www.udemy.com/course/switched-reluctance-motor-drive/
4.	https://www.udemy.com/course/complete-electrical-machinesacdc-motor-drivevfdmatlab/

COURSE TITLE		**POWER SYSTEM ANALYSIS**				**CREDITS**	**4**
COURSE CODE		**EEB4318**	**COURSE CATEGORY**		**PC**	**L-T-P-S**	**3-1-0-1**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**		**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		**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 solve system of linear equations by substitution and elimination 2. To define interpolation and prove the order of the polynomial is unique. 3. To develop own numerical differentiation and experience computational limitation 4. To identify the suitable methods to solve ordinary differential equations 5. To identify suitable method to solve partial differential equations
Course Outcome	Upon completion of this course, the students will be able to 1. compute the solution of system of equations using direct and indirect methods 2. apply method of interpolation and extrapolation for equal and unequal intervals 3. differentiate and integrate numerically 4. compute the solutions of initial value problems numerically 5. determine the solution of boundary value problems numerically

Prerequisites: EEB4218 - Transmission & Distribution
EEB4201- Electrical Machines

CO, PO AND PSO MAPPING

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

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

Module I: INTRODUCTION	**(12 L)**
Need for system planning and operational studies-basic components of a power system and its modelling- single line diagram-Impedance and reactance diagrams -per unit quantities-single phase and three phase-selection of base quantities-advantages of per unit system-changing the base of per unit quantities. Suggested Readings: Per phase analysis-Generator Model, transformer model, transmission line model.	**CO-1 BTL-3**
Module II: LOAD FLOW ANALYSIS	**(12 L)**
Introduction to load flow analysis-network model formulation-formation of bus admittance and bus impedance matrix-formulation of load flow problem-solution of load flow problem by iterative methods-Gauss Seidal, Newton Raphson (Qualitative analysis only) and Fast Decoupled method. Suggested Readings: Principle of DC load Flow	**CO-2 BTL-4**
Module III: SYMMETRICAL FAULT ANALYSIS	**(12 L)**
Introduction –need of power system protection- Power system faults-effects of faults-Symmetrical Faults - short circuit capacity –current limiting reactors- Z bus formulation by bus building algorithm - systematic fault analysis using bus impedance matrix. Suggested Readings: Methods of analysing faults in symmetrical case	**CO-3 BTL-4**
Module IV: UNSYMMETRICAL FAULT ANALYSIS	**(12 L)**

Unsymmetrical faults- single line to ground fault - line to line fault - double line to ground fault -fundamentals of symmetrical components - sequence impedances - sequence networks - Unbalanced fault analysis using bus impedance matrix-Effect of fault impedance. Suggested Readings: Methods of analysing faults in unsymmetrical case	**CO-4 BTL-4**
Module V: STABILITY ANALYSIS	**(12 L)**
Power system stability –steady state-dynamic-transient- (elementary view only) – power angle curve-steady state stability limit-Swing Equation-Equal area criterion – Reponses to a short circuit fault- factors influencing transient stability - Numerical integration methods - Euler method - modified Euler method – RK method. Suggested Readings: Methods of increasing stability limits	**CO-5 BTL-4**

TEXT BOOKS	
1.	HadiSaadat (2017), *Power system analysis*, Tata McGraw Hill Publishing Company, New Delhi.
2	P.Kundur (2018), *Power System Stability and Control*, Tata McGraw Hill Publishing Company, Ne Delhi.
REFERENCE BOOKS	
1.	Stevenson W. D. (2014) *Elements of Power System Analysis*, 4/e, McGraw Hill.
2.	Wadhwa C. L. (2014), *Electrical Power Systems*, 33/e, New Age International.
3	Weedy B. M., B. J. Cory, N. Jenkins, J. B. Ekanayake and G. Strbac, (2016), *Electric Power System* John Wiley & Sons.
4	Kothari D. P. and I. J. Nagrath (2017) *Modern Power System Analysis*, 2/e, TMH.
E BOOKS	
1.	https://docs.google.com/file/d/0B27aSM6YQlq2WmU3Q0FrTUphU1E/edit
MOOC	
1.	https://www.openlearning.com/courses/power-system-analysis/

COURSE TITLE	**BUSINESS ECONOMICS**			**CREDITS**	**2**
COURSE CODE	**GEA4304**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**2-0-0-2**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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	Business Economics is a popular course offered under the management stream, providing aspirants the knowledge to apply economic theory as well as analysis in the process of decision making of a specific business.
Course Objective	1.To familiarize the students with the basic concept of microeconomics. 2. To understand the demand and supply analysis in business applications 3. To familiarize students with the production and cost structure under different stages of production. 4. To understand the pricing and output decisions under various market structure. 5. To help students understand and apply the various decision tools to

	understand the market structure.
Course Outcome	Upon completion of this course, the students will be able to 1. Apply Engineering Economics in projects and day to day operation 2. Apply cost analysis in business application 3. Predict consumer's and producer's behavior applying various laws 4. Classify the budget and taxation in India 5. Classify financial instruments for trading

Prerequisites: GEA4123-Professional Ethics & Life Skills

CO, PO AND PSO MAPPING

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

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	**CO-1 BTL-3**
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	**CO-2 BTL-3**
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	**CO-3 BTL-3**
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.	**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.	**CO-5 BTL-2**

TEXT BOOKS	
1	S.Shankaran (2017) *Business Economics*, Margham Publications.
2	H.L. Ahuja (2015) *Business Economics – Micro & Macro*, Sultan Chand & Sons - New Delhi – 55.
REFERENCE BOOKS	
1	S.A.Ross, R.W.Westerfield, J.Jaffe and Roberts (2017) *Corporate Finance*, McGraw-Hill.
2	Joseph E Stiglitz (2002) *Principles of Macroeconomics*, W. W. Norton & Company, Third Editiom
ONLINE SOURCES	
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

COURSE TITLE		**POWER SYSTEM PROTECTION LABORATORY**			**CREDITS**	**1**
COURSE CODE		**EEB4341**	**COURSE CATEGORY**	**LAB**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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	Demonstrate the principles and techniques of industrial power system design.					
Course Objective	1. To gain knowledge on hands on experience of determining the various line parameters of a transmission line 2. To gain knowledge on hands on Analyzing fault in the transmission line using short circuit capacity. 3. To gain knowledge on hands on Analyzing various measuring transformer 4. To gain knowledge on hands on Analyzing various relay , protection and earth resistance					
Course Outcome	Upon completion of this course, the students will be able to 1. Apply measurement techniques associated with power system transient phenomena 2. Evaluate the influence of transients on protective systems 3. Evaluate the operation of protective devices 4. Apply experimental techniques for setting and testing relays					
Prerequisites: EEB4218 -Transmission and Distribution, EEB4316-Power System Protection and						

control

CO, PO AND PSO MAPPING

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

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

Transmission Line (9P)	
1. Short Transmission Line Experiments 2. Medium-length transmission line tests (Nominal-pi equivalent circuit), ohmic load, capacitive load 3. Medium-length transmission line tests (Nominal-pi equivalent circuit), inductive load	**CO1/BTL3**
Relay (9P)	
1. Symmetrical components method test 2. Measurement of earth resistance	**CO2/BTL3**
Current Relay (9P)	
1. Thermal over current relay 2. Instrument transformers (Voltage transformers)	**CO3/BTL3**
Application (9P)	
1. Instrument transformers (Current transformers) 2. Leakage current protection switches	**CO4/BTL3**

REFERENCE BOOKS

1.	V. K. Mehta &Rohit Mehta (2008) *Principles of Power System*, S.Chand fourth edition.
2.	S.N. Singh (2007*) Electric Power Generation, Transmission and Distribution,* Prentice Hall of India Pvt. Ltd, New Delhi.
3.	Wadhwa C. L. (2004) *Electrical Power Systems*, 33/e, New Age International, Second Edition.
4.	Badri Ram & D N Vishwakarma (2007). *Power system protection & switch gear*, Tata McGraw Hill.

E BOOKS

1.	https://www.springer.com/gp/book/9781461363415

MOOC

1.	https://onlinecourses.nptel.ac.in/noc20_ee80/preview

COURSE TITLE	COMPREHENSION			CREDITS	1
COURSE CODE	EEB4342	COURSE CATEGORY	PC	L-T-P-S	0:0:2:0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-4

ASSESSMENT SCHEME

Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
30%	10%	10%	50%

Course Description	Ability to understand and comprehend any given problem related to Electrical and Electronics Engineering
Course Objective	To encourage the students to comprehend the knowledge acquired from the first Semester to fifth Semester of B.Tech Degree Course through periodic exercise. To carry out discussion/aptitude test/quiz etc... to refresh the courses studied in the previous semesters
Course Outcome	Upon completion of this course, the students will be able to Comprehend any given problem related to Electrical Engineering field.

Prerequisites: The knowledge acquired from the first Semester to fifth Semester of B.Tech Degree Course

CO, PO AND PSO MAPPING

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

TEXT BOOKS

1. *Electrical Engineering for GATE/PSUs* (2016), Disha Publication, Second Edition

REFERENCE BOOKS

1. *Electrical Engineer's Reference Book Hardcover* – 27 September 2002
2. https://engineeringinterviewquestions.com/cse-lab-viva-interview-questions-and-answers/

E BOOKS

1. https://drive.google.com/file/d/15djKf5nevwjN3rG_M_xwd6NFtChp_deu/view
2. https://drive.google.com/file/d/1uiHSsnDLtDOxZ7zYYUEaDEhokmaZLxUs/view
3. https://drive.google.com/file/d/1HlcB2eIFLTNaynRCGDL_3ioUZt_s989i/view

MOOC

1. https://engineeringinterviewquestions.com/electrical-engineering-multiple-choice-interview-question s-and-answers/

COURSE TITLE	DESIGN PROJECT-IV		CREDITS	1
COURSE CODE	EEB4343	COURSE CATEGORY: PC	L-T-P-S	0-0-2-0
Version: 1.0	Approval Details: 23 ACM, 06.02.2021		LEARNING LEVEL	BTL-5

ASSESSMENT SCHEME

Review 1	Review 2	Review 3	Final Review
10%	20%	20%	50%

Course Description	This course provides a solid foundation in core electrical engineering disciplines, critical thinking and problem-solving skills. Through the academic program students also develop skills to implement real time system also develop excellent writting and oral communication skills, learn to work as a team and project management.
Course Objective	1.To investigate the students' ability in identifying and problem formulation.

	2.To provide the database in the respective discipline and also enable them to know the scale of the project that should be carried on. 3.To provide coding skills and give practical exposure for implementing the project proposed.
Course Outcome	Upon completion of this course, the students will be able to 1. Develop simple electrical and electronic models based on the knowledge gained. 2. Propose a project and defend it as a team. 3. Implement a real time system as proposed.

Prerequisites: Basic Electrical and Electronics Engineering 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	PSO 3
CO-1	3	2	3	2	1	1	1	-	3	-	3	3	3	3	1
CO-2	3	2	3	1	-	-	-	-	3	-	3	3	3	3	1
CO-3	3	2	3	2	3	1	1	-	3	-	3	3	3	3	2

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

To carry out a Design project and simple prototype in the area of interest based on the knowledge gained in Electrical and Electronics Engineering from previous semesters.

The students will carry out a project in one of the following Electrical and Electronics Engineering areas but with substantial multi-disciplinary components:

- Power Electronics
- Transmission and Distribution
- Machine Learning

Student groups will be formed (3/4 in a group) and a faculty member will be allocated to guide them. There will be three major reviews which will be carried out as listed below.

Review #	**Requirement**	**Mark Weightage**	
		Internal	**External**
0	Area / Title selection	-	-
1	Literature review / Proposal for the Project	10%	-
2	Mathematical modelling/Circuit Design	20%	-
3	Final simulation / Hardware presentation	20%	-
End Semester Exam	Final Viva-Voce and project demonstration	-	50%

SEMESTER-VII

COURSE TITLE	**ELECTRICAL ENERGY UTILIZATION AND CONSERVATION**			**CREDITS**	**4**
COURSE CODE	**EEB4401**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-**

						0-1
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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 is designed to make the students conversant with the basic aspects of power generation, conservation, and utilization of electrical energy.
Course Objective	To impart knowledge on 1. Electrical energy conservation, energy auditing and power quality. 2. Principle and design of illumination systems and methods of heating and welding. 3. Electric traction systems and their performance. 4. Industrial applications of electric drives.
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate Economics of power generation and conservation. 2. Apply and analyze the concepts of illumination, Industrial heating, and welding. 3. Apply and analyze the concepts of Economic dispatch and computer control of Power system. 4. Analyse the performance of Electrical traction. 5. Choose appropriate Industrial Electric Drives for various applications

Prerequisites: EEB4201-Electrical Machines, EEB4317 - Solid state Drives

CO, PO AND PSO MAPPING

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

MODULE 1: ELECTRICAL ENERGY GENERATION AND CONSERVATION (9L+3T)=12

System load variation: System load characteristics, load curves - daily, weekly, and annual, load-duration curve, load factor, diversity factor.

Reserve requirements: spinning reserves, cold reserves, hot reserves.

Economics of generation, Number and size of units, cost of energy, tariff, need for conservation, conservation methods, energy saving equipment, Energy management and auditing, economics of power factor improvement, selection of capacitors for pf improvement.

CO-1 BTL-2

Suggested Readings:

Bureau of energy efficiency, Energy Conservation Act 2001.

MODULE 2: ILLUMINATION ENGINEERING, HEATING AND WELDING (9L+3T)=12

Nature of radiation, laws, photometry, lighting calculations, design of illumination systems, types of lamps, energy efficient lamps. Methods of heating, requirement of heating material, furnaces, types of welding, welding generator, welding transformers and their characteristics **Suggested Readings:** Luminosity of eye, Factors responsible for visual acuity.	**CO-2** **BTL-4**
MODULE 3: ECONOMIC DISPATCH AND COMPUTER CONTROL (9L+3T)=12	
Statement of Unit Commitment (UC) problem; constraints in UC:UC solution methods: Priority-list methods, forward dynamic programming approach. Incremental cost curve, co-ordination equations without loss and with loss, solution by direct method and λ-iteration method. Energy control centre: Functions - Monitoring, data acquisition and control. System hardware configuration - SCADA and EMS functions **Suggested Readings:** Optimal Power Flow.	**CO-3** **BTL-4**
MODULE 4: ELECTRIC TRACTION (9L+3T)=12	
Requirements of traction system, supply systems, mechanism of train movement, traction motors and control, multiple units, braking, recent trends in traction **Suggested Readings:** **Diamagnetism, Magnetic Levitation.**	**CO-4** **BTL-2**
MODULE5:ELECTRIC DRIVES AND THEIR INDUSTRIAL APPLICATION (9L+3T)=12	
Motor selection, types of loads, characteristics, steady state and transient loads, load equalization, industrial applications, modern methods of speed control of industrial drives **Suggested Readings:** **Traction motors in Indian Railways**	**CO-5** **BTL-3**

TEXT BOOKS	
1.	B R Gupta (2003) *Generation of Electrical Energy*, Eurasia publishing House, New Delhi.
2.	C L Wadhwa (2003) *Generation, distribution and utilization of electrical energy*, New Age International (P) ltd, Second Edition.
REFERENCE BOOKS	
1.	H Partab (2014) *Art and Science of Utilization of Electrical Energy*, Dhanpat Rai & Co., Second Edition.
2.	Craig Di Louie (2005) *Advanced Lighting Controls: Energy Savings*, Productivity, Technology and Applications", CRC Press, Third Edition.
3.	William C. Whitman, William M. Johnson (2005*) Refrigeration & Air Conditioning Technology*, Thomson Delmar, Second Edition.
4.	J B Gupta (2002) *Utilization of electric power and electric traction*, S K Kataria and sons.
5	Gopal K Dubey (2002) *Fundamental of Electrical drives*, Narosa Publishing House (P) ltd, New Delhi.
E BOOKS	
1.	https://dlscrib.com/download/electrical-energy-by-dhanpat-rai_58d79608dc0d603125c34618_pdf
2.	https://www.skkatariaandsons.com/view_book.aspx?productid=8012
MOOC	
1.	http://nptel.ac.in/courses/108105060/

2.	http://nptel.ac.in/courses/108102046/

COURSE TITLE		INDUSTRY STANDARDS AND SPECIFICATIONS			CREDITS	3
COURSE CODE		EEB4403	COURSE CATEGORY	PC	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	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	Students would be able to learn the specifications, installation methods, commissioning and maintenance of the Transformer, Synchronous Machines, and Induction Motors
Course Objective	To impart knowledge on 1. Transformer Specifications and Installation methods 2. Synchronous Machines Specifications and Installation methods 3. Induction Motor Specifications, Installation methods and Commissioning Test 4. Switch Gear & Transformer Standards, types, specification, installation, commissioning tests and maintenance schedule
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the specifications applicable to transformers and rotating machines as per the standards. 2. Select the site and install the transformer and alternating current machines. 3. Measure the insulation resistance of armature and field windings of alternating current machines. 4. Conduct commissioning test and Performance test on alternating current machines and protective devices.

