GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

Curriculum and Syllabi For

B.E. (ELECTRICAL AND ELECTRONICS ENGINEERING)

(Full Time)

2016

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY

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GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)

Coimbatore – 641 013.

VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind.

MISSION

- To achieve academic excellence through innovative teaching and learning practices
- To enhance employability and entrepreneurship
- To improve the research competence to address societal needs
- To inculcate a culture that supports and reinforces ethical and professional behaviours for a harmonious and prosperous society

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

GOVERNMENT COLLEGE OF TECHNOLOGY

VISION AND MISSION OF THE DEPARTMENT

VISION:

To be a premier department providing value based and enlightening education committed to excellence in Electrical Engineering and Technology professions

MISSION:

- To facilitate quality learning blended with practical engineering skills.
- To prepare students to develop all round competitiveness.
- To motivate Faculty and students to do impactful research on societal needs.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

GOVERNMENT COLLEGE OF TECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Programme Educational Objectives (PEOs) of the department program in tune with the Vision and Mission of the department are:

PEO 1:

To prepare the students to excel in imbibing the concepts of higher education To impart the basic science and mathematical foundations, as also the principles and technological advancements made in Electrical and Electronics Engineering and allied Fields

PEO 2:

To induce the students to design electrical, electronic and computing systems that are innovative and socially acceptable

PEO 3:

To motivate the students to exhibit professionalism, ethics, communication skills and team work To motivate them to adapt to current trends through lifelong learning To motivate the students and faculty to do useful and application oriented research

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and Modern Engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Electrical and Electronics Engineering Graduates will be able to:

PSO1: Apply the knowledge of Mathematics and Science in Electrical and Electronics Engineering and adapt to a challenging environment through individual and team work.

PSO2: Design, analyze and evaluate the performance of Electrical system using latest tools and gain sufficient competence to solve the problems in the energy sector with future perspective considering socio-economic aspects.

PSO3: Develop the expertise in the technology for efficient operation and control of Electrical system with ethical responsibility and effective communication to engage in lifelong learning for a successful career.

B.E.ELECTRICAL AND ELECTRONICS ENGINEERING

CBCS 2016 REGULATIONS

FIRST SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16EHS1Z1	Communication Skills in English	HS	50	50	100	2	2	0	3
2	16EBS1Z2	Engineering Mathematics I	BS	50	50	100	3	2	0	4
3	16EBS103	Engineering Physics	BS	50	50	100	3	0	0	3
4	16EBS104	Applied Chemistry	BS	50	50	100	3	0	0	3
5	16EES105	Basics of Civil and Mechanical Engineering	ES	50	50	100	3	0	0	3
		PRACTICAL								
6	16EBS106	Chemistry Lab	BS	50	50	100	0	0	4	2
7	16EES107	Workshop Practice	ES	50	50	100	0	0	4	2
		TOTAL		350	350	700	14	4	8	**20**

SECOND SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16EHS2Z1	Technical English	HS	50	50	100	2	2	0	3
2	16EBS2Z2	Engineering Mathematics II	BS	50	50	100	3	2	0	4
3	16EBS2Z3	Materials Science	BS	50	50	100	3	0	0	3
4	16EHS2Z4	Environmental Science and Engineering	HS	50	50	100	3	0	0	3
5	16EES2Z5	Programming in C	ES	50	50	100	3	0	0	3
6	16EES206	Engineering Mechanics	ES	50	50	100	3	2	0	4
		PRACTICAL								
7	16EBS207	Physics Laboratory	BS	50	50	100	0	0	4	2
8	16EES208	Engineering Graphics	ES	50	50	100	2	0	4	4
9	16EES2Z9	Programming in C Laboratory	ES	50	50	100	0	0	4	2
		TOTAL		450	450	900	19	6	12	**28**

THIRD SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16EBS3Z1	Engineering Mathematics III	BS	50	50	100	3	2	0	4
2	16EPC302	Field Theory	PC	50	50	100	2	2	0	3
3	16EPC303	Electric Circuit Theory	PC	50	50	100	2	2	0	3
4	16EPC304	Electronic Circuits – I	PC	50	50	100	2	2	0	3
5	16EES305	Thermal Engineering and Fluid Mechanics	ES	50	50	100	4	0	0	4
6	16EES306	Object Oriented Programming and Data structures	ES	50	50	100	3	0	0	3
		PRACTICAL								
7	16EPC307	Circuits and Electronic Devices Lab	PC	50	50	100	0	0	4	2
8	16EEC308	Object Oriented Programming using C++ Lab	EEC	50	50	100	0	0	4	2
9	16EES309	Thermal Engineering and Fluid Mechanics Lab	ES	50	50	100	0	0	4	2
Total				450	450	900	16	8	12	**26**

FOURTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16EBS401	Numerical Methods	BS	50	50	100	3	2	0	4
2	16EPC402	Network Analysis and Synthesis	PC	50	50	100	2	2	0	3
3	16EPC403	DC Machines and Transformers	PC	50	50	100	2	2	0	3
4	16EPC404	Electronic Circuits – II	PC	50	50	100	3	0	0	3
5	16EPC405	Digital Circuits	PC	50	50	100	2	2	0	3
6	16EPC406	Electrical and Electronic Measurements	PC	50	50	100	3	0	0	3
		PRACTICAL								
7	16EPC407	Analog and Digital IC Laboratory	PC	50	50	100	0	0	4	2
8	16EPC408	Electrical Machines Laboratory – I	PC	50	50	100	0	0	4	2
9	16EEC409	Communication Skills Laboratory	EEC	50	50	100	0	0	4	2
Total				450	450	900	15	8	12	**25**

FIFTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16EPC501	Power Generation	PC	50	50	100	3	0	0	3
2	16EPC502	Microprocessor, Microcontroller and applications	PC	50	50	100	3	0	0	3
3	16EPC503	Rotating AC Machinery and Special Machines	PC	50	50	100	2	2	0	3
4	16EPC504	Control Systems	PC	50	50	100	2	2	0	3
5	16EPC505	Transmission and Distribution	PC	50	50	100	3	0	0	3
6	16EOEXXX	Elective – I (OE)	OE	50	50	100	3	0	0	3
		PRACTICAL								
7	16EEC507	Skill Development Practice	EEC	100	-	100	0	0	4	2
8	16EPC508	Microcontroller And Processors Laboratory	PC	50	50	100	0	0	4	2
9	16EPC509	Electrical Machines Laboratory – II	PC	50	50	100	0	0	4	2
10	16EEC510	Presentation Skills and Technical Seminars	EEC	100	-	100	0	0	4	2
Total				600	400	1000	16	4	16	**26**

SIXTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16EPC601	Power Electronic devices and Circuits	PC	50	50	100	2	2	0	3
2	16EPC602	Power System Analysis	PC	50	50	100	2	2	0	3
3	16EPC603	Electrical Machine Design	PC	50	50	100	2	2	0	3
4	16EOEXXX	Elective – II (OE)	OE	50	50	100	3	0	0	3
5	16EPEXXX	Elective - III (PE)	PE	50	50	100	3	0	0	3
		PRACTICAL								
7	16EPC606	Control Engineering and Simulation Laboratory	PC	50	50	100	0	0	4	2
8	16EPC607	Power Electronics and Drives Laboratory	PC	50	50	100	0	0	4	2
9	16EEC608	Mini Project	EEC	100	-	100	0	0	8	4
Total				450	350	800	12	6	16	**23**

SEVENTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16EHS701	Industrial Management and Economics	HS	50	50	100	3	0	0	3
2	16EPC702	Protection and Switchgear	PC	50	50	100	3	0	0	3
3	16EOEXXX	Elective– IV (OE)	OE	50	50	100	3	0	0	3
4	16EPEXXX	Elective– V (PE)	PE	50	50	100	3	0	0	3
5	16EPEXXX	Elective– VI (PE)	PE	50	50	100	3	0	0	3
6	16EPEXXX	Elective– VII (PE)	PE	50	50	100	3	0	0	3
		PRACTICAL								
7	16EPC707	Advanced Measurements Laboratory	PC	50	50	100	0	0	4	2
8	16EPC708	Power System Laboratory	PC	50	50	100	0	0	4	2
Total				400	400	800	18	0	8	**22**

EIGHTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	16EEC801	Project Work	EEC	50	50	100	0	0	1	8
2	16EPEXXX	Elective – VIII (PE)	PE	50	50	100	3	0	0	3
3	16EPEXXX	Elective – IX (PE)	PE	50	50	100	3	0	0	3
Total				150	150	300	6	0	16	**14**

LIST OF PROFESSIONAL ELECTIVES

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
1	16EPEX01	Principles of Virtual Instrumentation	PE	50	50	100	3	0	0	3
2	16EPEX02	Neural And Fuzzy Systems	PE	50	50	100	3	0	0	3
3	16EPEX03	Power System Economics	PE	50	50	100	3	0	0	3
4	16EPEX04	Power Quality Engineering	PE	50	50	100	3	0	0	3
5	16EPEX05	HVDC Transmission System	PE	50	50	100	3	0	0	3
6	16EPEX06	Facts Controllers	PE	50	50	100	3	0	0	3
7	16EPEX07	Energy Auditing And Management	PE	50	50	100	3	0	0	3
8	16EPEX08	Automotive Electronics For Electrical Engineering	PE	50	50	100	3	0	0	3
9	16EPEX09	Power System Stability	PE	50	50	100	3	0	0	3
10	16EPEX10	Power System Operation And Control	PE	50	50	100	3	0	0	3
11	16EPEX11	Digital Signal Processing And Processors	PE	50	50	100	3	0	0	3
12	16EPEX12	Internet Of Everything	PE	50	50	100	3	0	0	3
13	16EPEX13	Principles Of Embedded Systems	PE	50	50	100	3	0	0	3
14	16EPEX14	Special Machines And Controllers	PE	50	50	100	3	0	0	3
15	16EPEX15	Logic And Distributed Control Systems	PE	50	50	100	3	0	0	3
16	16EPEX16	Industrial Drives And Control	PE	50	50	100	3	0	0	3
17	16EPEX17	Solid State Relays	PE	50	50	100	3	0	0	3
18	16EPEX18	Mems And Applications	PE	50	50	100	3	0	0	3
19	16EPEX19	Power Plant Instrumentation	PE	50	50	100	3	0	0	3
20	16EPEX20	Professional Ethics	PE	50	50	100	3	0	0	3
21	16EPEX21	Energy Storage Technology	PE	50	50	100	3	0	0	3
22	16EPEX22	Optimization Techniques	PE	50	50	100	3	0	0	3
23	16EPEX23	Computer System Architecture	PE	50	50	100	3	0	0	3
24	16EPEX24	Power Electronics Applications To Power System	PE	50	50	100	3	0	0	3

BS – Basic Science; HS – Humanities and Social Science;
ES – Engineering Sciences; PC – Professional Core; PE – Professional Elective;
OE – Open Elective; EE – Employability Enhancement Course;

LIST OF OPEN ELECTIVES OFFERED AT INSTITUTE LEVEL

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
1	16AOEX01	Nanoscience And Technology	OE	50	50	100	3	0	0	3
2	16AOEX02	Material Characterizations	OE	50	50	100	3	0	0	3
3	16AOEX03	Electrochemical Technology	OE	50	50	100	3	0	0	3
4	16AOEX04	Polymer Technology	OE	50	50	100	3	0	0	3
5	16COEX05	Disaster Management and Mitigation	OE	50	50	100	3	0	0	3
6	16COEX06	Environmental Management	OE	50	50	100	3	0	0	3
7	16COEX07	Town Planning and Architecture	OE	50	50	100	3	0	0	3
8	16MOEX08	Total Quality Management for Engineers	OE	50	50	100	3	0	0	3
9	16MOEX09	Composite materials	OE	50	50	100	3	0	0	3
10	16MOEX10	Automobile Engineering	OE	50	50	100	3	0	0	3
11	16EOEX11	Renewable Energy Sources and Technology	OE	50	50	100	3	0	0	3
12	16EOEX12	Smart Grid Technology	OE	50	50	100	3	0	0	3
13	16LOEX13	Principles of Communication	OE	50	50	100	3	0	0	3
14	16LOEX14	Microcontrollers and its applications	OE	50	50	100	3	0	0	3
15	16NOEX15	Industrial Automation Systems	OE	50	50	100	3	0	0	3
16	16NOEX16	Measurements and Instrumentation	OE	50	50	100	3	0	0	3
17	16SOEX17	Enterprise JAVA	OE	50	50	100	3	0	0	3
18	16SOEX18	Cyber Security	OE	50	50	100	3	0	0	3
19	16SOEX19	Network Essential	OE	50	50	100	3	0	0	3
20	16IOEX20	Programming in Python	OE	50	50	100	3	0	0	3
21	16IOEX21	BIG Data Science	OE	50	50	100	3	0	0	3
22	16IOEX22	Object Oriented Programming using C++	OE	50	50	100	3	0	0	3
23	16BOEX23	Computational Biology	OE	50	50	100	3	0	0	3
24	16BOEX24	Biology for Engineers	OE	50	50	100	3	0	0	3
25	16BOEX25	Fundamentals of Bio Engineering	OE	50	50	100	3	0	0	3

LIST OF ONE CREDIT COURSES

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
1	16EOC1Z1	Human Values –I	OC	100	-	100	1	0	0	1
2	16EOCX02	Human Values and Professional Ethics	OC	100	-	100	1	0	0	1
3	16EOCX03	Yoga and Youth Empowerment	OC	100	-	100	1	0	0	1
4	16EOCX04	Embedded Controllers	OC	100	-	100	1	0	0	1
5	16EOCX05	Wind Energy Conversion System	OC	100	-	100	1	0	0	1
6	16EOCX06	Practical Aspects of VAR control and Energy storage Devices	OC	100	-	100	1	0	0	1
7	16EOCX07	Electrical Wiring, Winding and Earthing, Repairing of Household Appliances	OC	100	-	100	1	0	0	1
8	16EOCX08	Simulation of Electrical Systems and control using DIGSILENT	OC	100	-	100	1	0	0	1
9	16EOCX09	Distributed Generation and its Impacts	OC	100	-	100	1	0	0	1
10	16EOCX10	Solar Power Plant-Design	OC	100	-	100	1	0	0	1
11	16EOCX11	Energy Conservation	OC	100	-	100	1	0	0	1
12	16EOCX12	Power System Planning	OC	100	-	100	1	0	0	1
13	16EOCX13	Power System Deregulation	OC	100	-	100	1	0	0	1
14	16EOCX14	Energy Policies	OC	100	-	100	1	0	0	1
15	16EOCX15	PCB Design and Fabrication	OC	100	-	100	1	0	0	1
16	16EOCX16	Home Automation	OC	100	-	100	1	0	0	1
17	16EOCX17	Electrical Safety	OC	100	-	100	1	0	0	1
18	16EOCX18	Plug-in Electric Vehicle	OC	100	-	100	1	0	0	1
19	16EOCX19	LVDC Systems	OC	100	-	100	1	0	0	1
20	16EOCX20	Study of Weather Monitoring System	OC	100	-	100	1	0	0	1

ONLINE COURSES:

1. Fundamentals of Electronic Materials and Devices
2. Electromagnetic Theory
3. Analog Circuits
4. Probability and Statistics
5. Networks & Systems

OPEN ELECTIVES FROM (EEE)

1. 16EOEX11 Renewable Energy Sources and Technology
2. 16EOEX12 Smart Grid Technology

SUMMARY OF CREDIT DISTRIBUTION

B.E / B.TECH												
S. No	Course Work Subject Area	Credits Per Semester								Total Credits	Credit Range	
		I	II	III	IV	V	VI	VII	VIII		Min	Max
1	HS	3	6	-	-	-	-	3	-	12	9	18
2	BS	12	9	4	4	-	-	-	-	29	28	36
3	ES	5	13	9	-	-	-	-	-	27	27	36
4	PC	-	-	11	19	19	13	7	-	69	54	72
5	PE	-	-	-	-	-	3	9	6	18	18	27
6	OE	-	-	-	-	3	3	3	-	9	9	18
7	EEC	-	-	2	2	4	4	-	8	20	18	27
	Total	20	28	26	25	26	23	22	14	184	162	234

BS – Basic Science ; HS – Humanities and Social Science ;

ES – Engineering Sciences ; PC – Professional Core ; PE – Professional Elective ;

OE – Open Elective ; EEC– Employability Enhancement Course ;

16EHS1Z1 **COMMUNICATION SKILLS IN ENGLISH** **Category : HS**

(Common to all branches)

L T P C
2 2 0 3

PREREQUISITES : NIL

COURSE OBJECTIVES:

- To make the learners understand the usage of basic grammar in English.
- To enhance the learner's speaking skills through appropriate listening practice.
- To instill reading habits to practice communicative tasks and comprehension
- To improve the learner's writing skills through various means
- To enrich the vocabulary of learners for speaking and writing

UNIT I **6+6 Periods**

Listening - Listening to practice basic pronunciation at phonemic and word level, Listening to informal conversations of exchanging greetings and introducing oneself/others; **Speaking**-Introducing oneself, one's family / friend, speaking about one's place; **Reading**-Reading to practice stress and pause; **Writing**-Autobiographical writing, Letter to seek permission, Letter to issue certificates; **Grammar**- Use of Auxiliary Verbs, Adjectives and Adverbs; **Vocabulary**-Word formation, Synonyms and Antonyms of High frequency words.