Prerequisites: EEB4218 Transmission and Distribution, Protection and switchgear

CO, PO AND PSO MAPPING

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

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

MODULE I :TRANSFORMERS (8L+3P)

a. Specifications: Power and distribution transformers as per BIS standards. b. Installation: Location, site, selection, foundation details (like bolts size, their number, etc), code of practice for terminal plates, polarity & phase sequence, oil tanks, drying of windings and general inspection. **Practical component:** Identifying the types of transformer with their rating	**CO-1 BTL-2**

Suggested Readings: Transformer types	
MODULE II:SYNCHRONOUS MACHINES	**(9L+3P)**
a. Specifications: As per BIS standards. b. Installation: Physical inspection, foundation details, alignments, excitation systems, cooling and control gear, drying out. **Practical component:** To perform the heating of winding coil. **Suggested Readings:** Types of synchronous machines	**CO-2** **BTL-2**
MODULE III : INDUCTION MOTORS	**(8L+3P)**
a. Specifications for different types of motors, Duty, I.P. protection b. Installation: Location of the motors (including the foundation details) & its control apparatus, shaft &alignment for various coupling, fitting of pulleys & coupling, drying of windings. c. Commissioning Test: Mechanical tests for alignment, air gap symmetry, tests for bearings, vibrations &balancing. **Practical component:** To perform the efficiency of induction motor. **Suggested Readings:** Types of induction motor	**CO-3** **BTL-3**
MODULE IV :SWITCH GEAR & TRANSFORMER	**(8L+3P)**
Standards, types, specification, installation, commissioning tests, maintenance schedule, type & routine tests. Break down voltage of transformer. **Practical component:** To test the breakdown voltage of transformer oil with different gaps. **Suggested Readings:** Types and functions of switchgear	**CO-4** **BTL-3**

TEXT BOOKS	
1.	B.G Liptak (2005) *Instrumentation Engineers Handbook (Process Measurement & Analysis)*, Chilton Book Co, CRC Press, Fourth Edition.
2.	S. Rao (2004) *Testing & Commissioning Of Electrical Equipment*, Khanna Publishers, third edition.
REFERENCE BOOKS	
1.	*The Industrial Design Reference & Specification Book: Everything Industrial Designers Need to Know Every Day* (2013) Paperback.
2.	*Standards-ANSI/ISA-75.01.01-2002 (60534-2-1 Mod): Flow Equations for Sizing control Valves;ISA84 Process Safety Standards and User Resources* (2011), Second Edition.
E BOOKS	
1.	https://www.engineeringbookspdf.com/download/?file=13023
MOOC	
1.	https://nptel.ac.in/courses/108/105/108105064/
2.	https://www.udemy.com/course/the-complete-electrical-power-control-and-protection/

COURSE TITLE	**ARTIFICIAL INTELLIGENCE FOR ELECTRICAL**	**CREDITS**	**3**

		ENGINEERS				
COURSE CODE		**EEB4404**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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	The course describes the journey of AI technology. Various parameters of AI Technology and implemented for Electrical applications. Modeling and analysis of electrical systems with AI.
Course Objective	1.To locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic and genetic Algorithms. 2.To observe the concepts of feed forward neural networks and about feedback neural networks. 3.To practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control 4.To analyze genetic algorithm, genetic operations and genetic mutations. 5.To develop the AI technology for electrical systems.
Course Outcome	Upon completion of this course, the students will be able to 1.Apply feed forward neural networks, feedback neural networks and learning techniques. 2.Analyze fuzziness involved in various systems and fuzzy set theory. 3.Develop fuzzy logic control for applications in electrical engineering 4.Develop genetic algorithm for applications in electrical engineering. 5. Apply the AI in electrical systems.

Prerequisites: Fundamentals of Electrical engineering

CO, PO AND PSO MAPPING

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

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

MODULE 1: Artificial Neural Networks (9L)

Introduction-Models of Neural Network – Architectures – Knowledge representation – Artificial Intelligence and Neural networks – Learning process – Error correction learning – Hebbian learning – Competitive learning – Boltzman learning – Supervised learning – Unsupervised learning – Reinforcement learning – learning tasks. **Suggested Readings:** 1. knowledge of AI and Neural network. 2. learning process like error correction, hebbian, competitive, boltzman, supervised, unsupervised and reinforcement.	**CO-1** **BTL-2**

MODULE 2: ANN Paradigms (9L)	
Multi – layer perceptron using Back propagation Algorithm-Self – organizing Map – Radial Basis Function Network – Functional link, network – Hopfield Network. **Suggested Readings** 1. back propagation algorithm 2.radial basis function networks-functional link, network and Hopfield network	**CO-2** **BTL-3**
MODULE 3: Fuzzy Logic (9L)	
Introduction – Fuzzy versus crisp – Fuzzy sets – Membership function – Basic Fuzzy set operations – Properties of Fuzzy sets – Fuzzy cartesian Product – Operations on Fuzzy relations – Fuzzy logic – Fuzzy Quantifiers – Fuzzy Inference – Fuzzy Rule based system – Defuzzification methods. **Suggested Readings:** 1. Fuzzy sets, membership function and set operations. 2. Fuzzy relations and logics.	**CO-3** **BTL-3**
MODULE 4: Genetic Algorithms (9L)	
Introduction-Encoding – Fitness Function-Reproduction operators – Genetic Modeling – Genetic operators – Crossover – Single–site crossover – Two-point crossover – Multi point crossover-Uniform crossover – Matrix crossover – Crossover Rate – Inversion & Deletion – Mutation operator –Mutation – Mutation Rate-Bit-wise operators – Generational cycle-convergence of Genetic Algorithm. **Suggested Readings:** Genetic modeling and operations, genetic algorithms.	**CO-4** **BTL-3**
MODULE 5: APPLICATIONS OF AI TECHNIQUES (9L)	
Load forecasting – Load flow studies – Economic load dispatch – Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability) Reactive power control – speed control of DC and AC Motors **Suggested Readings:** 1. load forcasting, flow studies, dispatch. **2.** Small signal stability and speed control of DC and AC motors.	**CO-5** **BTL-3**

TEXT BOOKS	
1.	S. Rajasekaran and G. A. V. Pai (2013), “Neural Networks, Fuzzy Logic & Genetic Algorithms”-PHI, New Delhi.
2	G. J. Klir and T. A. Folger (2011), ”Fuzzy sets, Uncertainty and Information”-PHI, Pvt.Ltd.
REFERENCE BOOKS	
1.	P. D. Wasserman, Van Nostrand Reinhold (2012), ”Neural Computing Theory & Practice” – New York.
3.	S.N. Sivanandam, S.N.Deepa (2008),” Introduction to Genetic Algorithms”- Springer-Verlag Berlin Heidelberg
E BOOKS	
1.	https://www.igi-global.com/book/applications-artificial-intelligence-electrical-engineering/237832
2.	https://www.goodreads.com/book/show/49797940-applications-of-artificial-intelligence-in-electrical-engineering
MOOC	

1.	https://www.coursera.org/learn/ai-for-everyone
2.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/lecture-videos/

COURSE TITLE		ILLUMINATION LABORATORY			CREDITS	1
COURSE CODE		EEB4431	COURSE CATEGORY	PC	L-T-P-S	0:0:2:0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL		BTL-4

ASSESSMENT SCHEME

First Cycle Assessment	Second Cycle Assessment	Attendance	ESE
35%	35%	10%	20%

Course Description	**This course focuses on design and analysis of illumination system**
Course Objectives	To impart knowledge on 1. Different luminaires and its effects on light distribution 2. Understanding the luminous efficacy of various luminaires 3. The effect of cover glass and lamp focus on the beam spread 4. Understanding the utilization factor of different luminaires
Course Outcome	Upon completion of this course, the students will be able to 1. Select different luminaires based on the application and characteristics 2. Evaluate the effect of reflectors 3. Calculate the utilization factor of a luminaire. 4. Control the luminaire using different methods 5. Analyse the effect of cover glass and lamp focus on beam spread.

Prerequisites: - Electrical Energy Utilization and Conservation

CO, PO AND PSO MAPPING

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

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

LIST OF EXPERIMENTS

1	Study of Construction and function of each component of road/flood light etc. luminaries.	CO-1, BTL-4
2	To plot the candlepower, power consumed, current drawn v/s voltage characteristic curve of an incandescent lamp and compare with the theoretical curves.	
3	To determine luminous efficiency of a luminaire.	
4	To plot the candlepower, power consumed, current drawn v/s voltage characteristic curve of a road lighting luminaire and compare with the theoretical curves.	
5	To study the effect of reflectors on luminaire intensity distribution.	CO-2, BTL-4
6	To determine utilization factor of a luminaire.	CO-3, BTL-4
7	To plot the candlepower, power consumed, current drawn v/s voltage characteristic curve of a flood lighting luminaire and compare with the theoretical curves.	CO-4, BTL-4
8	To obtain polar curve of the light distribution of a flood lighting luminaire	CO-5, BTL-4
TEXT BOOKS		
1	D.C. Pritchard, (2016) Lighting, Routledge,	
2	Jack L. Lindsey, (1997) Applied Illumination Engineering , PHI.	
4	M.A. Cayless, (2012), Lamps and Lighting, Routledge,	
REFERENCE BOOKS		
1.	IS CODE 3646	
2	IS CODE 6665	
3	Ryer, Alex. Light Measurement Handbook. 2nd ed. Newburyport: International Light, 2008.	

COURSE TITLE		**POWER SYSTEM SIMULATION LABORATORY**			**CREDITS**	**1**
COURSE CODE		**EEB4432**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0:0:2:0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**		**BTL-4**
ASSESSMENT SCHEME						
First Cycle Assessment		**Second Cycle Assessment**	**Attendance**			**ESE**
35%		**35%**	**10%**			**20%**
Course Objectives		To impart knowledge on 1. Load flow analysis techniques for calculating the bus parameters and line flows. 2. Analyzing the fault in a transmission line 3. Identifying the transients in travelling waves 4. Determining the various line parameters of a transmission line.				
Course Outcome		Upon completion of this course, the students will be able to 1. Determine the various line parameters of a transmission line 2. Analyse the transients in travelling waves.				

	3. Apply load flow analysis for the given power system network by using Gauss-Seidal method, Newton-Raphson method and FDLF and determine line losses. 4. Analyze fault in the transmission line using short circuit capacity. 5. Analyze the stability of the given power system network using swing curve.

Prerequisites: - EEB4318-Power System Analysis, EEB4218-Transmission and Distribution

CO, PO AND PSO MAPPING

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

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

LIST OF EXPERIMENTS

1	Modelling of transmission line.	CO-1, BTL-4
2	Electromagnetic transients in travelling waves	CO-2, BTL-4
3	Formation of bus admittance matrix.	CO-3, BTL-4
4	Power flow analysis by Gauss-Seidal method.	
5	Power flow analysis using Newton-Raphson method.	
6	Power flow analysis by Fast decoupled method.	
7	Formation of bus impedance matrix using building algorithm.	CO-4, BTL-4
8	Short circuit analysis of transmission line.	
9	Stability analysis of power system.	CO-5, BTL-4
10	Analysis of switching surge using ETAP.	

TEXT BOOKS

1	Hadi Saadat (2007) *Power system analysis*, Tata McGraw Hill Publishing Company, New Delhi.
2	Kundur, P (2008) *Power System Stability and Control*, Tata McGraw Hill Publishing Company, New Delhi.
3	V. K. Mehta & Rohit Mehta (2008) *Principles of Power System*, S.Chand, fourth edition.
4	I.J.Nagrath and D.P.Kothari (2007) *Modern Power System Analysis*, Tata McGraw-Hill publishing company, New Delhi.

REFERENCE BOOKS

1.	M.A. Pai (2005) *Computer Techniques in power system Analysis*, Tata McGraw - Hill publishing company, New Delhi.
2.	S.L.Uppal (2008) *Electrical power*, Khanna publishers, 8th Edition
3.	J. Duncan Gloveratel (2008) *Power System Analysis and Design*, Cengage Learning, 4th Edition

COURSE TITLE	RENEWABLE ENERGY LABORATORY			CREDITS	1
COURSE CODE	EEB4434	COURSE CATEGORY	DE	L-T-P-S	0-0-2-0

Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-4

ASSESSMENT SCHEME

Internal Assessment	Attendance	ESE
75%	5%	20%

Course Description	To develop the skill for using different simulation software on renewable energy sources and technologies.
Course Objective	1. To train the students in Renewable Energy Sources and technologies. 2. To impart knowledge on the charging and discharging characteristics of battery 3. To provide adequate inputs on a variety of issues in harnessing Renewable Energy. 4. To recognize current and possible future role of Renewable energy sources.
Course Outcome	Upon completion of this course, the students will be able to 1. Familiarize with the working of various renewable energy sources 2. Analyze battery charging and discharging characteristics 3. Analyze various renewable energy technologies 4. Analyze the integration of renewable source power with grid.

Prerequisites: Basic of renewable energy concepts

CO, PO AND PSO MAPPING

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

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

LIST OF EXPERIMENTS

1. PV Characteristics (IV and PV curve, Effect of Shading, Effect of tilt angle)	**CO-1 BTL-2**
2. P, V and I measurement of output of Fuel cell generation	
3. IV Characteristics of wind turbine at different wind speed	
4. P,V and F measurement of output of wind generator	
5. Evaluation of cut-in speed and cut-off speed	
6. Battery charging and discharging characteristics	**CO-2 BTL-4**
7. Finding MPP across PV panel (varying load / varying duty cycle of DC-DC converter)	**CO-3 BTL-4**
8. Wind power MPPT algorithm testing	
9. Impact of load and wind speed on power and its quality	
10. Integration of solar / wind power to grid	**CO-4 BTL-4**

TEXT BOOKS

1.	D.Yogi Goswami, Frank Kreith, Jan F. Kreider (2003) *Principles of Solar Engineering*, , Taylor & Francis, 2nd Edition
2.	Solanki, *Solar Photovoltaics Fundamentals, Technologies and Applications* (2012), PHI, Eastern Economy Edition.
3.	S.R. Wenham, M.A. Green, M.E. Watt,R. Corkish (2007) *Applied Photovoltaics*, ARC Centre for Advanced Silicon Photovoltaics and Photonics, Second Edition.
REFERENCE BOOKS	
1.	Martin A. Green (2008) *Solar Cells Operating Principles, Technology, and System Applications,* Prentice- Hall, Second Edition.
E BOOKS	
1.	https://www.taylorfrancis.com/books/mono/10.1201/b18119/principles-solar-engineering-yogi-goswami
2.	https://www.routledge.com/Applied-Photovoltaics/Wenham-Green-Watt-Corkish-Sproul/p/book/9781849711425
MOOC	
1.	https://www.coursera.org/learn/photovoltaic-solar-energy
2.	https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee35/
3.	https://www.coursera.org/learn/wind-energy

COURSE TITLE	**DESIGN PROJECT-V**			**CREDITS**	**1**
COURSE CODE	**EEB4433**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**	**BTL-6**
ASSESSMENT SCHEME					
Review 1	**Review 2**	**Review 3**	**Final Review**		
10%	**20%**	**20%**	**50%**		
Course Description	This course provides a solid foundation in core electrical engineering disciplines, critical thinking and problem-solving skills. Through the academic program students also develop skills to implement real time system also develop excellent writting and oral communication skills, learn to work as a team and project management.				
Course Objective	1.To investigate the students' ability in identifying and problem formulation. 2.To provide the database in the respective discipline and also enable them to know the scale of the project that should be carried on. 3.To provide coding skills and give practical exposure for implementing the project proposed.				
Course Outcome	Upon completion of this course, the students will be able to 1.Develop simple electrical and electronic models based on the knowledge gained. 2.Propose a project and defend it as a team. 3.Implement a real time system as proposed.				
Prerequisites: Basic Electrical and Computer Engineering 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	PSO -3
CO-1	3	3	3	3	3	3	-	-	3	-	3	3	3	3	3
CO-2	3	3	3	3	3	3	-	-	3	-	3	3	3	3	3
CO-3	3	3	3	3	3	3	-	-	3	-	3	3	3	3	3
CO-4	3	3	3	3	3	3	-	-	3	-	3	3	3	3	3

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

To carry out a Design project and simple prototype in the area of interest based on the knowledge gained in Electrical and Electronics Engineering from previous semesters.

The students will carry out a project in one of the following Electrical and Electronics Engineering areas but with substantial multidisciplinary components:

- Power System Analysis
- Big Data and Analytics

Student groups will be formed (3/4 in a group) and a faculty member will be allocated to guide them. There will be three major reviews which will be carried out as listed below.

Review #	**Requirement**	**Mark Weightage**	
		Internal	**External**
0	Area / Title selection	-	-
1	Literature review / Proposal for the Project	10%	-
2	Mathematical modelling/Circuit Design	20%	-
3	Final simulation / Hardware presentation	20%	-
End Semester Exam	Final Viva-Voce and project demonstration	-	50%

SEMESTER VIII

COURSE TITLE		**PROJECT & VIVA-VOCE**			**CREDITS**	**8**
COURSE CODE		**EEB4441**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-8-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**		**LEARNING LEVEL**	**BTL-6**

ASSESSMENT SCHEME

Review 1	**Review 2**	**Review 3**	**Final Review**
10%	**20%**	**20%**	**50%**

Course Description	This course provides a solid foundation in core electrical engineering disciplines, critical thinking and problem-solving skills. Through the academic program students also develop skills to implement real time system also develop excellent writting and oral communication skills, learn to work as a team and project management.
Course Objective	1.Able to design and develop electrical / electronic prototype based on the knowledge gained. 2.Able to propose a project and defend it as a team

	3.Able to solve real time problem an electrical domain as a computer application
Course Outcome	Upon completion of this course, the students will be able to 1.Develop simple electrical and electronic models based on the knowledge gained. 2.Propose a project and defend it as a team. 3.Implement a real time system as proposed.

Prerequisites: Basic Electrical and Computer Engineering 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	PSO 3
CO-1	3	3	3	3	3	3	-	-	3	-	3	3	3	3	3
CO-2	3	3	3	3	3	3	-	-	3	-	3	3	3	3	3
CO-3	3	3	3	3	3	3	-	-	3	-	3	3	3	3	3
CO-4	3	3	3	3	3	3	-	-	3	-	3	3	3	3	3

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

To carry out a project in the area of interest based on the knowledge gained in Electrical and Electronics Engineering from previous semesters.

The students will carry out a project in one of the following Electrical and Electronics Engineering areas but with substantial multidisciplinary components:

- Electrical Machine
- Machine Learning
- Artificial Intelligence
- Power System
- Computer application

Student groups will be formed (2/3 in a group) and a faculty member will be allocated to guide them. There will be three major reviews which will be carried out as listed below

Review #	**Requirement**	**Mark Weightage**	
		Internal	**External**
0	Area / Title selection	-	-
1	Literature review / Proposal for the Project	10%	-
2	Mathematical modelling/Circuit Design	20%	-
3	Final simulation / Hardware presentation	20%	-
End Semester Exam	Final Viva-Voce and project demonstration	-	50%

Departmental Electives

COURSE TITLE		SOLAR ENERGY SYSTEMS AND REGULATION			CREDITS	3
COURSE CODE		EEC4251	COURSE CATEGORY	DE	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021		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 describes the fundamentals of solar power as it applies to the system installation. The main purpose of this course is to identify the key components of solar system and explain the functions of each component in the system. Leaners will understand the solar policies and MPPT techniques.
Course Objective	1. To gain Knowledge about different types of solar systems, tracker selection and storage systems 2. To understand about the Subsystems of PV, criteria for installation, control and monitoring system 3. To gain Knowledge about different Solar Policies, Solar Purchase obligation, Grid Parity and to calculate Energy saving and payback 4. To understand Solar Thermal Systems, design Active Systems, Solar Distillation and Solar Drying 5. To understand MPPT techniques and analyse Effect of Shading, integration with grid systems and Multilayered cells
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the fundamental of solar cell basics, roof top and off Grid Solar Systems 2. Elucidate the different configurations and control techniques of solar system and planning of solar installation 3. Describe different solar polices, Power Purchase Agreement, Energy saving and payback 4. Model the solar thermal system and design the Active Systems by f-chart and Utilizability Methods

Prerequisites: PHA4102-Engineering Physics, Electronic Devices

CO, PO AND PSO MAPPING

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

1: Weakly related, 2: Moderately related and 3: Strongly related	
MODULE 1: SOLAR ENERGY TECHNOLOGY AND ENGINEERING (9L)	
Introduction to Solar Energy;Solar cell basics, Roof Top and Off Grid Solar Systems, Grid Connected Solar System; Tracking / Static Solar Systems, Types of trackers, Tracker type selection; Concentrating Solar Power, Single and multi-junction cell efficiency chart, Thermal Storage Systems. **Suggested reading:** solar cell properties	**CO-1** **BTL-2**
MODULE 2: SOLAR SUBSYSTEMS AND INSTALLATION (9L)	
Components and subsystems of PV systems, Converters, different configurations; Inverter location trade -off studies; Planning of solar installation, Conditions & limits, Yield/loss study, Yield assessment for photovoltaic systems; Monitoring and control system, diesel plants, other renewable sources. **Suggested reading:** Modelling of different configurations of converter using MATLAB.	**CO-2** **BTL-3**
MODULE 3: REGULATION (9L)	
Solar Policies, Jawaharlal Nehru National Solar Mission ,Tax Incentives and Subsidies , Policies supporting Grid-interactive Renewable Power, Renewable Energy for Urban, Industrial and Commercial Applications; Solar Purchase Obligation, Renewable Energy Certificates; Grid Parity, Power Purchase Agreement, Energy saving and payback.	**CO-3** **BTL-3**
MODULE 4: SOLAR THERMAL SYSTEMS (9L)	
Modelling of Solar Thermal Systems and Simulations in Process Design, Design of Active Systems by f-chart and Utilizability Methods; - Water Heating Systems, Active and Passive; Passive Heating and Cooling of Buildings; Solar Distillation, Solar Drying. **Suggested Reading:** Water pumping system, Solar car.	**CO-4** **BTL-4**
MODULE 5: ADVANCED TOPICS IN SOLAR TECHNOLOGY (9L)	
Power Point Tracker for PV systems, Effect of Shading, Power Electronics for Efficient Interface; PV distributed generation units, integration with grid systems; Nano-structured solar cells; organic, hybrid, and dye-sensitized solar cells; Multilayered cells, Sunlight Concentrator; Biomimetic solar fuels.	**CO-5** **BTL-4**
TEXT BOOKS	
1	D.YogiGoswami, FrankKreith, Jan F. Kreider (2003) *Principles of Solar Engineering,* Taylor & Francis ,2nd Edition.
2	Solanki (2012) *Solar Photovoltaics- Fundamentals, Technologies and Applications*, PHI, Eastern Economy Edition.
3	S.R. Wenham, M.A. Green, M.E. Watt,R. Corkish (2007). *Applied Photovoltaics*, ARC Centre for Advanced Silicon Photovoltaics and Photonics, Second Edition.
REFERENCE BOOKS	
2	Martin A. Green (2008) *Solar Cells Operating Principles, Technology, and System Applications*, Prentice- Hall, second edition.
E BOOKS	

1.	https://www.amazon.com/Solar-Cells-Applications-Prentice-Hall-electronics/dp/0138222703
2.	http://www.springer.com/in/book/9789027719300
MOOC	
1.	https://ocw.mit.edu/courses/edgerton-center/ec-711-d-lab-energy-spring-2011/solar/
2.	https://ocw.mit.edu/courses/edgerton-center/ec-s07-photovoltaic-solar-energy-systems-fall-2004/index.htm

COURSE TITLE		**ELECTRICAL SAFETY**			**CREDITS**	**3**
COURSE CODE		**EEC4252**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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	Students can demonstrate their knowledge on hazards, injuries and controls associated with the electricity. Selection and suitability of electrical equipment and protective systems. Inspection and maintenance requirements for the safe execution of electrical work/use of electrical equipment.
Course Objective	1. To know about electrical safety and hazardous 2. To know about the need of insulation for electrical apparatus. 3. To recall the basics of electrical systems.
Course Outcome	Upon completion of this course, the students will be able to 1.Describe electrical hazards and safety equipment. 2.Analyze and apply various grounding and bonding techniques. 3. Describe safety method for low, medium and high voltage equipment. 4. Investigate electrical safety and provide precautions in industry 5. Maintain electrical equipment and implement standards for Electric Safety.

Prerequisites: Basic science and electrical engineering

CO, PO AND PSO MAPPING

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

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

MODULE I: ELECTRICAL HAZARDS AND SAFETY EQUIPMENT (9L)

Primary and secondary hazards- arc, blast, shocks-causes and effects-safety equipment-flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one line	**CO-1 BTL-3**

diagram- electrician's safety kit **Suggested Reading:** Electrical Hazards Awareness Guide https://www.lanl.gov/safety/electrical/docs/elec_hazard_awareness_study_guide.pdf	
MODULE II: GROUNDING AND BONDING TECHNIQUES (9L)	
General requirements for grounding and bonding- definitions- grounding of electrical equipment bonding of electrically conducting materials and other equipment- connection of grounding and bonding equipment- system grounding- purpose of system grounding- grounding electrode system grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage and high voltage systems. **Suggested Reading:** grounding techniques in substation and industry	**CO-2** **BTL-4**
MODULE III: ELECTRICAL SAFETY METHODS (9L)	
The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment , procedure for low, medium and high voltage systems- the one minute safety audit **Suggested Reading:** OSHA Electrical Safety Manuel https://www.osha.gov/dte/grant_materials/fy08/sh-17792-08/electrical_english_r6.pdf	**CO-3** **BTL-4**
MODULE IV : ELECTRICAL SAFETY PROGRAMME (9L)	
Electrical safety programme structure, development- company safety team- safety policy programme implementation- employee electrical safety teams- safety meetings- safety audit accident prevention- first aid- rescue techniques-accident investigation **Suggested Reading:** safety programs in industry	**CO-4** **BTL-4**
MODULE V: ELECTRICAL MAINTENANCE AND STANDARDS (9L)	
Safety related case for electrical maintenance- reliability centered maintenance (RCM) - eight step maintenance programme- frequency of maintenance- maintenance requirement for specific equipment and location- regulatory bodies- national electrical safety code- standard for electrical safety in work place- occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety. Suggested Reading: various national and international standards	**CO-5** **BTL-4**

TEXT BOOKS

1.	John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield (2012) ,'Electrical Safety Handbook', McGraw-Hill Education, 4th Edition.
2.	David J. Marne, P.E., B.S.E.E (2017),'National Electrical Safety Code (NESC) 2017Handbook', McGraw-Hill's.
3.	S.K. Sen (2006), 'Principles of Electrical Machine Design with Computer Programmes', Oxford and IBH Publishing Co.Pvt Ltd., New Delhi.

REFERENCE BOOKS

1.	Maxwell Adams.J (2016), 'Electrical Safety- a guide to the causes and prevention of electric hazards', The Institution of Electric Engineers, IET.
2.	Ray A. Jones, Jane G. Jones (2016), 'Electrical Safety in the Workplace', Jones & Bartlett Learning.

E BOOKS	
1.	Electrical Safety Handbook, 4th Edition,Kindle Edition by John Cadick (Author), Mary Capelli-Schellpfeffer (Author), Dennis K. Neitzel (Author), Al Winfield (Author)
2.	Peter E. Sutherland, Principles of Electrical Safety (eBook)
MOOC	
1.	https://www.mooc-list.com/course/introduction-national-electrical-safety-code-nesc-edx
2.	https://www.oshatrain.org/courses/mods/715e.html

COURSE TITLE		**BASIC PYTHON PROGRAMMING**			**CREDITS**	**3**
COURSE CODE		**EEC4253**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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	**The course is designed to provide Basic knowledge of Python. Python programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the Python programming language**
Course Objective	1. To understand the concept of Python basics 2.To know about the Data Wrangling and data transformation 3.To implement Python using Raspberry Pi
Course Outcome	Upon completion of this course, the students will be able to 1. Apply programming skills in core Python. 2. Apply Object Oriented Skills in Python 3. Design Graphical user Interfaces in Python 4. Implement database applications in Python 5. Design systems using Raspberry pi

Prerequisites: Nil

CO, PO AND PSO MAPPING

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

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

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

MODULE 1 – PythonConcepts, Data Structures, Classes (9L)	
Interpreter – Program Execution – Statements – Expressions – Flow Controls – Functions - Numeric Types – Sequences - Strings, Tuples, Lists and - Class Definition – Constructors – Inheritance – Overloading – Text & Binary Files - Reading and Writing.	**CO-1 BTL-3**
MODULE 2 – Data Wrangling (9L)	
Combining and Merging DataSets – Reshaping and Pivoting – Data Transformation – String Manipulation, RegularExpressions.	**CO-2 BTL-4**
MODULE 3 – Data Aggregation, Group Operations, Time series & Web Scrapping (9L)	
GoupBy Mechanics – Data Aggregation – GroupWise Operations and Transformations – Pivot Tables and CrossTabulations – Date and Time Date Type tools – Time Series Basics – Data Ranges, Frequencies and Shifting. Data Acquisition by Scraping web applications –Submitting a form - Fetching web pages – Downloading web pagesthrough form submission – CSS Selectors.	**CO-3 BTL-4**
MODULE 4 – Visualization in Python (9L)	
Matplot lib package – Plotting Graphs – Controlling Graph – Adding Text – More Graph Types – Getting and setting values – Patches.	**CO-4 BTL-4**
MODULE 5 – Implementation using Raspberry Pi (9L)	
Working with Raspberry Pi 3 Model - Installing OS and Designing Systems using Raspberry pi - Configuring Raspberry Pi for VNC Connection - Getting introduced to Linux OS Basic Linux commands and uses - Getting Started with Python - Interface sensor and Actuator with Raspberry Pi	**CO-5 BTL-4**

TEXT BOOKS	
1.	Mark Lutz (2016), “Learning Python”, O'Reilly Media, 5th Edition.
2.	White (2012), “Hadoop: The Definitive Guide”, Third Edition - O’Reilly.
REFERENCE BOOKS	
1.	Brandon Rhodes and John Goerzen (2016), “Foundations of Python Network Programming: The Comprehensive Guide to Building Network Applications with Python”,Apress, Second Edition.
E BOOKS	
1.	https://realpython.com/best-python-books/
MOOC	
1.	https://www.mooc-list.com/tags/python

COURSE TITLE	**WIND ENERGY CONVERSION SYSTEMS**			**CREDITS**	**3**
COURSE CODE	**EEC4266**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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	Students would be able to learn, design and control wind energy based conversion system.
Course Objective	1. To learn the design and control principles of Wind turbine 2. To learn about wind turbines and aerodynamic theory 3. To understand the concepts of fixed speed and variable speed, wind energy conversion systems. 4. To learn the concept of wind farm and project 5. To learn cost economics
Course Outcome	Upon completion of this course, the students will be able to 1. Explore the fundamentals of Wind Energy and understanding the wind characteristics and power production. 2. Familiarize and analyze Aerodynamic theory. 3. Analyze the different types of wind turbine generators and grid integration requirements. 4. Recognize and analyze the concept of wind farm and project planning. 5. Recognize and analyze the cost economics of wind power projects.