UNIT II **6+6 Periods**

Listening-Listening to Telephone Conversations for taking and leaving messages, making enquiries; **Speaking—**Role-play activities based on real life situations, Narrating daily routines; **Reading**–skimming and scanning, Reading for comprehension with exercises; **Writing**-Advertisements and slogan writing, Imperative instructions, Definitions; **Grammar** – Tenses, Prepositions; **Vocabulary**- Commonly confused words

UNIT III **6+6 Periods**

Listening -Listening to give instructions, Making requests and responding to requests, Thanking someone and responding to thanks; **Speaking** -Group Discussion on chosen topics, Describing a simple process; **Reading**-Reading and interpreting visual material, Critical reading; **Writing** –Letter to the Editor of a Newspaper, Recommendations; **Grammar**- Impersonal Passive, Subject-verb agreement; **Vocabulary**- Collocation, Word Association

UNIT IV **6+6 Periods**

Listening-Listening to accept/refuse invitation, Listening to apologize, Listening to congratulate; **Speaking** – Debates on current social affairs; **Reading** –Reading to make inference, Paraphrasing; **Writing**- Personal letter (Inviting your friend to a function, congratulating someone on his / her success, thanking one's friends / relatives); **Grammar** – 'Wh'-questions, Modal verbs; **Vocabulary** - Single word substitutes -Use of abbreviations & acronyms

UNIT V **6+6 Periods**

Listening -Video Listening to different accents, Viewing Speeches, Viewing English songs, Viewing short films; **Speaking** -Giving impromptu talks, Making presentations on given topics; **Reading** –Extensive reading; **Writing** –Writing General Article, Writing Short Stories; **Grammar** - Common Errors in English; **Vocabulary** –Word Pairs with Repetitive meaning.

Lecture: 30 Periods **Tutorial: 30 Periods** **Practical: 0 Periods** **Total: 60 Periods**

TEXT BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
Department of English, Anna University. Mindscapes	*English for Technologists and Engineers*	*Orient Blackswan, Chennai. 2012*
Sadanand, Kamlesh & Punitha, Susheela	*Spoken English: A Foundation Course (Part 1)*	*Orient Blackswan, Hyderabad. 2014*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Raman, Meenakshi & Sangeetha Sharma	*Technical Communication: Principles and Practice*	*Oxford University Press, New Delhi. 2011*
Vijay, Anbazhagan.J, & Jaishree.N	*Technical English-I*	*Global Publishers, Chennai, 2016*
Rizvi, Ashraf. M.	*Effective Technical Communication*	*Tata McGraw-Hill, New Delhi. 2005*
Rutherford, Andrea. J	*Basic Communication Skills for Technology*	*Pearson, New Delhi. 2001*
Redston, Chris, Cunningham, Gillie	*Face 2 Face: Elementary Student's Book*	*Cambridge University Press, New Delhi. 2009*

EXTENSIVE READING

(Not for Examination)

Kalam, Abdul.A.P.J Wings of Fire. Universities Press, Hyderabad. 1999.

Websites

1. http://www.usingenglish.com
2. http://www.uefap.com

COURSE OUTCOMES: Upon completion of the course, the students will be able to

CO1: The learner will be able to understand basic grammar and the learner will have sufficient command over language by training his tongue and tuning his ear through apt listening tasks.

CO2: Reading tasks will enable the learner practice phonological and linguistic aspect of learning, help comprehend and create interest in extensive reading.

CO3: The learner shall be able to write appropriately for a given context and use the right word at the right place.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	-	M	-	M	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	M	-	-	-	-	M	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	H	-	-	-	-	H
16EHS1Z1	-	-	M	-	M	M	-	-	-	H	M	-	-	-	H

L – Low, M – Moderate (Medium), H- High

16EBS1Z2 **ENGINEERING MATHEMATICS I** **Category : BS**

(Common to all branches)

L	T	P	C
3	2	0	4

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To familiarize techniques of matrix algebra including properties of eigen values and eigen vectors.
- To gain the knowledge of hyperbolic functions and application problems in differential calculus.
- To familiarize with functions of several variables and Functions of two variables including extremum problems, Jacobian and Leibnitz rule of integration.
- To perform double and triple integration with relevant to surface area and volume of solid.

UNIT I **MATRICES** **9+6 Periods**

Eigen values and Eigen vectors of a real matrix-Characteristic equation-Properties of Eigen values and eigen vectors-Cayley Hamilton theorem - Diagonalization of matrices-Reduction of a quadratic form to canonical form by orthogonal transformation-Nature of quadratic forms.

UNIT II **HYPERBOLIC FUNCTIONS AND DIFFERENTIAL CALCULUS** **9+6 Periods**

Hyperbolic and Inverse Hyperbolic functions-Identities- Real and Imaginary parts-Solving Problems using Hyperbolic functions.

Curvature and radius of curvature-Cartesian and polar coordinates- center of curvature and Evolutes- Envelopes and Evolute as envelope of normal.

UNIT III **FUNCTIONS OF SEVERAL VARIABLES** **9+6 Periods**

Functions of two variables- Taylor's theorem (statement only) and expansions-Maxima and Minima-Constrained extremum by Lagrange's multiplier method-Jacobians-Differentiation under integral sign

UNIT IV **INTEGRAL CALCULUS** **9+6 Periods**

Definite and Indefinite integrals-Substitution rule-Techniques of Integration-Integration by parts-Trigonometric substitutions-Integration of rational function by partial fractions-Integration of irrational functions-Improper integrals.

UNIT V **MULTIPLE INTEGRALS** **9+6 Periods**

Beta and Gamma integrals and properties. Double Integrals-Change of order of integration-Double integrals in polar coordinates-Area enclosed by plane curves-Triple integrals-Volume as a triple integral-Transformation to Polar, Cylindrical and Spherical polar coordinates.

Lecture: 45 Periods **Tutorial:30 Periods** **Practical: 0 Periods** **Total: 75 Periods**

TEXT BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
Veerarajan T	*Engineering Mathematics for Semesters I and II*	*Tata McGraw Hill Publishing Co., New Delhi, 2015.*
Kandasamy P, Thilagavathy K and Gunavathy K	*Engineering Mathematics for I year B.E/B.Tech.*	*S.Chand & Co, Ramnagar, New Delhi, Reprint2013.*
S. Narayanan and Manicavachagom Pillai T.K.	*Calculus, Vol.I , II and III*	*S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai, 2009.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Erwin Kreyszig	*Advanced Engineering Mathematics*	*Wiley & sons (Asia) Ltd, 10th Edition, 2015.*
Ray Wylie.C and Louis Barrett	*Advanced Engineering Mathematics*	*Tata McGraw Hill Company, New Delhi, 2004.*
Grewal B. S	*Higher Engineering Mathematics*	*Khanna Publishers, New Delhi, 43rd Edition, 2014.*
Ramana B V	*Higher Engineering Mathematics*	*Tata McGraw Hill Co. Ltd, NewDelhi, 11th Print, 2010.*
Bali N., Goyal M and Watkins C	*Advanced Engineering Mathematics*	*Firewall Media (An Imprint of Laxmi Publications Pvt Ltd), New Delhi, 7th Edition, 2009.*
Bali N.P and Goyal M	*A text book of Engineering Mathematics*	*University Science Press (An Imprint of Laxmi Publications Pvt Ltd), New Delhi,2014*

COURSE OUTCOMES:

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

CO1: Acquire knowledge of eigen values and eigen vectors including properties through matrix theory.

CO2: Understand the hyperbolic functions and applications of differential calculus.