Prerequisites: Electrical Machines

CO, PO AND PSO MAPPING

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

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

MODULE I: WIND ENERGY FUNDAMENTALS	**(9L)**
Wind energy basics, Components of wind turbine, wind speeds, wind characteristics and power production, terrain Roughness, turbulence, boundary layers, Betz coefficient, limits **Practical component:** Simulation of wind characteristics **Suggested Readings:** Renewable energy basics	**CO-1** **BTL-2**
MODULE II: WIND TURBINES AND AERODYNAMIC THEORY	**(9L)**
Horizontal Axis and Vertical Axis wind turbine, Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control-stall control- Schemes for maximum power extraction, Air foil terminology , blade element theory **Practical component:** Simulation of Wind turbines using MATLAB **Suggested Readings:** Manufacturing of wind turbines	**CO-2** **BTL-2**
MODULE III: WIND GENERATORS	**(9L)**

Constant Speed Systems: Generating Systems- Constant speed constant frequency systems -Choice of Generators-Deciding Factors-Synchronous Generator-Squirrel Cage Induction Generator **Variable speed systems:** Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG - Variable speed variable frequency schemes. **Grid Connected systems:** Wind interconnection requirements, low-voltage ride through (LVRT) **Practical component:** Simulation of Wind generator using MATLAB **Suggested Readings:** Literature review of various wind generator control schemes	**CO-3** **BTL-3**
MODULE IV: CONCEPT OF WIND FARM AND PROJECT	**(9L)**
Project planning, personal measurement, anemometer measurement, wind direction measurement, site selection, operation and maintenance, environmental concerns **Practical component:** Simulation of wind farms **Suggested Readings:** Study of erection of wind farms	**CO-4** **BTL-2**
MODULE V: COST ECONOMICS	**(9L)**
Fixed and variable costs, value of wind energy, return on investment, wind energy market, cash flow of wind power projects **Practical component:** Cost analysis using software **Suggested Readings:** **Case study of wind energy markets**	**CO-5** **BTL-2**

TEXT BOOKS	
1.	S.N.Bhadra, Kastha,S.Banerjee (2014) *Wind Electrical Systems*, Oxford University Pres
2.	Siraj Ahmed (2013) *Wind Energy Theory and Practice*, PHI, 2nd Edition.
REFERENCE BOOKS	
1.	L.L.Freris (1990) *Wind Energy conversion Systems*, Prentice Hall.
2.	Joshua Earnest (2013) *Wind Power Technology*, PHI learning Pvt. Ltd-New Delhi.
3.	Tony Burton, David Sharpe, Nick Jenkins, Ervin Bossanyi (2011) *Wind Energy Handbook* John Wiley & Sons, Ltd , Second Edition.
E BOOKS	
1.	https://www.researchgate.net/publication/322488286_WIND_ENERGY_Theory_and_Practice
MOOC	
1.	https://www.coursera.org/learn/wind-energy

COURSE TITLE		**HIGH VOLTAGE ENGINEERING**			**CREDITS**	**3**
COURSE CODE		**EEC4267**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**		**BTL-3**

ASSESSMENT SCHEME					
First Periodical	**Second Periodical**	**Seminar/ Assignments/**	**Surprise Test / Quiz**	**Attendance**	**ESE**

Assessment	Assessment	Project			
15%	15%	10%	5%	5%	50%

Course Description	This course covers specifications of insulation materials in liquid, gas and solid case and identifies the effect of extra high voltage on the environment. This module will prepare students for effective participation in the field of high voltage power systems within the electrical engineering environment.
Course Objective	1.To estimate over voltage levels in various Electric power equipment and to perform basic design of protection devices 2. To evaluate high voltage withstand of various insulating media. 3. To evolve basic design of various HV test equipment 4. To apply various measuring principles in high voltage. 5. To explain HV test requirements and evaluate insulation coordination of HV system.
Course Outcome	Upon completion of this course, the students will be able to 1. Identify causes and protection methods of switching and lightning over voltages 2. Describe the theories behind the beak down of gases, liquids and solids. 3. Evaluate and compare different methods to generate AC, DC and impulse voltages and impulse currents. 4. Compare different methods for measuring AC, DC and impulse voltages and impulse currents. 5. Describe different testing methods of transformers, lightning arresters, insulators and circuit breakers.

Prerequisites: EEB4316 - Power Electronics and Drives

CO, PO AND PSO MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	-	-	-	-	-	-	-	-	1	1
CO2	3	3	2	2	3	-	-	-	-	-	-	-	-	1	1
CO3	3	3	2	2	3	-	-	-	-	-	-	-	-	1	1
CO4	3	3	2	2	3	-	-	-	-	-	-	-	-	1	1
CO5	3	3	3	2	3	-	-	-	-	-	-	-	-	1	1

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

MODULE 1: OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS	**(9L)**
Introduction: Causes of over voltage and its effect on power systems, lightning, switching surges and temporary over voltages, protection against over voltages, Bewley's lattice diagram **Suggested Reading:** Estimation and Control of Electric Stress **Practical component: simulation**	**CO-1** **BTL-2,3**
MODULE 2: ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS	**(9L)**
Gaseous breakdown in uniform and non-uniform fields, corona discharges, vacuum breakdown, conduction and breakdown in pure and commercial liquids, breakdown mechanism in solids and composite dielectrics. **Practical component:** simulation **Suggested Readings:** Ionization process, Gases as insulating media.	**CO-2** **BTL-2,3,4**
MODULE 3: GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS	**(9L)**
Generation of High DC, AC and impulse voltages and currents, control and tripping of	**CO-3**

impulse generators	**BTL-3**
MODULE 4: : MEASUREMENT OF HIGH VOLTAGES AND CURRENTS	**(9L)**
Measurement of High DC, AC, high frequency AC and impulse voltages and currents, digital techniques in high voltage measurements **Suggested Reading:** Oscilloscope for impulse voltage and current measurements	**CO-4** **BTL-2**
MODULE 5: HIGH VOLTAGE TESTING AND INSULATION COORDINATION	**(9L)**
High voltage testing of electrical power apparatus- Power frequency AC, DC and impulse testing, international and national standards, insulation coordination **Suggested Reading:** Measurement of D.C Resistivity .	**CO-5** **BTL-2,3**
TEXT BOOKS	
1.	M.S. Naidu and V. Kamaraju (2013), 'High Voltage Engineering', Tata McGraw Hill, 5th Edition.
REFERENCE BOOKS	
1.	E. Kuffel and W.S. Zaengl (1986), 'High Voltage Engineering Fundamentals', Pergamon press, Oxford, London.
E BOOKS	
1.	https://www.springer.com/gp/book/9783642119927
2.	Heeps://www.elsevier.com/books/high-voltage-engineering/Hammond/978-0-08-024212-5
MOOC	
1.	https://nptel.ac.in/courses/108/104/108104048/#

COURSE TITLE		**POWER PLANT ENGINEERING**			**CREDITS**	**3**
COURSE CODE		**EEC4268**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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 contains the details of conventional and non-conventional energy sources					
Course Objective	1. To introduce students to different aspects of power plant engineering. 2. To familiarize the students to the working of power plants based on different fuels. 3. To expose the students to the principles of safety and environmental issues.					
Course Outcome	Upon completion of this course, the students will be able to 1. Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation. 2. Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts					

	3. Combine concepts of previously learnt courses to define the working principle of diesel power plant, its layout, safety principles and compare it with plants of other types. 4. Describe the working principle and basic components of the nuclear power plant and the economic and safety principles involved with it. 5. Discuss the working principle and basic components of the hydro-electric plants and the economic principles and safety precautions involved with it.

Prerequisites: ESB4217 Electrical Machines

CO, PO AND PSO MAPPING

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

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

MODULE I : THERMAL POWER PLANTS	**(10L)**
Basic Thermo dynamic cycles, various components of a steam power plant, layout, pulversed coal burning system, fluid bed combustion, coal and ash handling plants, boilers, induced and forced draft fans, super heaters, re heaters, economisers, deaertors, condenser, cooling tower, electrostatic precipitators, air-preheaters	**CO-1 BTL-3**
MODULE II: HYDRO ELECTRIC POWER PLANTS	**(8L)**
Hydrology, layout of hydroelectric power plants, dams, selection of water turbines, types of turbines and pumped storage	**CO-2 BTL-4**
MODULE III : NUCLEAR POWER PLANTS	**(9L)**
Principles of nuclear energy, fission reaction, nuclear reactors, nuclear power plants	**CO-3 BTL-4**
MODULE IV :GAS AND DIESEL POWER PLANTS	**(9L)**
Open and closed cycle gas turbines, work output and thermal efficiency, improving performance-reheating, inter cooling and regeneration, diesel engine power plant components and layout	**CO-4 BTL-4**
MODULE V: NON CONVENTIONAL POWER GENERATION	**(9L)**
Solar energy, OTEC, wind power plants, tidal power, geo thermal plants, fuel cell, principle of MHD power, thermoelectric and thermionic power generation	**CO-5 BTL-4**

TEXT BOOKS

1.	P K Nag (2015)– "Power Plant Engineering" Tata McGraw Hill Third edition.

REFERENCE BOOKS

1.	Arora and Domkundwar (2017) – " A course in Power plant Engineering " DhanpatRai& Co.

E BOOKS

1.	https://books.google.co.in/books/about/Pow_Plant_Engg.html?id=RVCyoAEACAAJ&redir_esc=y

MOOC

1.	https://onlinecourses.nptel.ac.in/noc20_me10/preview

COURSE TITLE	**INTERNET OF THINGS**	**CREDITS**	**3**

COURSE CODE		EEC4269	COURSE CATEGORY	PC	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	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	Learners will understand the concept of Internet of Things, IOT sensors, IOT development examples and projects
Course Objective	1. To gain knowledge on fundamentals and applications of IoT 2.To familiarize with industrial sensors and integrated IOT sensors 3. To apply technological advances of wireless sensor structure, RF module, power module to IOT projects 4.To learn the important concepts of IOT development examples 5. To develop IOT based projects
Course Outcome	Upon completion of this course, the students will be able to 1.Describe the fundamentals and applications of IoT 2. Apply industrial sensors and integrated IOT sensors 3. Apply technological advances of wireless sensor structure, RF module, power module to IOT projects 4. Describe and apply the important concepts of IOT development examples 5. Develop IOT based projects

Prerequisites: Introduction to Embedded Systems, C Programming

CO, PO AND PSO MAPPING

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

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

MODULE 1: INTRODUCTION	**(9L)**
Internet of Things Promises–Definition– Scope–Sensors for IoT Applications–Structure of IoT– IoT Map Device **Suggested Activity:** Collect environmental data using sensors.	**CO-1** **BTL-3**
MODULE 2: IOT SENSORS	**(9L)**
Industrial sensors – Description & Characteristics–First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics–Polytronics Systems – Description &Characteristics–Sensors' Swarm – Description & Characteristics–Printed Electronics – Description & Characteristics–IoT Generation Roadmap **Suggested Activity:** Apply appropriate IoT protocols to connect sensors and actuators.	**CO-2** **BTL-3**
MODULE 3: TECHNOLOGICAL ANALYSIS	**(9L)**
Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module	**CO-3** **BTL-3**

Suggested Activity: Establish virtual sensor network.	
MODULE 4: IOT DEVELOPMENT EXAMPLES	**(9L)**
ACOEM Eagle – EnOcean Push Button – NEST Sensor – Ninja Blocks -Focus on Wearable Electronics	**CO-4 BTL-3**
MODULE 5: IOT PROJECTS (9L)	
Creating the sensor project - Preparing Raspberry Pi/ ARM Cortex - Clayster libraries - Hardware-Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values –Exporting sensor data - Creating the actuator project- Hardware - Interfacing the hardware -Creating a controller - Representing sensor values - Parsing sensor data – Calculating control states - Creating a camera - Hardware -Accessing the serial port on RaspberryPi/ ARM Cortex - Interfacing the hardware - Creating persistent default settings –Adding configurable properties - Persisting the settings - Working with the current settings -Initializing the camera **Suggested Activity:** Interface RaspberryPi with sensors and actuators.	**CO-5 BTL-4**

REFERENCE BOOKS	
1.	Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier (2014), 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights.
2.	Peter Waher (2015), 'Learning Internet of Things', Packt Publishing.
3.	Editors Ovidiu Vermesan Peter Friess (2017),'Internet of Things – From Research and Innovation to Market.
4.	N. Ida, Sensors (2014), Actuators and Their Interfaces, Scitech Publishers.
E BOOKS	
1.	https://consense.com.ua/en/lib/book/learning_internet_of_things
2.	https://www.researchgate.net/publication/263970385_Internet_of_Things_-_From_Research_and_Innovation_to_Market_Deployment_Chapter_4_-_Internet_of_Things_Global_Standardisation_-_State_of_Play
MOOC	
1.	https://www.coursera.org/specializations/iot
2.	https://www.coursera.org/specializations/internet-of-things
3.	https://www.edx.org/course/introduction-to-the-internet-of-things-iot
4.	https://onlinecourses.nptel.ac.in/noc21_cs17/preview

COURSE TITLE	**ALTERNATIVE SOURCES OF ENERGY**			**CREDITS**	**3**
COURSE CODE	**EEC4351**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3:0:0:0**
Version **1.0**	**Approval Details**	**23 ACM, 06.02.2021**		**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	Enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding Alternative Sources of Energy
Course Objective	1. To know about the biogas and biomass with applications in industry/home. 2. To know about the ocean energy and the applications in industry/home. 3. To know the geothermal energy and process to storage. 4. To know the importance of power flow management along with techniques.
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the basic concepts of alternative sources of energy 2. Facilitate the concept, working and applications of wind energy 3. Facilitate the concept, working and applications of Bio-mass for industry/home. 4. Describe the concept, working and applications of geothermal, tidal and ocean energy. 5. Analyze energy management techniques.
Prerequisites: NIL	

CO, PO AND PSO MAPPING

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

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

MODULE 1: INTRODUCTION TO ALTERNATIVE SOURCES OF ENERGY	**(6L+3L=9)**
Introduction; Global trend in alternative sources of energy; wind, biomass, biogas and other alternatives sources of energy for power generation in India – opportunities and challenges **Practical component:** Detection of various energy generation challenges. **Suggested Readings:** Evolution of alternative sources of energy	**CO-1** **BTL-2**
MODULE 2: WIND ENERGY	**(6L+3L=9)**
Global trend in wind power; Wind energy – source of energy, variations with location and height; Wind power and wind power density; Wind atlas of India; Wind power in India – opportunities and challenges; Wind power – Layout and working principle, classification (onshore, near shore and offshore wind farms), economics, regulation; Policy regarding wind power – World and India **Practical component:** Range of different wind generators. **Suggested Readings:** Wind energy: Principles, Techniques, and Applications	**CO-2** **BTL-2**
MODULE 3: BIOMASS, POLICIES AND GENERATION	**(6L+3L=9)**
Biomass based power generation – technology (gasification and anaerobic digestion), economics, regulation; Opportunities and challenges regarding biomass power; Policy regarding biomass power – World and India **Practical component:** Range of different Biomass based power generation.	**CO-3** **BTL-3**

Suggested Readings: Biomass power generation technology and policy.	
MODULE 4: OTHER ALTERNATIVE SOURCES OF ENERGY	**(6L+3L=9)**
Other alternative sources of energy (Tidal, Geothermal, OTEC); Issues of intermittency, storage and grid integration; alternative sources of energy projects **Practical component:** Range of different Tidal, Geothermal, and OTEC. **Suggested Readings:** Tidal, Geothermal, and OTEC, power generation technology and policy.	**CO-4** **BTL-3**
MODULE 5: ENERGY MANAGEMENT	**(6L+3L=9)**
Energy economics, energy audit, energy conservation, cogeneration, waste heat recovery, concept of total energy system, combined cycle plant, energy management, scope of alternate energy sources in India **Practical component:** Energy management in home or university. **Suggested Readings:** Case study on energy management in industries	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Twidell J., Weir T. (2015). *Renewable Energy Resources*. Routledge. ISBN: 0415584388, 3rd Edition.
2.	Kandpal T.C., Garg H.P. (2003). *Financial Evaluation of Renewable Energy Technologies*. Macmillan Publishers India Limited. ISBN: 1403909520.
3.	N.K.Giri (2012) *Alternate Energy (Sources, Applications and Technologies)*, Khanna Publishers, first Edition.
REFERENCE BOOKS	
1.	Gasch R., Twele J. (2011). *Wind Power Plants: Fundamentals, Design, Construction and Operation*, Springer Science & Business Media. ISBN: 3642229387 2nd Edition.
2.	Van Swaaij W.P.M., Kersten S.R.A., Palz W. (2015). *Biomass Power for the World*. CRC Press. ISBN: 9814613894..
3.	N K Bansal (2014). *Non-Conventional Energy Resources*, Vikas Publishing, second edition.
E BOOKS	
1.	http://nptel.ac.in/courses/112104225/22
2.	https://www.amazon.in/Integration-Alternative-Sources-Energy-Wiley-ebook/dp/B000W3WIWI
MOOC	
1.	http://nptel.ac.in/courses/108103009/34
2.	http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/notused/Non-Conventional%20Energy%20Systems-/Learning%20Materail%20-%20NCES.pdf

COURSE TITLE	**POWER QUALITY**			**CREDITS**	**3**
COURSE CODE	**EEC4352**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**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 is intended to provide tools to classify, quantify, and analyze the power quality problems and to provide practical engineering solutions to mitigate these problems
Course Objective	1. To determine the various power quality issues. 2. To explain concept of power and power factor in single-phase and three-phase systems supplying nonlinear loads. 3. To examine the active compensation techniques used for reactive power compensation, load balancing, power factor correction, and load voltage regulation. 4. To develop active filters for harmonics elimination. 5. To explain power quality improvement in SMPS, drive systems, and renewable energy systems.
Course Outcome	Students will be able to 1. Describe the power quality issues like Overloading, under voltage, sustained interruption; sags and swells; waveform distortion and Total Harmonic Distortion 2. Evaluate the sources and effects of transient over voltages and the surge arresters 3. Analyse the fundamental idea in harmonics and the associated protection schemes 4. Analyse the effects of harmonics in the power system and grounding techniques 5. Examine the monitoring devices used to check the quality of power

Prerequisites: Transmission and Distribution

CO, PO AND PSO MAPPING

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

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

MODULE I : INTRODUCTION, VOLTAGE SAGS AND INTERRUPTIONS	**(9L)**
Terms and definitions: Overloading, under voltage, sustained interruption; sags and swells; waveform distortion, Total Harmonic Distortion (THD), Computer Business Equipment Manufacturers Associations (CBEMA) curve, Sources of sags and interruptions, estimating voltage sag performance, fundamental principles of protection, motor starting sags. **SuggestedReading:**https://www.wiley.com/en-us/Understanding+Power+Quality+Problems%3A+Voltage+Sags+and+Interruptions-p-9780780347137	**CO-1 BTL-3**
MODULE II: TRANSIENT OVERVOLTAGES	**(9L)**
Sources of transient over voltages: Capacitor switching, magnification of capacitor switching transients, lightning, ferro resonance and other switching transients; Devices	**CO-2 BTL-4**

for over voltage protection: Surge arresters and transient voltage surge suppressors, isolation transformers, low pass filters, low impedance power conditioners - utility surge arresters, utility system Lightning protection : shielding, line arresters, low side surges, cable protection and scout arrester scheme. **Suggested Reading**: Causes and Effects of Transient Voltages	
MODULE III: FUNDAMENTALS OF HARMONICS (9L)	
Harmonic distortion: Voltage and current distortion, harmonic indices, harmonic sources from commercial and industrial loads, locating harmonic sources; system response characteristics: resonance. low side surges, cable protection and scout arrester scheme. **Suggested Reading:** Power quality and harmonics causes and effect	**CO-3 BTL-4**
MODULE IV: APPLIED HARMONINCS, WIRING AND GROUNDING (9L)	
Effects of harmonic distortion - harmonic distortion evaluation, principles for controlling harmonics -devices for controlling harmonic distortion – interharmonics caused by induction furnaces - IEEE standard 519-1992 – over view of IEC standards on harmonics – reasons for grounding – typical wiring and grounding problems – isolated ground – summary of wiring and grounding solutions. **Suggested Reading:** The Effects of Harmonics on Power Quality and Energy Efficiency	**CO-4 BTL-4**
MODULE V: POWER QUALITY MONITORING (9L)	
Monitoring considerations: Disturbance analyzer, harmonic / spectrum analyzer, combination, Disturbance harmonic analyzer , flicker meters, smart power quality monitors, transducers requirements , applications of expert system - power quality monitoring and the internet - EMI, Electromagnetic compatibility **Suggested Reading:** various real time monitoring of power quality	**CO-5 BTL-4**
TEXT BOOKS	
1.	Roger.C.Dugan, Mark.F. McGranagham (2012). *Electrical Power Systems Quality*, 3rd Edition, McGraw Hill.
2.	Ewald F. Fuchs, Mohammad A. S. Masoum (2011). *Power Quality in Power Systems and Electrical Machines*, 2nd Edition, Academic Press.
3.	Francisco C. De La Rosa (2006). *Harmonics and Power Systems*, 1st Edition, CRC Press.
REFERENCE BOOKS	
1.	Angelo Baggiri (2008) *Handbook of Power Quality*. 1st Edition, John Wiley & Sons.
2.	C. Sankaran (2002) *Power Quality*, 1st Edition, CRC Press.
3.	P.S. Satnam P.S. Kang (2008) *Power Capacitor for Reactive Compensation*, 1st Edition, Dhanpat Rai & Sons Publications.
E BOOKS	
1.	http://www.gcebargur.ac.in/sites/gcebargur.ac.in/files/lectures_desk/electrical_power_systems_quality.pdf
2.	http://nptel.ac.in/courses/108106025/Power%20quality_in_power_distribution_systems.pdf
3.	https://www.accessengineeringlibrary.com/browse/power-quality-in-electrical-systems#
MOOC	
1.	http://nptel.ac.in/syllabus/108106025/

2.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-061-introduction-to-electric-power-systems-spring-2011/

COURSE TITLE	ADVANCED CONTROL THEORY			CREDITS	3
COURSE CODE	EED4353	COURSE CATEGORY	DE	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	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 introduces students to recently developed and advanced techniques for solving complex control problems. The course presents theory and methodology for analysis and modeling of systems and signals, and methods for design and synthesis of feedback controllers.
Course Objective	1. To provide a strong concept on the compensator design and on advanced control system analysis and design techniques 2. To analyse the behaviour of discrete time systems and nonlinear control systems.
Course Outcome	Upon completion of this course, the students will be able to 1.Analyze State variables and understand its application 2.Analyze Phase plane and understand its application 3.Describe function and its analysis for common non-linearities 4.Apply various stability analysis techniques to physical systems 5. Apply various optimal control methods in design of controllers

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

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

MODULE 1: STATE VARIABLE ANALYSIS	**(6L+3L=9)**
Concept of state – State Variable and State Model – State models for linear and continuous time systems – Solution of state and output equation – controllability and observability - Pole Placement –State observer Design of Control Systems with observers. **Suggested Reading:** http://nptel.ac.in/courses/101108056/module9/lecture39.pdf	**CO-1 BTL-3**
MODULE 2 : PHASE PLANE ANALYSIS (6L+3L=9)	
Features of linear and non-linear systems - Common physical non-linearities – Methods of linearising non-linear systems - Concept of phase portraits – Singular points – Limit	**CO-2 BTL-3**

cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method. **Suggested Reading**: Phase plane analysis	
MODULE 3: DESCRIBING FUNCTION ANALYSIS	**(9L)**
Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – Conditions for stability – Stability of oscillations. **Suggested Reading:** Stability analysis	**CO-3** **BTL-3**
MODULE 4: STABILITY ANALYSIS	**(9L)**
Introduction – Liapunov's stability concept – Liapunov's direct method – Lure's transformation –Aizerman's and Kalman's conjecture – Popov's criterion – Circle criterion. **Suggested Reading:** Applications of stability analysis	**CO-4** **BTL-3**
MODULE 5: OPTIMAL CONTROL (9L)	
Introduction -Decoupling - Time varying optimal control – LQR steady state optimal control – Optimal estimation – Multivariable control design. **Suggested Reading:** Adaptive control	**CO-5** **BTL-3**

TEXT BOOKS	
1.	I.J. Nagrath and M. Gopal (2013). *Control Systems Engineering*, New Age International Publishers, second edition.
2	AshishTewari (2012). *Modern control Design with Matlab and Simulink*, John Wiley & sons, New Delhi.
3	M.Gopal (2016). *Modern control system theory*, New Age International Publishers.
REFERENCE BOOKS	
1.	George J. Thaler (2017). *Automatic Control Systems*, Jaico Publishers.
2.	Gene F. Franklin, J. David Powell and Abbasemami-Naeini (2016). *Feedback Control of Dynamic Systems*, Fourth edition, Pearson Education, Low price edition.
E BOOKS	
1.	http://www.springer.com/in/book/9783540239512
2	https://www.kopykitab.com/Advanced-Control-Systems-by-Sarkar-B-N
MOOC	
1.	https://www.mooc-list.com/course/introduction-feedback-control-theory-edx
2.	https://www.edx.org/course/introduction-control-system-design-first-mitx-6-302-0x
3	https://www.openlearning.com/courses/signals-and-systems

COURSE TITLE		**RENEWABLE POWER GENERATION TECHNOLOGIES**			**CREDITS**	**3**
COURSE CODE		**EEC4354**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**		**BTL-4**
ASSESSMENT SCHEME						
First		**Second**	**Seminar/**	**Surprise Test**	**Attendance**	**ESE**

Periodical Assessment	Periodical Assessment	Assignments/ Project	/ Quiz		
15%	15%	10%	5%	5%	50%

Course Description	**The course focuses on constructional details, working principles and operation of different RE technologies for power generation and beyond.**
Course Objective	The objective of the courses is to develop in-depth knowledge for the following: 1.Construction and operation of different solar PV technologies and their applications 2. Solar PV business models 3. Construction and operation of different solar thermal technologies and their applications 4.Construction and operation of different Wind Energy Conversion Systems (WECS) and their applications 5.Construction and operation of different biomass and biogas technologies and their applications
Course Outcome	Upon completion of this course, the students will be able to 1. Appraise the need and possibility of extracting solar energy and converting into electrical energy using PV cell. 2.Design and analyze stand-alone and grid connected PV system. 3.Describe the dynamics of wind turbine and electrical generator 4.Select and design suitable configuration of the wind energy conversion system based on application. 5.Suggest, design and analyze hybrid energy systems.

Prerequisites: Basic Electronics and Machines, Power 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	PSO 3
CO-1	3	3	2	2	2	-	-	-	-	-	-	-	-	-	1
CO-2	3	3	2	2	3	-	-	-	-	-	-	-	-	-	1
CO-3	3	3	2	2	3	-	-	-	-	-	-	-	-	-	1
CO-4	3	3	2	2	3	-	-	-	-	-	-	-	-	-	1
CO-5	3	3	3	2	3	-	-	-	-	-	-	-	-	-	1

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

MODULE 1 – SOLAR ENERGY (9L)	
Definition, Energy available from Sun, Solar radiation data, solar energy conversion into heat, Flat plate and Concentrating collectors, Principle of natural and forced convection. power generation. PV Systems - Design of PV systems-Standalone system with DC and AC loads with and without battery storage-Grid connected PV systems-Maximum Power Point Tracking	**CO-1 BTL-3**
MODULE 2 – WIND ENERGY (9L)	
Wind energy – energy in the wind – aerodynamics - rotor types – forces developed by blades - Aerodynamic models – braking systems – tower - control and monitoring system - design considerations power curve - power speed characteristics-choice of electrical generators	**CO-2 BTL-4**
MODULE 3 – WIND TURBINE GENERATOR SYSTEMS (9L)	

Fixed speed induction generator-performance analysis- semi variable speed induction generator-variable speed induction generators with full and partial rated power converter topologies -isolated systems-self excited induction generator- permanent magnet alternator - performance analysis	**CO-3 BTL-4**
MODULE 4 – NATURE OF GEOTHERMAL RESOURCES (9L)	
Definition and classification of resources, Utilization for electricity generation and direct heating, Wellhead power generating units. Basic features: Atmospheric exhaust and condensing, Exhaust types of conventional steam turbines. Pyrolysis of Biomass to produce solid, liquid and gaseous fuels. Biomass gasification, Constructional details of gasifier, Usage of biogas for chullas, various types of chullas for rural energy needs.	**CO-4 BTL-4**
MODULE 5 – HYBRID ENERGY SYSTEMS (9L)	
wind-diesel system, wind - PV system ,micro hydro-PV system ,biomass - PV-diesel system, geothermal-tidal and OTEC systems	**CO-5 BTL-4**

TEXT BOOKS	
1.	Rai, G.D. (2015), Non-Conventional Energy Sources, Khanna Publishers.
2.	Ashok Desai V (2016), *Non-Conventional Energy,* Wiley Eastern Ltd.
3.	Mittal K.M (2014), Non-Conventional Energy Systems*,* Wheeler Publishing Co. Ltd.
4.	Ramesh R, Kurnar K.U (2017), Renewable Energy Technologies*,* Narosa Publishing House, New Delhi, reprint.
REFERENCE BOOKS	
1.	Chetan Singh Solanki (2013), 'Solar Photovoltaics -Fundamentals, Technologies and Applications', PHI Learning Pvt. Ltd., New Delhi.
2.	Van Overstraeton and Mertens R.P. (2012), 'Physics, Technology and use of Photovoltaics', Adam Hilger, Bristol.
3.	John F.Walker& Jenkins. N (2019) , 'Wind energy Technology', John Wiley and sons, Chichester, UK.
4.	Freries LL (2017),'Wind Energy Conversion Systems', Prentice Hall, U.K.,
E BOOKS	
1.	https://books.google.co.in/books?isbn=0215521137
2.	https://books.google.co.in/books?isbn=0128132175
MOOC	
1.	https://www.mooc-list.com/course/wind-resources-renewable-energies-coursera
2.	https://www.edx.org/course/solar-energy
3.	https://www.renewableenergyworld.com/geothermal-energy/tech.html

COURSE TITLE		**EMBEDDED IOT**			**CREDITS**	**3**
COURSE CODE		**EEC4355**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**		**BTL-2**
ASSESSMENT SCHEME						
First Periodical Assessment		**Second Periodical**	**Seminar/ Assignments/**	**Surprise Test / Quiz**	**Attendance**	**ESE**

	Assessment	Project			
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	This course mainly focuses on networking and communication technologies, cloud infrastructure, cloud computing, server concepts, IoT Protocols,				
Course Objective	1.To gain knowledge on fundamentals and applications of IoT 2.To acquire knowledge on the key concepts of communication interfaces of IoT 3.To learn the important concepts of cloud security				
Course Outcome	Upon completion of this course, the students will be able to 1.Describe the functional characteristics and societal benefits of IOT 2. Select the components of IoT architecture 3.Explain the functional requirements and communication interfaces of IOT 4. Apply the communication protocols of IOT devices 5. Explain the key concepts of cloud security.				