CO3: Acquire fluency in partial differentiation and solving problems related to maxima and minima for more independent variables.

CO4: Understand the standard types of integration and solution to various integrals.

CO5: Understand the multiple integrals and their applications to engineering problems.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	M	-	-	-	-	-	H	M	M	-	-	-
CO2	H	M	M	-	-	-	-	-	-	M	-	-	-	-	-
CO3	H	H	H	-	-	-	-	-	-	L	-	-	-	-	-
CO4	H	H	M	M	-	-	-	-	-	M	L	M	-	-	-
CO5	H	M	M	-	-	-	-	-	-	L	L	M	-	-	-
16EBS1Z2	H	H	M	M	-	-	-	-	-	M	L	M	-	-	-

L – Low, M – Moderate (Medium), H- High

16EBS103 **ENGINEERING PHYSICS** **Category : BS**

(Common to EEE, ECE, CSE, EIE & IT branches) L T P C

3 0 0 3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology. Upon completion of this course the students will be familiar with:

- Concepts, types of lasers and its applications, fibre optic principles and its applications.
- Basics of properties of matter & thermal physics
- Origin of quantum physics, Schrödinger's equation and applications.
- Principles of acoustics, ultrasonics and their industrial applications.
- Fundamentals of crystal Physics and its packing factor calculations.

UNIT I LASERS & FIBRE OPTICS 9 Periods

Introduction- Principle of laser action - characteristics of laser - Spontaneous emission and Stimulated emission –Einstein's coefficients - population inversion – methods of achieving population inversion – Optical Resonator -Types of Lasers – Principle, construction and working of Nd-YAG, CO_2, Semiconductor laser - applications of laser-Hologram

Introduction – Basic Principles involved in fiber optics- Total internal reflection – Structure of optical fiber –Propagation of light through optical fiber –Derivation for Numerical Aperture and acceptance angle - fractional index change - Classification of optical fiber based on materials, refractive index profile and Modes - Fiber optical communication links-Fiber optic sensors- displacement.

UNIT II PROPERTIES OF MATTER & THERMAL PHYSICS 9 Periods

Elasticity- Hooke's law- stress-strain diagram - Factors affecting elasticity - Bending moment - Depression of a cantilever - Young's modulus by uniform bending - I shaped girders.

Thermal expansion - thermal stress - thermal conductivity - heat conduction in solids - flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment.

UNIT III QUANTUM PHYSICS AND APPLICATIONS 9 Periods

Limitations of classical Physics - Introduction to Quantum theory - Dual nature of matter and radiation- de-Broglie wavelength in terms of voltage, energy and temperature –Heisenberg's Uncertainty principle – verification – physical significance of a wave function- Schrödinger's Time independent and Time dependent wave equations – Particle in a one dimensional potential well– Scanning Electron Microscope (SEM)-Transmission Electron Microscope (TEM).

UNIT IV ACOUSTICS & ULTRASONICS 9 Periods

Classification of sound - loudness and intensity - Weber-Fechner law - standard intensity and intensity level - decibel - reverberation - reverberation time - sound absorbing materials - Determination of absorption coefficient - factors affecting acoustics of buildings.

Introduction - properties of ultrasonic waves - production of ultrasonic waves; Magnetostriction effect- Magnetostriction generator- Piezoelectric effect- Piezoelectric generator- Acoustic grating - Determination of wavelength and velocity of ultrasonics-cavitation - applications- ultrasonic drilling- ultrasonic welding- ultrasonic soldering and ultrasonic cleaning-Non- destructive Testing- Pulse echo system.

UNIT V CRYSTAL PHYSICS 9 Periods

Introduction – Crystalline and amorphous materials –Lattice – Unit Cell –Crystal system - Bravais lattices – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC, and HCP structures – Crystal defects – Point, line and surface defects.

Lecture: 45 Periods **Tutorial:0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS		
AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
Arumugam M	*Engineering Physics*	*Anuradha Publishers, 2010. (Unit I, Unit III & Unit IV)*
P.K.Palanisamy	*Engineering Physics*	*Scitech Publications (India) Pvt. Ltd,2015 (Unit II & Unit V)*

REFERENCE BOOKS		
AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
Avadhanulu M N and Kshirsagar P G	*A Textbook of Engineering Physics*	*S.Chand and Company Ltd, New Delhi, 2010.*
Gaur R.K. and Gupta S.L	*Engineering Physics*	*Dhanpat Rai Publishers, 2009.*
K.Rajagopal	*Engineering Physics*	*PHI Learning Private Ltd, NewDelhi, 2015.*

COURSE OUTCOMES:

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

CO1: Analyze the construction and working of Nd-YAG, CO_2, Semiconductor lasers. Explain fiber optics and classify fibers based on index profiles and modes. [Familiarity]

CO2: Acquire knowledge in properties of matter and thermal physics [Application]

CO3: Analyze the dual nature of matter using Heisenberg's Uncertainty principle, Schrodinger's time independent and dependent wave equations.[Assessment]

CO4: Apply piezoelectric detector method for industrial applications. [Usage and Assessment]

CO5: Compare crystalline and non-crystalline materials and describe the lattice structure, coordination number and packing factor for crystals.[Usage and Assessment]

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	H	H	H	-	-	-	-	-	-	H	H	H
CO2	H	H	H	H	H	H	-	-	-	-	-	-	H	M	H
CO3	H	H	M	M	M	M	-	-	-	-	-	-	H	M	H
CO4	H	H	M	M	M	M	-	-	-	-	-	-	H	H	H
CO5	H	H	M	M	M	M	-	-	-	-	-	-	H	H	H
16EBS103	H	H	M	M	M	M	-	-	-	-	-	-	H	H	H

L – Low, M – Moderate (Medium), H- High

16EBS104 **APPLIED CHEMISTRY** **Category : BS**

(Common to EEE, ECE, EIE, CSE & IT branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- The course is aimed at inculcating knowledge of applied chemistry topics which would be useful for students to understand Chemistry relevant to circuitry Engineering subjects.

UNIT I **ELECTROCHEMICAL CELLS** **9 Periods**

Galvanic cells – redox reactions- electrodes - metal and metal ion, hydrogen electrode and calomel electrode – electrode potentials – standard oxidation and reduction potentials - Nernst equation and problems - EMF series and significance – Application of EMF measurements – equilibrium constant, solubility of sparingly soluble salt, potentiometric titration of a redox system (Fe^{2+} Vs Cr^{6+}), pH measurement using glass electrode and fluoride measurement by ISE.

UNIT II **BATTERIES** **9 Periods**

Batteries - components, characteristics - voltage, current, current capacity, power density, energy density, cycle life, shelf life and self - discharge. Types of batteries - Primary - Zn/MnO_2 , Zn/HgO, Zn/Ag_2O, $Li/SOCl_2$ - construction, function and performance comparison – Secondary- Pb/ acid, Ni/Cd, and Lithium ion battery - construction, function and performance comparison.

UNIT III **CORROSION** **9 Periods**

Corrosion - Spontaneity - Chemical corrosion- mechanism, nature of oxides – Pilling Bedworth rule - electrochemical corrosion – mechanism - types – galvanic and differential aeration – Galvanic series and importance – Prevention methods - design of materials, cathodic protection techniques (sacrificial anode and impressed current cathode), Inhibitors - Protective coatings - Inorganic coating - electroplating – surface preparation and plating method applied to Cr and Ni and galvanising – Organic coating- paints - constituents and functions.

UNIT IV **POLYMER TECHNOLOGY** **9 Periods**

Polymers - definitions of monomer, polymer, functionality, degree of polymerisation – Free radical mechanism -Individual polymers - PVC, PMMA, Teflon, polyamide, poly carbonate, epoxy, polyurethane - preparation, properties and their end users - compounding of plastics - components and functions - fabrication techniques - compression, injection, extrusion and blow moulding - Conducting polymers - structures of polypyrrole, polyaniline and poly acetylene - conduction mechanism of polyacetylene only - Biodegradable polymers – polylactide, starch and cellulose.

UNIT V **SILICON WAFER TECHNOLOGY** **9 Periods**

Silicon for IC chips - single crystal – preparation by Czechralsky and float zone processes - wafer preparation, P-N junction formation – Ion implantation, Diffusion and epitaxial growth techniques - Insulator layer by oxidation - Printing of circuits by photolithography – masking and electron beam methods - etching by chemical and electrochemical methods - metal coatings.