Prerequisites: Nil

CO, PO AND PSO MAPPING

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

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

MODULE 1: FUNDAMENTALS AND APPLICATIONS OF IoT (6L+3L=9)	
Introduction to Internet of Things (IoT)– Functional Characteristics – Recent Trends in the Adoption of IoT – Societal Benefits of IoT, Health Care –– Machine to Machine (M2M) - Smart Transportation – Smart Living – Smart Cities- Smart Grid **Suggested Readings:** Evolution of IoT and Embedded systems	**CO-1 BTL-2**
MODULE 2 : IoT ARCHITECTURE (6L+3L=9)	
Functional Requirements - Components of IoT: Sensors – Actuators – Embedded Computation Units – Communication Interfaces – Software Development **Suggested Readings:** Power management in IOT devices	**CO-2 BTL-2**
MODULE 3: COMMUNICATION PRINCIPLES (9L)	
RFID – ZigBEE – Bluetooth – Internet Communication- IP Addresses - MAC Addresses - TCP and UDP – IEEE 802 Family of Protocols – Cellular-Introduction to EtherCAT **Suggested Readings:** IoT Protocols	**CO-3 BTL-2**
MODULE 4: COMMUNICATION INTERFACE IN IoT (9L)	
IEEE 802.11 Wireless Networks Attacks: Basic Types, WEP Key Recovery Attacks, Keystream Recovery Attacks against WEP – RFID Security – Security Issues in ZigBEE: Eavesdropping Attacks, Encryption Attacks – Bluetooth Security: Threats to Bluetooth Devices and	**CO-4 BTL-2**

Networks. **Suggested Readings:** LPWAN Technology	
MODULE 5: CLOUD SECURITY CONCEPTS (9L)	
Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defence in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PAAS, IAAS and SAAS. e.g. User authentication in the cloud; Cryptographic Systems- Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL. **Suggested Readings:** SaaS, IaaS and PaaS	**CO-5 BTL-2**

TEXT BOOKS	
1.	Adrian McEwen and Hakim Cassimally (2014), ―Designing the Internet of Things‖, John Wiley and Sons Ltd, UK.
2	Olivier Hersent, David Boswarthick and Omar Elloumi (2012), ―The Internet of Things: Key Applications and Protocols‖, John Wiley and Sons Ltd., UK.
3	Dieter Uckelmann, Mark Harrison, Florian Michahelles (2011), ―Architecting the Internet of Things‖, Springer, New York.
REFERENCE BOOKS	
1.	Joseph Yiu, (2010)" The Definitive Guide to the ARM Cortex-M3", Second Edition, Elsevier Inc.
2.	Andrew N Sloss, Dominic Symes, Chris Wright (2015), "ARM System Developer'sGuide Designing and Optimizing System Software", Elsevier Publications,
3	Steve Furber (2015), "ARM System-on-Chip Architecture", 2nd Edition, Pearson Education, India ISBN: 9788131708408, 8131708403.
E BOOKS	
1.	Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed (Wiley - IEEE)
MOOC	
1.	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs15/
2.	https://nptel.ac.in/courses/108/108/108108098/

COURSE TITLE		**ENERGY CONVERSION AND STORAGE TECHNOLOGIES**			**CREDITS**	**3**
COURSE CODE		**EEC4366**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3:0:0:0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**		**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	This course covers all types of currently- Principles of Energy Conversion and				

Description	available energy storage systems, which are, or can be, used in the electricity, heat and transport sectors.
Course Objective	1. To explain the different energy sources and conversions. 2. To explain the energy measurement systems. 3. To discuss the theory of different energy storage devices. 4. To enable learners to identify the optimal (appropriateness, cost and sustainability) solutions to any potential energy storage application. 5. To discuss the applications of different energy storage devices.
Course Outcome	Upon completion of this course, the students will be able to 1. Examine the concept, and working of energy sources and conversions 2. Describe the concept energy measurement systems. 3. Familiarize with different energy storage devices. 4. Illustrate the Battery and fuel cell storage 5. Analyze the energy storage applications.

Prerequisites: NIL

CO, PO AND PSO MAPPING

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

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

MODULE 1: ELECTRICAL ENERGY SOURCES (6L+3L=9)

Importance of Electrical energy in modern industrial society, Production of electricity using coal, oil, natural gas, nuclear fuels and hydel, -its relative advantages and disadvantages (i.e. conversion of Thermal, Nuclear, hydel energy into electric energy) Electricity generation using Renewable Energy Sources: Basic Principles and Applications. (Conversion of Electromagnetic energy and natural energy sources like solar radiation, Wind, Ocean waves, Solid waste etc. to electricity) Conversion of chemical energy into electrical energy (fuel cell) Thermal power plant, nuclear power plants and hydroelectric power plant, Transmission and distribution of electricity, Villages electrification program and problems in India. **Practical component:** Recognition of various energy conversion challenges. **Suggested Readings:** Basic principles electrical energy sources.	**CO-1 BTL-2**

MODULE 2: ENERGY MEASUREMENT & VERIFICATION (6L+3L=9)

Electrical Energy Measurements, Thermal Energy Measurements, Mechanical & Utility System Measurements, Measurement & Verification, M & V Protocol Energy availability, Demand and storage, Need for energy storage, Different types of energy storage; Mechanical, Chemical, Electrical, Electrochemical, Biological, Magnetic, Electromagnetic, Thermal; Comparison of energy storage technologies **Practical component:**	**CO-2 BTL-2**

Range of different measurement system. **Suggested Readings:** Electrical, Thermal measurement system	
MODULE 3: THERMAL ENERGY AND FLYWHEEL AND COMPRESSED AIR STORAGE (6L+3L=9)	
Principles and applications, Sensible and Latent heat, Phase change materials; Energy and exergy analysis of thermal energy storage, solar energy and thermal energy storage, case studies. Flywheel and compressed air storage; Pumped hydro storage; Hydrogen energy storage, Capacitor and super capacitor, Electrochemical Double Layer Capacitor: Principles, performance and applications **Practical component:** Range of different Biomass based power generation. **Suggested Readings:** Thermal Energy and Flywheel and compressed air storages	**CO-3** **BTL-3**
MODULE 4: ELECTROCHEMICAL ENERGY STORAGE (6L+3L=9)	
Battery – fundamentals and technologies, characteristics and performance comparison: Lead-acid, Nickel-Metal hydride, Lithium Ion; Battery system model, emerging trends in batteries. Hydrogen as energy carrier and storage; Hydrogen resources and production; Basic principle of direct energy conversion using fuel cells; Thermodynamics of fuel cells **Practical component:** Range of different battery's. **Suggested Readings:** Battery and Hydrogen energy storage.	**CO-4** **BTL-3**
MODULE5:APPLICATION OF ENERGY STORAGE (6L+3L=9)	
Food preservation, Waste heat recovery, Solar energy storage: Greenhouse heating; Drying and heating for process industries. **Practical component:** Energy applications in real time applications. **Suggested Readings:** Application of Energy Storage systems	**CO-5** **BTL-3**

TEXT BOOKS

1.	Rakosh das Begamudre (2000) *Energy conversion systems*, New age international publishers, New Delhi - 2000.
2.	John Twidell and Tony Weir (2004) *Renewable Energy Resources*, 2nd ed., Fspon & Co
3.	Dincer I., and Rosen M. A. (2011*) Thermal Energy Storage: Systems and Applications*, Wiley
4.	Huggins R. A. (2016) *Energy Storage: Fundamentals, Materials and Applications*, Springer International Publishing, second edition.

REFERENCE BOOKS

1.	O'Hayre R., Cha S., Colella W., and Prinz F. B. (2009) *Fuel Cell Fundamentals*, John Wiley & Sons, Second Edition.
2.	Narayan R. and Viswanathan B. (2001) *C.hemical and Electrochemical Energy System*, Universities Press, Second Edition
3.	Rahn C. D. and Wang C. (2013) *Battery Systems Engineering*, First Edition, John Wiley & Sons, Third Edition.

4.	Moseley P. T., and Garche J. (2014) *Electrochemical Energy Storage for Renewable Sources and Grid Balancing*, Elsevier Science.
5.	Miller F. P., Vandome A. F., and John M. B. (2010*) Compressed Air Energy Storage*, VDM Publishing
E BOOKS	
1.	https://www.elsevier.com/books/renewable-energy-conversion-systems/kamran/978-0-12-823538-6
2.	https://www.kobo.com/us/en/ebook/solar-energy-conversion-systems
MOOC	
1.	https://www.fun-mooc.fr/en/courses/molecules-and-materials-energy-tomorrow-momentom/
2.	https://www.coursera.org/lecture/photovoltaic-solar-energy/6-survey-of-electricity-storage-technologies-jUpTG

COURSE TITLE		**ELECTRICAL SYSTEM DESIGN**			**CREDITS**	**3**
COURSE CODE		**EEC4367**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3:0:0:0**
Version	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**		**BTL-5**

ASSESSMENT SCHEME

First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
x15%	**15%**	**10%**	**5%**	**5%**	**50%**

Course Description	This course is designed to make the students conversant with the design of electrical layouts, lighting, earthing, cable sizing and selection of protective devices.
Course Objective	To impart knowledge on 1. To make aware of the Acts and Rules regulating the design of electrical systems in India. 2. To impart knowledge in the design of low voltage and medium voltage electrical installations. 3. To give basic knowledge of design of distribution transformer substations, their installations and earthing design for transformer substations 4. To familiarize lighting calculations and external lighting.
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the basic design and evaluation of a power system. 2. Design the layout of lighting system considering various entities. 3. Calculate the cable sizing and choose between single and three phase. 4. Design the internal electrification design such as cable and protective devices selection. 5. Design the protection system of building and other allied structures against lightning.
Prerequisites: EEB4116 - Electromagnetic Theory, EEB4117-Circuit Theory, EEB4201-Electrical	

Machines

CO, PO AND PSO MAPPING

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

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

MODULE 1: SYSTEM PLANNING AND COST ESTIMATES (5L+4L=9)

Basic design considerations, Planning guide for the supply and distribution system, Power system modernization and evaluation studies/programs, Voltage considerations, Voltage control in electric power systems, Voltage selection, Voltage ratings for low-voltage utilization equipment , Voltage drop considerations in locating the low-voltage/ high-voltage ,Calculation of voltage drops. Preparing the cost estimate, Classes of estimates, Equipment and material costs, installation costs , Other costs

CO-1 BTL-3

Suggested Readings:

Apparatus for High & Extra high voltages

MODULE 2: LIGHTING DESIGN (5L+4L=9)

Different entities of illuminating systems Light sources: daylight, incandescent, electric discharge, fluorescent, arc lamp and Lasers Luminaries, wiring, switching & control circuits Laws of illumination; illumination from point, line and surface sources Photometry and spectrophotometry Interior lighting – industrial, residential, office departmental stores, indoor stadium, theater and hospitals. Exterior lighting- flood, street, aviation and transport lighting, lighting for displays and signaling- neon signs, LED-LCD displays beacons and lighting for surveillance Utility services for large building/office complex & layout of different meters and protection units Different type of loads and their individual protections Selection of cable/wire sizes; potential sources of fire hazards and precautions. Prepare layout of Different type lights

CO-2 BTL-5

Suggested Readings:

Lighting schemes, Luminaire design, Glare limitation,Comfort lighting

MODULE 3: CABLE AND PHASE SELECTION (5L+4L=9)

Load Details Calculation Cable type and Construction features Site Installation Conditions Cable Selection Based on Current Rating of feeder Base Current Ratings of feeder Installed Current Ratings of Cable Cable Selection and Coordination with Protective Devices Feeders load detail Motors load detail Voltage Drop of cable Cable Impedances Maximum Permissible Voltage Drop by ANSI and IEC std. Calculating Maximum Cable Length due to Voltage Drop Short Circuit Temperature Rise calculation of cable selection Minimum Cable Size Due to Short Circuit Temperature Rise Initial and Final Conductor Temperatures withstand capability of cable.

CO-3 BTL-5

Suggested Readings:

Types of conductors and cables, Classifications of cables based on voltage levels

MODULE 4: INTERNAL ELECTRIFICATION DESIGN

(6L+3L=9)	
Electrical Layout in residential building using Auto CAD. Selection of house wiring. Sizing and Selection of Conduit. Sizing and selection of Switch Socket. Calculation of load on circuit. Design of sub circuit (Lighting Circuit and Power Circuit).Distribution of Power Circuit. Calculation of fan. Calculation of Earthing for residential buildings **Suggested Readings:** Wiring systems	**CO-4** **BTL-5**
MODULE 5: LIGHTNING PROTECTION (6L+3L=09)	
Method of Lightening protection Basic Consideration for Protection Calculations for Evaluating the Need for Protection Calculation of Protective Angles And Zone Of Protection For Various Forms of Air Termination Selection of lightening protection device Selection of ESE type Lightening Protection **Suggested Readings:** Risk index of lightning protection	**CO-5** **BTL-5**
TEXT BOOKS	
1	J. B. Gupta (2013). *A Course in Electrical Installation Estimating and Costing*, S.K. Kataria & Sons, 2nd edition.
2	K. B. Raina, S. K. Bhattacharya (2010) *Electrical Design Estimating Costing*, NEW AGE; Reprint edition.
3	M. K. Giridharan (2016) *Electrical Systems Design*, I K International Publishers, New Delhi, 2nd edition.
REFERENCE BOOKS	
1.	IEC62504 General Lighting — LEDs and LED Modules —terms and definitions
2	IEC 60598-2-3 Particular requirements – Luminaires for road and street lighting
3	IEC 60502-2: Power cables with extruded insulation and their accessories for rated voltages from 6kV up to 30Kv
4	IS 1255:Code of practice for installation and maintenance of power cables up to and including 33 kV rating
5	IEC 60364-5-52:election and erection of electrical equipment –Wiring systems
6	IEC 60364-5-54:Selection and erection of electrical equipment –Earthing arrangements, protective conductors and protective bonding conductors
7	IEC 60502-2: Power cables with extruded insulation and their accessories for rated voltages from 6kV up to 30Kv
E BOOKS	
1	http://www.springer.com/la/book/9780442008741
2	https://books.google.co.in/books/about/Electrical_Systems_Design.html?id=Tt6G60zZF3cC
3	http://electrical-engineering-portal.com/download-center/books-and-guides/electrical-engineering/lighting-electrical-systems-design
MOOC	
1.	https://www.coursera.org/learn/electricity/lecture/UJ4FB/electric-system-basics-in-buildings

COURSE TITLE	**SPECIAL ELECTRICAL MACHINES**			**CREDITS**	**3**
COURSE CODE	**EEC4368**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**

Version	1.0	Approval Details	23 ACM, 06.02.2021	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	The course will enable the students to gain detailed skills related to Special Type Of Electrical Machines and its control.
Course Objective	1. To impart knowledge on Construction, principle of operation and performance of stepper motors. 2. To impart knowledge on the Construction, principle of operation, control and performance of switched reluctance motors. 3. To impart knowledge on the Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors. 4. To impart knowledge on the Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors. 5. To impart knowledge on the Construction, principle of operation and performance of synchronous reluctance motors
Course Outcome	Upon completion of this course, the students will be able to ibe the construction, principle of operation, control and performance characteristics pping motors and its applications. ibe the construction, principle of operation and various control techniques of switched ance motors and its applications. ze the operation and performance of permanent magnet brushless D.C. motors. ze the operation and performance of permanent magnet synchronous motors. ibe the construction, principle of operation and performance characteristics of ronous reluctance motors.

Prerequisites: Electrical Machines, Power 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	PSO 3
CO-1	3	3	3	3	2	-	-	-	-	-	-	-	-	2	2
CO-2	3	3	3	3	2	-	-	-	-	-	-	-	-	2	2
CO-3	3	3	3	3	2	-	-	-	-	-	-	-	-	2	2
CO-4	3	3	3	3	2	-	-	-	-	-	-	-	-	2	2
CO-5	3	3	3	3	2	-	-	-	-	-	-	-	-	2	2

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

MODULE I: STEPPING MOTORS	**(9L)**
Constructional features, principle of operation, modes of excitation, torque production in Variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor. **Suggested Reading:** Closed loop speed control of stepper motor using MATLAB.	**CO-1** **BTL-2**
MODULE II: SWITCHED RELUCTANCE MOTORS	**(9L)**
Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control, Microprocessor based controller.	**CO-2** **BTL-2**

Suggested Reading: Mathematical Modeling of Switched Reluctance Motor using MATLAB and Sensorless operation of Switched Reluctance Motor Drives.	
MODULE III: PERMANENT MAGNET BRUSHLESS DC MOTORS (9L)	
Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equations, Torque-speed characteristics, Controllers-Microprocessor based controller. **Suggested Reading:** Closed loop speed control of BLDC motor using MATLAB	**CO-3** **BTL-3**
MODULE IV: PERMANENT MAGNET SYNCHRONOUS MOTORS (9L)	
Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self-control, Vector control, Current control schemes. **Suggested Reading:** Vector control of PMSM motor using MATLAB	**CO-4** **BTL-3**
MODULE V: SYNCHRONOUS RELUCTANCE MOTORS (9L)	
Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque - phasor diagram, motor characteristics. **Suggested Reading:** Transient stability analysis of a sensor less synchronous reluctance motor using MATLAB.	**CO-5** **BTL-2**

TEXT BOOKS	
1.	K.Venkataratnam (2008) *Special Electrical Machines.* University Press, Hyderabad.
2	T.J.E. Miller (2001). *Brushless Permanent Magnet and Reluctance Motor Drives.* Clarendon Press, Oxford, second edition.
3	T. Kenjo (2002). *Stepping Motors and Their Microprocessor Controls*. Clarendon Press London.
REFERENCE BOOKS	
1.	Takashi Kenjo, Akira Sugawara (2006) *Stepping Motors and Their Microprocessor Controls*. Clarendon Press.
2.	E.G. Janardanan (2014). *Special electrical machines*, PHI learning Private Limited, Delhi.
3.	Kenjo,T and Naganori,S (2011) *Permanent Magnet and brushless DC motors*, Clarendon Press, Oxford.
4.	P. P. Acarnley (2012) *Stepping Motors: A Guide to Theory and Practice*, IET.
E BOOKS	
1.	https://www.kopykitab.com/Special-Electrical-Machines-by-E-G-Janardanan
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc20_ee38/preview
2.	https://www.coursera.org/learn/motors-circuits-design

COURSE TITLE		**INDUSTRIAL IOT**			**CREDITS**	**3**
COURSE CODE		**EEC4370**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-0**
Versio	**1.0**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**		**BTL-4**

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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 describes the IOT and sensor network for automation in industrial applications.
Course Objective	1.To gain knowledge of smart systems. 2.To gain knowledge of sensor network with IOT 3. To gain knowledge of programing. 4.To know the industrial Automation with IOT. 5.To design proper system for industrial applications
Course Outcome	Upon completion of this course, the students will be able to 1.Apply Sensor network to smart systems. 2. Develop various systems using sensor networks 3. Integrate Physical system development of IOT devices. 4. Integrate Industrial Automation and IOT to various systems. 5.Apply IOT to Real time systems.

Prerequisites: ESB4304 Sensor and sensor networks

CO, PO AND PSO MAPPING

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

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

MODULE 1: INTRODUCTION (9L)	
Introduction to Sensor networks in smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. **Suggested Readings:** Smart technology and energy management.	**CO-1 BTL-2**
MODULE 2: SENSOR NETWORK SYSTEMS (9L)	
Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Desig	**CO-2 BTL-3**

Suggested Readings Sensor network and architectures, real-world design	
MODULE 3: IOT PHYSICAL DEVICES & ENDPOINTS (9L)	
Exemplary Device Board, Linux on Raspberry, Interface and Programming & IOT Device. Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases **Suggested Readings:** Interface and programming, routing.	**CO-3** **BTL-4**
MODULE 4: INDUSTRIAL AUTOMATION& IoT (9L)	
Industrial Automation-Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation **Suggested Readings:** Industrial automation and web of things	**CO-4** **BTL-4**
MODULE 5: CASE STUDY – IoT Implementations (9L)	
Case study: Smart Grid &IoT, Commercial building automation using IoT, Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT. **Suggested Readings:** case study of IOT like smart grid, automation	**CO-5** **BTL-4**

TEXT BOOKS	
1.	Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L.(2015), Internet of Things. IoT Infrastructures, Springer International Publication
2.	ArsheepBahg, Vijay Madisetti(2015), Internet of Things: A Hands-On Approach Paperback – 2015, by
REFERENCE BOOKS	
1.	Hanes David (Author), Salgueiro Gonzalo (Author), Grossetete Patrick (Author), Barton Rob (2017), IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things by Pearson Paperback.
E BOOKS	
1.	https://www.routledge.com/Introduction-to-Industrial-Internet-of-Things-and-Industry-40/Misra-Roy-Mukherjee/p/book/9780367897581
2.	http://alvarestech.com/temp/InternetOfThings/Kepware-Industrial-IOT-eBook.pdf
MOOC	
1.	https://www.coursera.org/specializations/developing-industrial-iot

COURSE TITLE	**IOT APPLICATION DEVELOPMENT USING MOBILE PHONE**	**CREDITS**	**3**

COURSE CODE		EEC4371	COURSE CATEGORY	DE	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	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 the latest microcontrollers with application development, product design and prototyping.
Course Objective	1.Understand the concepts of embedded system design and analysis 2.Learn the architecture and programming of ARM processor 3.Be exposed to the basic concepts of IoT Application 4.Learn the real time operating systems
Course Outcome	Upon completion of this course, the students will be able to 1. Describe microcontroller classification, programming techniques, usage of compiler tools for Arduino based development environment 2.Comprehend the programming skills using Arduino software/IDE in windows/ linux platforms. Able to write C program solve the given problem 3.Develop programming skills to program Arduino Uno board (Atmega238) using Arduino IDE 4.Design, Interface and program a temperature interface, serial interface, Bluetooth communication, L298 Motor driver interface & LCD interface using Node MCU 5 Apply compiler tools for Blynk IoT development environment and write Arduino Program to solve the given problem

Prerequisites: Signals & 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	PSO 3
CO-1	3	3	2	2	2	-	-	-	-	-	-	-	1	2	1
CO-2	3	3	2	2	3	-	-	-	-	-	-	-	1	2	1
CO-3	3	3	2	2	3	-	-	-	-	-	-	-	1	2	1
CO-4	3	3	2	2	3	-	-	-	-	-	-	-	1	2	1
CO-5	3	3	3	2	3	-	-	-	-	-	-	-	1	2	1

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

MODULE 1: EMBEDDED SYSTEM- OVERVIEW (9L)

Characteristics of an Embedded System– Basic Structure of an Embedded System- Embedded System Architecture- Embedded System Tools and Peripherals. **Suggested Readings:** 1. The 8051 Microcontroller and Embedded Systems: 2. Overview of Embedded OS	**CO-1 BTL-3**

MODULE 2: ARDUINO – BASICS, ARDUINO – PROGRAM STRUCTURE (2L+6P)

Arduino Overview– Board Types– Arduino Board Description- Arduino Program Structure- Functions and Values - Arduino Time function - Arduino communication– Arduino – Pulse Width Modulation **Suggested Readings** 1. *basic structure* of *Arduino programs* 2. System-on-*Chip* Design with *Arm* Cortex-M *Processors*	**CO-2** **BTL-3**
MODULE 3 :INTRODUCTION TO ARDUINO UNO INTERFACING TECHNIQUES (2L+6P)	
Blinking an LED – Fading an LED - Reading Analog Voltage – Serial communication using Software serial. **Suggested Readings:** 1 *Interface* with the display units such as LED or LCD 2. Networking Basics and Socket Programming	**CO-3** **BTL-2**
MODULE 4: Node MCU (2L+6P)	
Temperature Sensor Interfacing (LM35) - Bluetooth Interfacing (HC05)- Motor driver Interfacing (L298) - LCD Interfacing (HD44780). **Suggested Readings:** SP8266 *NodeMCU reads* in temperature & relative humidity	**CO-4** **BTL-2**
MODULE 5: IMPLEMENTATION OF IoT using BLYNK (2L+11P)	
Blynk basics – Installation and Activation - Blinking an LED -Reading Analog Voltage - LCD Interfacing (HD44780) **-** Project **Suggested Readings:** 1. *Blynk application* on Android 2. Mobile APP development for IOT 3hrs Th	**CO-5** **BTL-2**

TEXT BOOKS	
1.	Ashok Kamthane, (2007),ITL Education Solution Limited,—Computer Programming‖, Pearson Education Inc.
REFERENCE BOOKS	
1.	Blum - Arduino Programming, Pearson, 1st Edition, 2015
2.	SaiYamanoor (2017), - Python Programming with Raspberry Pi, Packt Publishing, Edition: 1.
E BOOKS	
1.	https://www. /Real-Time-Embedded-Systems-Principles-Engineering-ebook/dp/B00UFGXJNY
MOOC	
1.	https://www.coursera.org/specializations/real-time-embedded-systems

COURSE TITLE	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS			CREDITS	3
COURSE CODE	EEC4451	COURSE CATEGORY	DE	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	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	The course is designed to make the students conversant with the renewable energy technologies.
Course Objective	1. Gain knowledge about the stand alone and grid connected renewable energy systems 2. Discover the importance of power converters for renewable energy applications. 3. Learn the importance of various operating modes of wind electrical generators and solar energy system 4. To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems 5. Acquire the importance of maximum power point tracking algorithms.
Course Outcome	Upon completion of this course, the students will be able to 1. Examine the various types of renewable energy sources 2. Acquiring the knowledge about the performance of IG, PMSG, SCIG and DFIG 3. Fabricate different power converters namely AC to DC , DC to DC and AC to AC converters for renewable energy sources 4. Analyze various operating modes of wind electrical generators and solar energy system 5. Apply maximum power point tracking algorithms Gain the knowledge about various grid integrated 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	PSO 3
CO-1	2	3	2	3	2	-	-	-	-	-	-	-	-	1	2
CO-2	2	3	2	3	2	-	-	-	-	-	-	-	-	1	2
CO-3	2	3	2	3	2	-	-	-	-	-	-	-	-	1	2
CO-4	2	3	2	3	2	-	-	-	-	-	-	-	-	1	2
CO-5	2	3	2	3	2	-	-	-	-	-	-	-	-	1	2

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

MODULE I: INTRODUCTION	(9L)
Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different	CO-1 BTL-2

renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems. **Suggested Reading:** Operation of power plants	
MODULE II: ELECTRICAL MACHINES FOR RENEWABLEENERGY CONVERSION	**(9L)**
Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG. **Suggested Reading:** DC & AC Machines	**CO-2** **BTL-2**
MODULE III: POWER CONVERTERS	**(9L)**
Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters(inversion-mode) - Boost and buck-boost converters-selection of inverter, battery sizing, array sizing Wind: three phase AC voltage controllers-AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters. **Suggested Reading:** semiconductor devices characters	**CO-3** **BTL-3**
MODULE IV: ANALYSIS OF WIND AND PV SYSTEMS	**(9L)**
Standalone operation of fixed and variable speed wind energy conversion systems and solar system Grid Connection Issues -Grid integrated PMSG and SCIG Based WECS-Grid Integrated solar system **Suggested Reading:** Grid systems	**CO-4** **BTL-2**
MODULE V: HYBRID RENEWABLE ENERGY SYSTEMS	**(9L)**
Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV-Maximum Power Point Tracking (MPPT). **Suggested Reading:** Hybrid systems	**CO-5** **BTL-2**

TEXT BOOKS	
1.	Rai, G.D. (2015). *Non-Conventional Energy Sources*, Khanna Publishers, second edition.
2.	Gary, L. Johnson (2001) *Wind energy system*, prentice hall inc.
3.	Rashid .M. H (2001) *Power electronics Hand book*, Academic press, 2001.
4.	Ramesh R, Kurnar K.U. (2017) *Renewable Energy Technologies*, Narosa Publishing House, New Delhi.
REFERENCE BOOKS	
1.	B.H.Khan (2012) *Non-conventional Energy sources*, Tata McGraw-hill Publishing Company, New Delhi.
2.	S. Heir (2002). *Grid Integration of WECS*,J ohn Wiley & Sons
3.	Ion Boldea (2006) *Variable speed generators*, Taylor & Francis group.
E BOOKS	
1.	https://books.google.co.in/books?isbn=0215521137
2.	https://books.google.co.in/books?isbn=0128132175
MOOC	
1.	https://www.mooc-list.com/course/wind-resources-renewable-energies-coursera
2.	https://www.edx.org/course/solar-energy
3.	https://www.renewableenergyworld.com/geothermal-energy/tech.html

COURSE TITLE		POWER SYSTEM AND SMART GRID			CREDITS	3
COURSE CODE		EEC4452	COURSE CATEGORY	DE	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	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	To enable the students acquire knowledge on smart grid, different options of architectural design and communication technology for various aspects of smart grid, system analysis and stability analysis in smart grid, renewable energy sources and storage integration with smart grid
Course Objective	1. To introduce students to the basic concepts of power systems and electricity markets 2. To impart knowledge on the various aspects of the smart grid, including, technologies, components, architectures and applications. 3. To impart knowledge about the significant characteristics of smart grid 4. To familiarize the basic components and appropriate traits of smart grid 5. To impart knowledge about the various communication and measurement technologies in smart grid
Course Outcome	Upon completion of this course, the students will be able to 1. Illustrate the economic fundamentals of power systems and electricity markets 2. Demonstrate the concepts of various components of Smart Grid, and their impacts on the energy industry, including renewable integration, demand side management, and greenhouse gas (GHG) emissions reductions 3. Describe the basic components and anticipated features of power grid 4. Enlighten the impact of smart grids on reliability and emission reduction 5. Illustrate the communication infrastructure of smart grid.

Prerequisites: Power System Protection & Control, Power 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	PSO 3
CO-1	3	3	1	3	3	-	1	-	-	-	-	-	3	3	3
CO-2	3	3	1	3	3	-	-	-	-	-	-	-	3	3	3
CO-3	3	3	1	3	3	-	1	-	-	-	-	-	3	3	3
CO-4	3	3	1	3	3	-	1	-	-	-	-	-	3	3	3
CO-5	3	3	1	3	3	-	1	-	1	-	-	-	3	3	3

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

MODULE 1: SUPPLY SIDE AND DEMAND SIDE OF ELECTRICITY (9L)

Basics of electricity- Fossil fuel and hydro power plants- Renewable and alternative energy- Supply curve- Load characteristics- Load curve and load duration curve- Demand side management- Plug-in hybrid vehicles and smart appliances **Suggested Reading:** TNEB Demand supply handbook	**CO-1** **BTL-3**
MODULE 2: TRANSMISSION AND DISTRIBUTION NETWORKS (9L)	
Physical laws of electricity; AC vs. DC Power flow- Optimal power flow and unit commitment models- Distribution network basics **Suggested Reading:** Demand Side Management in India: Technology Assessment	**CO-2** **BTL-4**
MODULE 3: BASIC ELEMENTS AND DESIRABLE TRAITS OF SMART GRID (9L)	
The origin of power grid – dependency on power grid – desirable features of power grid- reliability – security –economic –efficiency –environmental friendly – safety. **Suggested Reading:** Smart Grid: Concepts and Deployment	**CO-3** **BTL-4**
MODULE 4: KEY CHARACTERISTICS OF SMART GRID (9L)	
Demand-side participation- Impacts of Smart Grid on reliability- Impacts of Smart Grid on air pollutant emissions reduction. Conformal mapping **Suggested Reading:** A Roadmap to Tamil Nadu's Electricity Demand-Supply by 2050	**CO-4** **BTL-4**
MODULE 5: ISSUES RELATED TO SMART GRID (9L)	
Communication and sensing in a smart grid- smart grid threats-vulnerabilities-cyber security strategies. **Suggested Reading:** Smart grid Challenges	**CO-5** **BTL-4**

TEXT BOOKS	
1.	D. S. Kirschen and G Strbac (2009) *Fundamentals of Power System Economics*, Reprinted edition. John Wiley & Sons Ltd.
2.	G. M. Masters (2004) *Renewable and Efficient Electric Power Systems*, John Wiley & Sons, Inc.
REFERENCE BOOKS	
1.	S.Stoft (2002) *Power System Economics: Designing Markets for Electricity*, Wiley-Interscience.
2.	A.Mazer (2007) *Electric Power Planning for Regulated and Deregulated Markets*, John Wiley & Sons, Inc, second edition.
E BOOKS	
1.	https://www.smartgrid.gov/files/sg_introduction.pdf
2.	https://www.tandfonline.com/doi/full/10.1080/15325008.2013.868558
MOOC	
1.	https://nptel.ac.in/courses/108/107/108107113/
2.	https://nptel.ac.in/courses/108/107/108107143/
3.	https://www.mooc-list.com/course/smart-grids-electricity-future-edx

COURSE TITLE	**INDUSTRIAL AUTOMATION**			**CREDITS**	**3**
COURSE CODE	**EEC4453**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-0**
Versio	**1.**	**Approval Details**	**23 ACM, 06.02.2021**	**LEARNING LEVEL**	**BTL-4**

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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 automation is the use of control devices such as PLCs/PACs etc. to control industrial processes and machinery by removing as much labor intervention as possible, and replacing dangerous assembly operations with automated ones. Industrial automation is closely linked to control engineering. This course is tailor made to accommodate learning Automation and controls with knowledge of industrial safety , International acts and standards.
Course Objective	1. To Understand the Automation process in Industries 2. To Able to make program for real time situations 3. To Able to control the process from remote places
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the fundamental industrial automation techniques and architectures adopted in Industry. 2. Familiarize with various types of process control concepts. 3. Formulate and design a process control equipment housing various sensors used in the process industry. 4. Apply standard industrial safety & precautions. 5. Apply the International Industrial Acts and standards.