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
Vairam S, Subha Ramesh	*Engineering Chemistry*	*Wiley India, 2015.*
Jain. P.C. and Monica Jain	*Engineering Chemistry*	*Dhanpat Rai Publications Pvt Ltd, New Delhi, 16th Edition, 2004.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Dara. S.S, Umarae	*Text book of Engineering Chemistry*	*S. Chand Publications, 2004.*
M.S.Tyagi	*Introduction to semiconductor materials and devices*	*Wiley India, 2011.*
Kuriakose, J.C., and Rajaram J	*"Chemistry in Engineering and Technology", Vol.1 &II*	*Tata Mc Graw Hill Publishing company, Pvt.Ltd, New Delhi, 2001.*
P. Aggarwal, Avinash Aggarwal	*Engineering Chemistry*	*Khanna Publishers, 2010.*
David Linden and Thomas Reddy	*Hand book of batteries and fuel cells, Vol.1 &II*	*Tata Mc Graw Hill, 2001.*

COURSE OUTCOMES:

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

CO1: Understand the principles of electrochemical principles such as EMF measurements, electrode potentials and apply them in experimental techniques useful for electrochemical instrumentation.

CO2: Know the knowledge about different types of batteries with the functions which find use in their society including engineering fields.

CO3: Be familiar with corrosion of the instruments and equipment they use in their field and also to learn the mechanisms and the preventive measures by various techniques.

CO4: Know about the different types of polymeric materials, properties and fabrication which match the specific applications.

CO5: Gain the knowledge about the silicon chips and their fabrication methods and to apply in preparation of in electrical and electronic instruments.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	L	L	L	L	L	L	L	M	L	L	M	L	L
CO2	H	L	M	L	M	L	L	L	L	M	L	L	M	L	L
CO3	H	H	M	L	M	L	L	L	L	M	L	L	M	L	L
CO4	H	L	H	L	L	M	M	L	L	M	L	L	M	M	L
CO5	H	L	H	L	L	L	L	L	L	M	L	L	M	M	L
16EBS104	H	M	L	L	M	L	L	L	L	M	L	M	M	L	M

L – Low, M – Moderate (Medium), H- High

16EES105 BASICS OF CIVIL AND MECHANICAL ENGINEERING Category : ES

(Common to EEE, ECE, EIE branches)

L T P C
3 0 0 3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To learn the manufacturing process, types, applications and testing procedures for materials used for construction
- To impart knowledge about basis of recent paradigms, and new materials
- To make the students aware of the basic fields in Civil Engineering and about the construction.
- To impart knowledge to the students in the basics of mechanical sciences.
- To impart basic knowledge on manufacturing and machining processes.

PART A : CIVIL ENGINEERING 50 Marks

UNIT I BUILDING MATERIALS AND CONSTRUCTION 8 Periods

Stone - Properties and uses, **Bricks** - Properties and uses , **Cement** - composition, types and uses, Properties and uses of **Steel**, **Timber**, **Concrete** and its Properties.

Masonry - Brick masonry and Stone masonry.

Flooring - Various types of floor finishing for Residential, Industrial and Office buildings.

Roofing - RCC roof and Steel trusses.

UNIT II WATER SUPPLY AND SANITARY ENGINEERING 8 Periods

Water Supply Engineering – Objectives of water supply projects – necessity – sources of water – distribution of water.

Sanitary Engineering – Objectives of sanitary projects – systems of sewerage – natural methods of sewage disposal.

UNIT III IRRIGATION ENGINEERING AND TRANSPORTATION ENGINEERING 8 Periods

Irrigation Engineering – Needs of irrigation **–** purpose and functions of storage structures – Dams – parts of the dam and their functions.

Transportation Engineering - Roads **–** types- purposes - uses. Railways – gauges – components – usefulness.

PART B : MECHANICAL ENGINEERING 50 Marks

UNIT IV ENERGY ENGINEERING 8 Periods

Working principles of impulse and reaction turbines -working principles of IC engines (CI an SI engines) – power plants – steam power plant**.**

UNIT V MANUFACTURING PROCESS 8 Periods

Basic principles of moulding- melting of metals and casting-crucible furnace and cupola-Basic principles of hand forging-mechanical power hammers-hot and cold forging process –basics of extrusion process - Basic principle of welding – manual metal arc welding -gas welding and gas cutting-brazing and soldering.

UNIT VI METAL CUTTING PROCESS 8 Periods

Lathe: Main components and their functions- basic operations of turning, facing, taper turning, and thread cutting - introduction to CNC lathe - Drilling Machine: types of drilling machines -bench, upright - main parts and their functions-reaming operations

Lecture: 48 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 48 Periods

TEXT BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
S.C. Rangawala	*Engineering materials*	*Charotar Publishing House, New Delhi.2014.*
S.K. Duggal	*Building Materials*	*New Age International, 2012.*
M.S.Palanichamy	*"Basic Civil Engineering", Third Edition*	*Tata McGraw Hill Company Limited, New Delhi, 2000.*
Venugopal. K	*Basic Mechanical Engineering*	*Anuradha Publications, 3rd Edition, 2010.*
Ramesh babu	*Basic Mechanical Engineering*	*VRB Publishers Pvt. Ltd, 2007.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
R.C.Smith	*Materials of Construction*	*Mc Graw Hill Publications, 1973.*
Janardhana Jha	*Engineering materials*	*Khanna Publishers, New Delhi, 1981.*
P.C.Varghese	*Building Materials*	*PHI Learning pvt. Ltd, New Delhi, 2015*
K.S.Jagadish, B.V. Venkataraman Reddy and K.S. Nanjunda Rao	*Alternative Building Materials and Technologies*	*New Age International (P) Ltd. Publishers, New Delhi.*
NPTEL Resource material	*Building Materials and Construction*	
Nagpal G.R	*Power Plant Engineering*	*Khanna Publishers, New Delhi, 2002.*
Jain R.K	*Production Technology*	*Khanna Publishers, New Delhi, 2004*
Shanmugam.G	*Basic Mechanical Engineering*	*McGraw Hill Education (India) Pvt. Ltd, New Delhi, 4th Edition, 2013.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to

CO1: Understand the types, basic properties, uses of basic building materials.
CO2: Understand the importance of water supply systems and disposal of sewages.
CO3: Understand the basics of irrigation and transportation engineering.
CO4: Apply the principles of mechanical engineering in their respective field of specialization.
CO5: Appreciate the importance of energy generation.
CO6: Apply the concept of manufacturing and metal cutting processes in engineering in their applications.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	L	-	-	-	-	-	-	-	-	-	-	-	L	-	-
CO4	H	-	H	-	-	M	L	L	M	-	-	-	H	M	L
CO5	-	-	H	-	-	M	H	-	-	-	M	-	M	H	M
CO6	H	M	M	-	-	M	M	M	-	-	-	-	M	M	M
16EES105	H	M	H	-	-	M	M	M	M	-	M	-	M	M	M

L – Low, M – Moderate (Medium), H- High

16EBS106 **CHEMISTRY LAB** **Category : BS**

(Common to EEE, ECE, EIE, CSE & IT branches)

L	T	P	C
0	0	4	2

PREREQUISITES: NIL

COURSE OBJECTIVES:

- The course is aimed at imparting knowledge of experimental techniques which would be useful for students to apply the practical principles relevant conventional engineering field.

LIST OF EXPERIMENTS

1. Estimation of hardness by EDTA method
2. Estimation of chloride by Argentometric method
3. Determination of dissolved oxygen by Winkler's method
4. Conductometric titration of mixture of strong acid and weak acid using strong base
5. Potentiometric titration of ferrous iron by dichromate
6. Estimation of copper in brass by EDTA method
7. Estimation of Iron by Spectrophotometry
8. Estimation of HCl by pH titration.

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total:60 Periods**

REFERENCE BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
A.O. Thomas	*Practical Chemistry*	*Scientific Book Centre, Cannanore, 2003.*
Jeffery G H, Basset J. Menthom J, Denney R.C.	*Vogel's Text book of quantitative analysis, 5th Edition*	*EBS, 1988.*

COURSE OUTCOMES:

Upon completion of this practical classes, the students will be able to

CO1: Understand the nature of hardness, chloride level, pollution level using dissolved oxygen content, iron present in water and analyse them in water.

CO2: Apply the EMF and conductometric measurements in quantitative analysis of substances.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	L	L	M	L	L	L	L	M	L	M	M	L	L
CO2	H	M	L	L	H	L	L	L	L	M	L	M	M	L	L
16EBS106	H	M	L	L	M	L	L	L	L	M	L	M	M	L	L

L – Low, M – Moderate (Medium), H- High

16EES107 **WORKSHOP PRACTICE** **Category : ES**

(Common to EEE, ECE, EIE, CSE & IT branches)

L	T	P	C
0	0	4	2

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To make various basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail joint, Mortise & Tenon joint and Cross-Lap joint.
- To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint.

LIST OF EXPERIMENTS

1. Introduction to use of tools and equipments in Carpentry, Welding, Foundry and Sheet metal
2. Safety aspects in Welding, Carpentry and Foundry
3. Half lap Joint and Dovetail Joint in Carpentry
4. Welding of Lap joint, Butt joint and T-joint
5. Preparation of Sand mould for cube, conical bush, pipes and V pulley
6. Fabrication of parts like tray, frustum of cone and square box in sheet metal
7. Electrical wiring – simple house wiring
8. Plumbing

Lecture: 0 Periods Tutorial:0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

Upon completion of this practical classes, the students will be able to

CO 1: Use tools and equipments used in Carpentry, Welding, Foundry and Sheet metal.
CO 2: Make half lap joint and dovetail joint in carpentry.
CO 3: Make welded lap joint, butt joint and T-joint.
CO 4: Prepare sand mould for cube, conical bush, pipes and V pulley.
CO 5: Fabricate parts like tray, frustum of cone and square box in sheet metal
CO 6: Carry out minor works/repair related to electrical wiring and plumbing.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	-	-	-	-	M	M	-	M	L	-	M	M	M	L
CO2	M	H	M	-	-	M	L	-	M	L	-	M	M	M	L
CO3	M	H	M	-	-	M	L	-	M	L	-	M	M	M	L
CO4	M	H	M	-	-	M	L	-	M	L	-	M	M	M	L
CO5	M	H	M	-	-	M	L	-	M	L	-	M	M	M	L
CO6	M	H	L	-	-	M	L	-	M	L	-	M	M	M	L
16EES107	M	-	M	-	-	M	L	-	M	L	-	M	M	M	L

L – Low, M – Moderate (Medium), H- High

16EHS2Z1	TECHNICAL ENGLISH *(Common to all branches)*	Category : HS L T P C 2 2 0 3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To make learners acquire guided listening and speaking skills in both formal and informal contexts.
- To help them develop reading skills by familiarizing them with different types of reading tasks and strategies
- To make them understand advance level of grammar and equip them with writing skills needed for academic as well as workplace contexts.
- To explore the learner to Technical English and Technical Vocabulary.

UNIT I **6+6 Periods**

Listening - Listening to ask for/ give opinions, Listening to persuade/dissuade people, Listening to make complaints, Listening to transfer information; **Speaking** –Role play activities on a formal/corporate context, Delivering Welcome Address- **Reading** – Reading to infer lexical and contextual meaning; **Writing** - Effective use of SMS on Whatsapp/ Hike/ Messenger, Writing E-mails on a business context, Technical style; **Grammar** – Use of relative / reflexive pronouns, Discourse Markers; **Vocabulary**- Homonyms and Homophones.

UNIT II **6+6 Periods**

Listening - Listening to express regrets/sympathy/condolences, Listening and Note-taking; **Speaking** – Addressing at an official meeting to deal with problems/ sensitive issues, Discussion on a movie with a poignant social message/ or on a recently read book; **Reading** - Reading a short story or an article from newspaper; **Writing** - Writing a review of a book/movie/music concert/sports event, Graph Description; **Grammar** – Noun/Adjective/Adverbial phrases, Cause and effect expressions; **Vocabulary** - Using phrasal verbs in sentences, Jargon.

UNIT III **6+6 Periods**

Listening - Listening to a talk about using quantities, Listening to describe manner and frequency, Listening to expressions of assumptions/inference, Listening to make comparisons; **Speaking** –Making conversation to practice stress, pause, pronunciation and intonation, Introducing the chief-guest; **Reading** - Speed reading – reading passages with time limit - **Writing** – Notice, Agenda and Minutes of meetings; - Elements of Writing Technical articles - **Grammar** - Numerical expressions, Conditional clauses; **Vocabulary** - Same word used as different parts of speech, Register

UNIT IV **6+6 Periods**

Listening - Listening to talks about future events/plans, Listening to a talk about making arrangements, Listening to language of reporting, Viewing a model discussion; **Speaking** – Discussion on a formal/corporate context, Proposing vote of thanks; **Reading** - Reading the job advertisements and the profile of the company concerned; **Writing** - Process Description, Applying for a job with résumé; **Grammar** - Direct and indirect speech; **Vocabulary** - Idioms

UNIT V **6+6 Periods**

Listening – Listening to expressions of possibility, Listening to expressions of obligations, Listening to expressions of ability, Viewing model interviews; **Speaking** - Mock interview; **Reading** - Note making, Intensive reading; **Writing** – Checklist, - Feasibility / Project report; **Grammar** – Time Statements and Contracted Time Statements; **Vocabulary** – Nominal Compounds

Lecture: 30 Periods **Tutorial:30 Periods** **Practical: 0 Periods** **Total: 60 Periods**

TEXT BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Department of English, Anna University. Mindscapes	*English for Technologists and Engineers.*	*Orient Blackswan, Chennai. 2012*
Sadanand, Kamlesh & Punitha, Susheela	*Spoken English: A Foundation Course (Part 2).*	*Orient Blackswan, Hyderabad. 2014*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Raman, Meenakshi & Sangeetha Sharma	*Technical Communication: Principles and Practice*	*Oxford University Press, New Delhi. 2011*
Vijay, Anbazhagan.J, & Jaishree.N	*Technical English-II*	*Global Publishers, Chennai, 2016*
Rizvi, Ashraf. M.	*Effective Technical Communication*	*Tata McGraw-Hill, New Delhi. 2005*
Herbert, A.J	*Structure of Technical English*	*The English Language Society, London. 1971*
Michigan,E.A	*Word Power and Speed Reading: English Improvement Series*	*Infinity Books, New Delhi, 2007*
Rajendrapal & Korlahalli. J.S	*Essentials of Business Communication*	*Sultan Chand & Sons*

WEBSITES

1. http://www.usingenglish.com
2. http://www.uefap.com

COURSE OUTCOMES:

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

CO1: The learners will be able to speak convincingly at work place and social contexts through guided listening tasks and different genres and strategies of reading.

CO2: The learner will understand advance level of grammar and write professionally to a larger extent for workplace and general contexts.

CO3: The learners will familiarize themselves with Technical Vocabulary and Technical English.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	-	L	-	L	M	-	-	-	-	M	-	-	-	H
CO2	-	-	-	-	-	-	-	-	-	H	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16EHS2Z1	-	-	L	-	L	M	-	-	-	H	M	-	-	-	H

L – Low, M – Moderate (Medium), H- High

16EBS2Z2 **ENGINEERING MATHEMATICS II** **Category : BS**

(Common to all branches)

L T P C
3 2 0 4

PRE-REQUISITES : Basics of - trigonometry- differential and integral formulae.

COURSE OBJECTIVES:

- To acquire knowledge of techniques of ordinary differential equations leading to engineering problems.
- To acquire knowledge of vector Calculus with engineering applications.
- To gain standard techniques of complex variable applicable to fluid dynamics, heat conduction, and elasticity.
- To develop skill of solving transforms leading to engineering applications.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 9+6 Periods

Second and Higher order Differential Equations, Method of variation of parameters- Method of undetermined coefficients-Homogeneous equations of Euler's and Legendre's type-System of Simultaneous first order Linear equations with constant coefficients - Method of reduction of order.

UNIT II VECTOR CALCULUS 9+6 Periods

Gradient and directional derivative, Divergence and Curl – Irrotational and Solenoidal fields- Vector identities - Line, Surface and Volume Integrals – Green's Theorem in a Plane , Gauss Divergence and Stoke's Theorems (Statements only) –Verifications and Applications.