Prerequisites: EEB4101 -Introduction to 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	PSO 3
CO-1	3	3	3	3	1	-	-	-	-	-	-	-	1	3	1
CO-2	3	3	3	3	1	-	-	-	-	-	-	-	1	3	1
CO-3	3	3	3	3	1	-	-	-	-	-	-	-	1	3	1
CO-4	2	3	3	1	1	-	-	-	-	-	-	-	1	2	3
CO-5	2	3	3	1	1	-	-	-	-	-	-	-	1	2	3

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

MODULE 1: INTRODUCTION TO INDUSTRIAL AUTOMATION (9L)	
Introduction to Industrial Automation & Control. Role & benefits of Automation in Industry. Common Process variables. Common Process Measurements. Architecture of Industrial Automation Systems. Temperature, Pressure and Force, Displacement and speed measurement, Flow measurement techniques, Signal Conditioning and Processing. **Practical component:** Architecture of Industrial Automation Systems **Suggested Readings:** Evolution of Industrial Automation	**CO-1** **BTL-2**
MODULE 2: INTRODUCTION TO PROCESS CONTROL (12L)	
Proportional Controllers, Integral Controllers, Derivative Controllers, Controller Tuning. Implementation of PID Controllers. Special Control Structures:Feed forward and Ratio Control. Special Control Structures: Predictive Control, Control of Systems with Inverse Response .	**CO-2** **BTL-2**

Introduction to Sequence Control, PLCs and Relay Ladder Logic. Pneumatic Control Systems: Controllers and Integrated Control Systems. **Practical component:** 1) Develop a ladder program for DOL starter 2) Develop an application using On-Delay timer 3) Develop an application using OFF Delay Timer 4) Develop an application using UP/DOWN counter **PID Simulator** https://instrumentationtools.com/pid-simulator-download/ **Suggested Readings:** Advances in Process control Techniques, and Applications	
MODULE 3: MEASUREMENT OF PARAMETERS (12L)	
Voltage & Current Transducers, Frequency Transducers, Temperature, Pressure & Flow Measurements, Power Transducers. Implementation of transducer measurements & calibration. Solenoid Valves. Control valves. Introduction to Actuators. Pumps & Motors. Electrical Drives Relays & Contactors **Practical component:** Matlab Simulink & tools. https://www.mathworks.com/help/physmod/hydro/valves-hyd.html **Suggested Readings:** Best practices for implementation of sensor based control system.	**CO-3** **BTL-3**
MODULE 4: INDUSTRIAL SAFETY & PRECAUTIONS (6L)	
Objective of industrial safety. Personal safety & Safety Equipments Electrical Safety Gas safety. Fire safety. Work Discipline. Maintenance of Registers & Log Books **Suggested Readings:** Personal safety & Safety Equipment's schemes	**CO-4** **BTL-2**
MODULE 5: INTERNATIONAL ACTS AND STANDARDS (6L)	
Occupational Safety and Health act of USA (The Williames -Steiger Act of 11270) – Health and safety work act (HASAWA 11274, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI). **Suggested Readings:** International standards and recommended practices	**CO-5** **BTL-2**
TEXT BOOKS	
1.	Singh, S. K. (2009). *Process Control: Concepts Dynamics and Applications*. India: Prentice-Hall Of India Pvt. Limited.
REFERENCE BOOKS	
1.	*Instrument Engineers' Handbook, Volume Two: Process Control and Optimization*. (2018). United Kingdom: CRC Press.
2.	Orakhelashvili, A. (2008). *The Interpretation of Acts and Rules in Public International Law*. United Kingdom: OUP Oxford.
E BOOKS	
1.	https://www.ee.iitb.ac.in/web/academics/courses#EE302
MOOC	
1.	http://coep.vlab.co.in/?sub=33&brch=97
2.	https://instrumentationtools.com/pid-simulator-download/
3.	https://www.mathworks.com/help/physmod/hydro/valves-hyd.html

COURSE TITLE		DISTRIBUTED GENERATION AND MICRO-GRIDS			CREDITS	3
COURSE CODE		EEC4454	COURSE CATEGORY	DE	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	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	Enable the students to develop skills to assess performance of distributed generation and its impact on the grid.
Course Objective	1. To assess the need of DG sources and their appropriate placement in the power system. 2. To make a comprehensive study about different types of renewable sources as DGs 3. To understand the concepts of grid integration ,interfaces and impact of DG upon power system. 4. To know the importance of power quality and reliability in DER. 5. To evaluate energy storage and control techniques for DER integration.
Course Outcome	Upon completion of this course, the students will be able to 1. Comment about the current scenario of Distributed Generation and the need to implement DG sources. 2. Investigate the different types of RES as DGs. 3. Appraise the grid integration ,interfaces and technical impacts of DGs upon transmission and distribution systems 4. Analyze the aspects of Power Quality and Reliability. 5. Choose different types of Storage systems based on application.

Prerequisites: Transmission and Distribution, Power System Analysis

CO, PO AND PSO MAPPING

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

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

MODULE 1: INTRODUCTION , PLACING AND SIZING THE DISTRIBUTED ENERGY RESOURCES (9L)

Need for Distributed generation, renewable sources in distributed generation, current	**CO-1**

scenario in Distributed Generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems. **Suggested Reading:** Detailed study of Renewable Energy Sources **,** Siting and Sizing of DGs using ETAP	**BTL-3**
MODULE 2: RENEWABLE ENERGY SOURCES	**(9L)**
Wind Power-Photovoltaic and Thermo-solar power-Biomass Power, Fuel cells types, types of Tidal power generation schemes, mini and micro hydro power schemes. **Suggested Reading:** Micro turbines for DG, bulb and tubular turbines-	**CO-2** **BTL-2**
MODULE 3: GRID INTEGRATION , INTERFACES AND IMPACTS OF DGS	**(9L)**
Grid integration of DGs – Different types of interfaces - Inverter based DGs - Aggregation of multiple DG units. – Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying **Suggested Reading:** Rotating machine based interfaces	**CO-3** **BTL-3**
MODULE 4: POWER QUALITY AND RELIABILITY IN DER (9L)	
Voltage control techniques, Reactive power control, Harmonics, Power quality issues. Reliability of DG based systems – Steady-state and Dynamic analysis. **Suggested Reading:** Various aspects of Operations	**CO-4** **BTL-3**
MODULE 5: ENERGY STORAGE AND CONTROL TECHNIQUES (9L)	
Energy Storage for use with Distributed Generation-Battery Storage, Capacitor Storage, ultra-capacitors and Mechanical Storage: Flywheels, Pumped and Compressed Fluids. Control Techniques for DER integration systems- Standards and codes for interconnection- future structure of grid. **Suggested Reading:** Various aspects such as Market Management Retailing , Trading and Ancillary Services	**CO-5** **BTL-3**

TEXT BOOKS	
1.	H. Lee Willis & Walter G. Scott (2000). *Distributed Power Generation*, *Planning & Evaluation*,. CRC Press Taylor & Francis Group.
2.	Godfrey Boyle (2004), *Renewable energy power for a sustainable future*, Oxford University Press in association with the Open university.
3.	Godoy Simoes, Felix A.Farret (2004), *'Renewable Energy Systems – Design and Analysis with Induction Generators* ', CRC press.
REFERENCE BOOKS	
1.	Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson(2005) '*Facility Microgrids'*, Subcontract report.
2.	Mohammad Shahid ehpour, M. Alomoush,(2001) *Restructured Electrical Power Systems: Operation: Trading, and Volatility*, CRC Press.
3.	N. Jenkins, J.B. Ekanayake and G. Strbac,(2010) *Distributed Generation*, The Institution of Engineering and Technology.
E BOOKS	
1.	https://pdfcoffee.com/distributed-generation-pdf-free.html
2.	https://digital-library.theiet.org/content/books/po/pbrn006e
MOOC	
1.	https://www.coursera.org/lecture/electric-power-systems/smart-grid-the-environment-aH8g0
2.	https://onlinecourses.nptel.ac.in/noc19_ee64/preview
3.	https://www.edx.org/course/solar-energy-integration-of-photovoltaic-systems-i

COURSE TITLE		SMART GRID AND IOT			CREDITS	3
COURSE CODE		EEC4455	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	23 ACM, 06.02.2021	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	The course provides a platform for deep understanding of smart features of an electric grid. This course provides knowledge about ▪ Smart electric power grids, including definition, design criteria, technology and IoT. Information processing and communications to the power grid.
Course Objective	This course provides knowledge about 1. Smart electric power grids, including definition, design criteria, technology and IoT. 2. Information processing and communications to the power grid. Understanding the development of the smart grid, 3.Smart grid design, implementation, evaluation and management of smart electricity infrastructure.
Course Outcome	Upon completion of this course, the students will be able to 1. Select suitable technologies for smart grid 2. Select appropriate smart sensors, communication technology, network structures for smart grid. 3.Apply Intelligent Monitoring Devices, Wide Area monitoring system, SCADA and GIS to monitor Smart Grid 4. Apply Multi-agent technology for Smart Grid operation and control 5. Apply IoT architecture, Data Analytics, Artificial Intelligence and Machine Learning to Smart Grid application

Prerequisites: Power System 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	PSO 3
CO-1	3	3	2	2	2	-	-	-	-	-	-	-	-	1	3
CO-2	3	3	2	2	3	-	-	-	-	-	-	-	-	1	3

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

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

Module I:- INTRODUCTION TO SMART GRID (9L+1T)	
Smart Grids: Smart grid landscape and its characteristics; smart grid architecture; Smart grid scenario in Indian power sector	**CO-1 BTL-3**
Module II:- SMART GRID TECHNOLOGIES (9L+1T)	
Information and Communication Technology: Smart sensors, Wired and wireless communication Technology, Network Structures (HAN, LAN, NAN, WAN); Smart sensors, Smart Metering and advanced metering infrastructure (AMI)	**CO-2 BTL-4**
Module III:- MONITORING SMART GRID (9L+1T)	
Intelligent Electronic Devices (IED), wide-area monitoring system (WAMS), SCADA, Phasor Measurement Units s, Geographical Information System; Penetration of Clean Energy Technologies; Storage Technology, Geomagnetic Storms as Generators, Near space power generation, Electric Vehicle Technology ; Power electronics and power quality in Smart grid	**CO-3 BTL-4**
Module IV:- COMMUNICATION TECHNOLOGIES IN SMART GRID (9L+1T)	
Multi-agent technology in Smart grid; Superconducting Technologies- Superconducting power cables, Wireless Power Transmission technology; Smart grid operation & control, self-healing, Resilience, E-Commerce of Electricity, Case study on substation automation; Micro grid: Integration of distributed energy sources, operation, control and protection of Micro grid, Overview of generation, transmission and distribution automation.	**CO-4 BTL-4**
Module V:- IOT IN SMART GRID (9L+1T)	
IoT Architecture and its application; Introduction to cloud computing and edge computing application in smart grid, Standards for Information Exchange - Data Security methods; Embedded web servers, Energy Data Analytics in the Smart Grid-Sources , Characteristics, Need, Tools, and Challenges; Artificial Intelligence, Machine Learning and M2M applications in Smart grid applications	**CO-5 BTL-4**

TEXT BOOKS

1.	Ali Keyhani (2016), “Design of Smart Power Grid Renewable Energy Systems”, John Wiley & Sons, IEEE Press.
2.	James Momoh (2012), “Smart Grid - Fundamentals of Design and Analysis”, John Wiley & Sons, IEEE Press.
3.	Janaka Ekanayake, N. Jenkins, K. Liyanage, J. Wu, Akihiko Yokoyama (2015), “Smart Grid: Technology and Applications”, Wiley.
4.	Andres Carvello, John Cooper (2015), “The Advanced Smart Grid”, ARTECH House.

REFERENCE

1	White paper (2017) “Big Data Analytics, Machine Learning and Artificial Intelligence in the Smart Grid: Introduction, Benefits, Challenges and Issues”.
2	IEEE Power and Energy magazine, (2019)

EBOOK

1	https://www.pdfdrive.com/smart-grid-e28246234.html
2	https://www.pdfdrive.com/smart-grid-e33586478.html
3	http://e4uhu.com/down/smart%20grid%20technology/JanakaGrid.pdf

MOOCS	
1	NPTEL :: Electrical Engineering - NOC:Introduction to Smart Grid
2	https://onlinecourses.nptel.ac.in/noc21_cs17/

COURSE TITLE	EMBEDDED SYSTEMS FOR ELECTRIC AND HYBRID VEHICLES			CREDITS	3
COURSE CODE	EEC4456	COURSE CATEGORY	PC	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	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 provides an overview of embedded system for EV fundamentals. It describes the fundamentals of the operation, diagnosis, and repair of electric and hybrid vehicles.
Course Objective	1. To understand the need of embedded system of EVs 2. To understand the concept of electric traction.
Course Outcome	Upon completion of this course, the students will be able to 1. Compare the performance and characteristics of hybrid and electric vehicles. 2.Analyze the concepts, topologies and power flow control of electric traction systems. 3. Choose the appropriate drive system for the control of various hybrid electric vehicles 4. Select appropriate power train electronic system and chasis control system 4.Design control area network for Electric Vehicles.

Prerequisites: ESB4201 Electromagnetic Theory

CO, PO AND PSO MAPPING

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

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

MODULE 1 – INTRODUCTION HYBRID AND ELECTRIC VEHICLES (9L)	
History of hybrid and electric vehicles, social and environmental importance of hybrid and	CO-1

electric vehicles, impact of modern drive-trains on energy supplies. Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. Suggested Reading: Future prospectus of hybrid and electric vehicles Applications: Modern hybrid vehicles	**BTL-3**
MODULE 2 – ELECTRIC TRACTION SYSTEMS (9L)	
Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Basic concepts of electric traction, introduction to various electric drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Suggested Reading: https://link.springer.com/chapter/10.1007/978-3-642-30281-7_2 (Railway traction system)	**CO-2** **BTL-4**
MODULE 3 – HYBRID ELECTRIC MOTOR DRIVES (9L)	
Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.	**CO-3** **BTL-4**
MODULE 4 – AUTOMOTIVE POWERTRAIN ELECTRONIC SYSTEMS & CHASSIS CONTROL SYSTEMS (9L)	
Power train electronic systems: sensors and actuators- electronic control units-engine management-electronic ignition systems-engine management systems for diesel and petrol injection systems. Transmission systems: sensors, actuators & control-chassis and body electronic systems: sensors and actuators for chassis and body systems. Comfort and control systems: HVAC-engine cooling-vehicle security-driver comfort and assistance-signalling and vision- safety system Chassis control systems: ABS-ESP-TCS-ACC-active suspension system. Automatic transmission- X–by–wire systems – automotive alarm systems - vehicle immobilization & deactivation - driver information systems - parking systems - central locking system and electric windows. Occupants and driver safety systems: Seat belt lighteners and air–bags-fault tolerant schemes.ADAS and Autonomous Vehicles.	**CO-4** **BTL-4**
MODULE 5 – VEHICULAR NETWORKS (9L)	
Controller Area Networks (CAN) - field of application- physical layer and bit coding-frame types and format-Bit stuffing and synchronization- error management. Overview of other communication protocols: LIN-Flex ray	**CO-5** **BTL-4**
TEXT BOOKS	
1.	Sira -Ramirez, R. Silva Ortigoza (2016), 'Control Design Techniques in Power Electronics Devices', Springer.
2.	Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse (2016), 'Sliding mode control of switching Power Converters', CRC Press.
3.	William Ribbens (2017), "Understanding Automotive Electronics – An Engineering Perspective", Eighth Edition, Butterworth Heinemann.
4.	Tom Denton (2012), "Automobile Electrical and Electronic Systems", Fourth Edition, Routledge.
REFERENCE BOOKS	

1.	Bimal Bose (2006), 'Power electronics and motor drives', Elsevier.
2.	Ion Boldea and S.A Nasar (2015), 'Electric drives', CRC Press.
	Dominique Paret (2017), "Multiplexed Networks for Embedded Systems: CAN, LIN, FlexRay, Safe–by–Wire", Wiley, First Edition.
E BOOKS	
1.	https://www.elsevier.com/books/electric-and-hybrid-vehicles/pistoia/978-0-444-53565-8 (**eBook ISBN:** 9780444535665)
2.	https://onlinelibrary.wiley.com/doi/book/10.1002/9781119998914 Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives
MOOC	
1.	https://www.edx.org/course/electric-cars-introduction