UNIT III COMPLEX DIFFERENTIATION 9+6 Periods

Functions of a Complex variable-Analytic functions- Cauchy Riemann equations and sufficient conditions (excluding proof)–Harmonic conjugates–Construction of analytic functions-Conformal mappings: $w=z+a$, az, $1/z$, z^2, e^z , sinz, cosz and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION 9+6 Periods

Cauchy's integral theorem, Cauchy's integral formula -Taylor's and Laurent's theorems (Statements only) and expansions – Poles and Residues – Cauchy's Residue theorem – Contour integration – Circular and semi circular contours with no pole on real axis.

UNIT V LAPLACE TRANSFORMATIONS 9+6 Periods

Laplace transforms- Properties and standard transforms-Transforms of unit step, unit Impulse and error functions –Transforms of periodic functions- Inverse Laplace transforms- Initial and Final value theorems- Convolution theorem (Statement only) and applications - Applications to Solution of Linear differential equations of second order with constant coefficients.

Lecture: 45 Periods **Tutorial:30 Periods** **Practical: 0 Periods** **Total:75 Periods**

TEXT BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
Veerarajan T	*Engineering Mathematics for Semesters I and II*	*Tata McGraw Hill Publishing Co., New Delhi, 2015.*
Kandasamy P, Thilagavathy K and Gunavathy K	*Engineering Mathematic for I year B.E/B.Tech*	*S.Chand & Co, Ramnagar, New Delhi, Reprint 2013.*
S. Narayanan and Manicavachagom Pillai T.K.	*Calculus-Vol.III*	*S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai, 2009.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Erwin Kreyszig	*Advanced Engineering Mathematics*	*Wiley & sons(Asia) Ltd, 10th Edition, 2015.*
Ray Wylie.C and Louis Barrett	*Advanced Engineering Mathematics*	*Tata McGraw Hill Company, New Delhi, 2004.*
Grewal B. S	*Higher Engineering Mathematics*	*Khanna Publishers, New Delhi, 43rd Edition, 2014.*
Ramana B V	*Higher Engineering Mathematics*	*Tata McGraw Hill Co. Ltd, NewDelhi, 11th Print, 2010.*
Bali N., Goyal M and Watkins C	*Advanced Engineering Mathematics*	*Firewall Media (An Imprint of Laxmi Publications Pvt Ltd), New Delhi, 7th Edition,2009.*
Bali N.P and Goyal M	*A text book of Engineering Mathematics*	*University Science Press (An Imprint of Laxmi Publications Pvt Ltd), New Delhi,2014.*

COURSE OUTCOMES:

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

CO1: Understand the kinds of differential equations and their solutions in the field of engineering.

CO2: Evaluate gradient, divergence and curl and also line, surface and volume integrals in Cartesian form and simple coordinate systems and calculate integrals applying Greens, stokes and Gauss theorems.

CO3: Understand the concepts of analytic functions and conformal mappings.

CO4: Evaluate contour integrals using calculus of residues.

CO5: Apply Laplace transform methods to solve differential equations.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	H	-	-	-	-	-	M	H	H	-	-	-
CO2	H	H	M	M	-	-	-	-	-	M	-	M	-	-	-
CO3	H	H	M	H	-	M	-	-	-	M	M	M	-	-	-
CO4	H	H	M	M	-	M	-	-	-	M	M	M	-	-	-
CO5	H	H	H	H	-	H	-	-	-	M	M	H	-	-	-
16EBS2Z2	H	H	M	H	-	M	-	-	-	M	M	M	-	-	-

L – Low, M – Moderate (Medium), H- High

16EBS2Z3 **MATERIALS SCIENCE** **Category : BS**

(Common to all branches)

L T P C

3 0 0 3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology. Upon completion of this course the students will be familiar with:

- The properties of conducting materials.
- The application of magnetic and super conducting materials.
- Application and properties of dielectric and ferro electric materials.
- Applications and properties of Modern engineering materials.
- Nano materials and its properties.

UNIT I CONDUCTING MATERIALS 9 Periods

Introduction to Conductors – classical free electron theory of metals – Draw backs of classical theory – quantum theory - Electrical and Thermal conductivity of Metals – Derivation for Wiedeman – Franz law – Lorentz number — Fermi distribution function - effect of temperature – density of energy states – calculation of Fermi energy- carrier concentration in metals.

UNIT II SEMICONDUCTING MATERIALS AND DEVICES 9 Periods

Introduction – Properties – elemental and compound semiconductors - Intrinsic and extrinsic semiconductors – properties - Carrier concentration in intrinsic Semiconductor - variation of Fermi level with temperature and carrier concentration - Electrical Conductivity – band gap determination - extrinsic semiconductors - Carrier concentration in P- type and N-type semiconductors – variation of Fermi level with temperature and impurity concentration – Hall effect- Determination of Hall Co-efficient in N type and P type Semiconductor - Applications.

UNIT III MAGNETIC AND SUPER CONDUCTING MATERIALS 9 Periods

Introduction - Origin of magnetic moment - Bohr magneton - Dia, Para, and Ferro magnetic materials - Domain theory of ferromagnetism - Hysteresis - Hard and Soft magnetic materials. Ferrites - structure and applications. - Magneto optical recording and readout – Superconductivity - Types of superconductors - BCS theory of superconductivity (qualitative) - properties- High Tc superconductors, Applications of superconductors- SQUID, Cryotron, Magnetic levitation.

UNIT IV DIELECTRICS AND FERROELECTRICS 9 Periods

Introduction to dielectric materials – Electric polarization and Dipole moment - Electrical susceptibility – dielectric constant – Various polarization mechanisms in dielectrics - electronic, ionic, orientational and space charge polarization– frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – Applications of dielectric materials - Ferro electricity –Ferro electric materials -$BaTiO_3$ – Applications- Ferro electric energy converter.

UNIT V MODERN ENGINEERING MATERIALS 9 Periods

Metallic glasses- preparation of metallic glasses - properties – applications of the metallic glasses - Shape Memory Alloys (SMA) - Characteristics, properties of NiTi alloy - applications of the Shape memory alloys - advantages and disadvantages of SMA - Nanomaterials-synthesis –chemical vapour deposition – Sol Gel – ball Milling – properties of nanoparticles and applications of nanoparticles – Carbon Nanotubes (CNT) – structure – properties – applications of CNTs.

Lecture: 45 Periods **Tutorial:0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
P.K.Palanisamy	*Engineering Physics–II*	*Scitech Publications (India) Pvt. Ltd 2015 (Unit I, Unit III & Unit IV)*
Dr.Jayakumar .S	*Materials science*	*R.K.Publishers,2008.(Unit II & IV)*
Dr.V.Rajendran	*Material Science*	*Tata McGraw Hill Publications, NewDelhi, 2011.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Charles P.Poole, Jr; Frank J.Owens	*Introduction to Nanotechnology*	*Wiley India, 2012.*
Gaur R.K. and Gupta S.L	*Engineering Physics*	*Dhanpat Rai Publishers, 2009.*
K.Rajagopal	*Engineering Physics*	*PHI Learning Private Ltd, New Delhi, 2015.*

COURSE OUTCOMES:

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

CO1: Analyze the properties of conducting materials. [Familiarity]

CO2: List and analyze the properties of Semiconducting materials and Devices. [Familiarity]

CO3: Identify, analyze the properties and applications of magnetic & super conducting materials. [Familiarity]

CO4: List and analyze the properties of dielectric Ferro electric materials. [Familiarity & Application]

CO5: List the properties and applications of modern engineering materials. [Familiarity & Application]

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	H	H	H	H	-	-	-	-	-	H	H	H
CO2	H	H	H	H	H	H	H	-	-	-	-	-	H	H	H
CO3	H	H	M	M	M	M	M	-	-	-	-	-	H	H	H
CO4	H	H	H	H	H	H	H	-	-	-	-	-	H	H	H
CO5	H	H	M	M	M	M	M	-	-	-	-	-	H	H	H
16EBS2Z3	H	H	M	M	M	M	M	-	-	-	-	-	H	H	H

L – Low, M – Moderate (Medium), H- High

16EHS2Z4 ENVIRONMENTAL SCIENCE AND ENGINEERING C**ategory : HS**

(Common to all branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- The course is aimed at creating awareness among students and also to inseminate the critical ideas of preserving environment.

UNIT I ENVIRONMENTAL RESOURCES 9 Periods

Natural resources -Forest – benefits, over exploitation, deforestation & consequences – Water - unique features, hydrological cycle & over exploitation – Food -effect of modern agriculture, fertilizers, pesticides, eutrophication & biomagnifications - Energy resources - renewable & non-renewable resources - wind, solar and tidal - harnessing methods.

UNIT II ECO SYSTEM AND BIODIVERSITY 9 Periods

Ecology - ecosystem, physical and chemical components of ecosystem, biological components of ecosystem - forest ecosystem, desert ecosystem and pond ecosystem, Energy flow in ecosystem, nitrogen cycle and carbon dioxide cycle, food pyramid, ecological succession, Biodiversity - types, values of biodiversity, hot spots of biodiversity, endangered and endemic species, conservation of biodiversity – in situ – ex situ conservation.

UNIT III ENVIRONMENTAL POLLUTION 9 Periods

Air pollution, classification of air pollutants – sources, effects and control of gaseous pollutants SO_2, NO_x, H_2S, CO, CO_2 and particulates, control methods - cyclone separator and electrostatic precipitator - Water pollution - classification of water pollutants, organic and inorganic pollutants, sources, effects and control of water pollutants Soil pollution - sources, effects and control - Noise pollution - decibel scale, sources, effects and control.

UNIT IV ENVIRONMENTAL THREATS 9 Periods

Acid rain, greenhouse effect, global warming and ozone depletion, disaster management, flood, drought, earthquake and tsunami, Threats to biodiversity - destruction of habitat, habit fragmentation - hunting, over exploitation and man - wildlife conflicts, The IUCN red list categories, status of threatened species.

UNIT V SOCIAL ISSUES AND ENVIRONMENT 9 Periods

Sustainable development - sustainable technologies, need for energy and water conservation, rain water harvesting, water shed management, waste land reclamation, Pollution control Act, Wild life protection act, Forest conservation act, population growth - exponential and logistic growth, variation in population among nations, population policy, women and child welfare programs, role of information technology in human and health, HIV/AIDS - effects and preventive measures.

Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
Sharma J.P	*"Environmental Studies", 3rd Edition*	*University Science Press, New Delhi 2009.*
Anubha Kaushik and C.P. Kaushik	*"Environmental Science and Engineering", 3rd Edition*	*New age International Publishers, New Delhi, 2008.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
R.K. Trivedi	*Hand book of Environmental laws, Rules, Guidelines, Compliances and Standards", Vol.I&II,*	*Environ Media, 2006.*
G. Tyler Miller Jr	*"Environmental Science", 10th Edition*	*Thomson Brooks/Cole Publishing, 2004.*
Gilbert M. Masters	*Introduction to Environmental Engineering and Science, 2nd Edition*	*Pearson Education, 2004.*

COURSE OUTCOMES:

Upon the completion of the course, Students will be able to

- **CO1:** To know about the various environmental resources, the effective utility and problems accompanied in over exploitation.
- **CO2:** To acquire knowledge about the interaction of biosphere with environment and conservation methods of bio diversity.
- **CO3:** To be aware of the source of various types of pollution, their ill effects and preventive methods.
- **CO4:** To understand the environmental threats, Acid rain, Green house effect and Ozone depletion and natural disasters.
- **CO5:** To create an idea about sustainable development and social issues.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	L	M	M	L	L	L	L	L	L	L	L	M	M	L	L
CO2	L	L	H	L	L	L	M	M	L	M	L	M	L	L	L
CO3	L	L	L	M	L	L	M	L	L	L	L	M	L	L	L
CO4	L	L	L	L	L	L	H	M	L	L	L	M	M	L	M
CO5	L	L	M	L	L	L	H	H	L	L	L	M	M	L	M
16EHS2Z4	M	L	M	L	L	M	H	M	M	M	L	M	L	L	M

L – Low, M – Moderate (Medium), H- High

16EES2Z5 **PROGRAMMING IN C** **Category : ES**

(Common to all branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- The Computer and Programming fundamentals
- Data types in C and Flow control statements
- Functions, Arrays, Pointers And Strings
- Bitwise Operators, Preprocessor Directives, Structures and Unions
- Structures, List Processing, Input And Output

UNIT I **COMPUTER AND PROGRAMMING FUNDAMENTALS** **9 Periods**

Computer fundamentals – Evolution, classification, Anatomy of a computer: CPU, Memory, I/O – Introduction to software – Generation and classification of programming languages – Compiling – Linking and loading a program – Translator – loader – linker – develop a program – software development – Introduction to OS –Types of OS – Algorithms – Structured programming concept.

UNIT II **DATA TYPES AND FLOW OF CONTROL** **9 Periods**

An overview of C – Programming and Preparation – Program Output – Variables – Expressions, and Assignment, The use of #include, printf(), scanf() – Lexical elements, operators and the C systems – The fundamental data types – Flow of control

UNIT III **FUNCTIONS, ARRAYS, POINTERS AND STRINGS** **9 Periods**

Functions and storage classes - 1D Arrays – Pointers – Call by reference – Relationship between Arrays and Pointers – Pointer arithmetic and element size – Arrays as function argument – Dynamic memory allocation – Strings – String handing functions – Multidimensional Arrays.

UNIT IV **ARRAY OF POINTERS, BITWISE OPERATORS, PREPROCESSOR DIRECTIVES** **9 Periods**

Arrays of Pointers – Arguments to main () - Ragged Arrays – Functions as Arguments – Arrays of Pointers to Functions - Type qualifiers.-Bitwise operators and expressions – Masks – Software tools – Packing and unpacking – Enumeration types – The preprocessor directives.

UNIT V **STRUCTURES AND UNIONS, I/O AND FILE OPERATIONS** **9 Periods**

Structures and Unions – Operator precedence and associativity – Bit fields – Accessing bits and bytes - Input and Output functions – File Processing Functions – Environment variables – Use of make and touch.

Lecture: 45 Periods **Tutorial:0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Pradip Dey, Manas Ghosh	*Computer Fundamentals and Programming in C, Second Edition*	*Oxford University Press, 2013.*
Al Kelley, Ira Pohl	*A Book on C-Programming in C, Fourth Edition*	*Addison Wesley, 2001.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Stephen G. Kochan	*Programming in C-A complete introduction to the C programming language, Third Edition*	*Sams Publication, 2004.*
Yashavant P. Kanetkar	*Let Us C, 13th edition*	*BPB Publications, 2013.*
Brian W. Kernighan and Dennis Ritchie	*The C Programming Language", Second Edition*	*Prentice Hall Software Series, 1988.*
Stephen Prata	*C Primer Plus, Fifth Edition*	*Sams Publishing, 2005.*

COURSE OUTCOMES:

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

CO1: Articulate the programming environment [Familiarity]
CO2: Write algorithm for solving the given problem statement [usage]
CO3: Use right data types and flow control statement [Assessment]
CO4: Write programs using functions, arrays, pointers and strings [Usage]
CO5: Use right storage classes, preprocessor directives, bitwise operators in programs [Assessment]
CO6: Use structures, unions and files [Usage]

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	M	H	H	-	M	M	M	M	L	M	M	M	L
CO2	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO3	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO4	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO5	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO6	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
16EES2Z5	H	H	M	H	H	-	M	M	M	M	L	M	M	M	L

L – Low, M – Moderate (Medium), H- High

16EES206 **ENGINEERING MECHANICS** **Category : ES**

(Common to all except ECE, CSE and IT branches)

L	T	P	C
3	2	0	4

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To analyze the force systems, friction and to study the dynamics of particles, impulse and momentum.

UNIT I **INTRODUCTION TO MECHANICS AND FORCE CONCEPTS** **9+6 Periods**

Principles and Concepts – Laws of Mechanics – system of forces – resultant of a force system – resolution and composition of forces – Lami's theorem – moment of a force – physical significance of moment-Varignon's theorem – resolution of a force into force and couple – forces in space – addition of concurrent forces in space – equilibrium of a particle in space.

UNIT II **FRICTION** **9+6 Periods**

Frictional resistance – classification of friction- laws of friction – coefficient of friction-angle of friction – angle of repose — cone of friction – free body diagram-advantages-equilibrium of a body on a rough inclined plane – non-concurrent force system - ladder friction – rope friction – wedge friction.

UNIT III **GEOMETRICAL PROPERTIES OF SECTION** **9+6 Periods**

Centroids – Determination by integration – moment of inertia – theorems of moment of inertia – Product of Inertia – Principal moment of inertia of plane areas - radius of gyration.

UNIT IV **BASICS OF DYNAMICS - KINEMATICS** **9+6 Periods**

Kinematics and kinetics – displacements, velocity and acceleration - Equations of motion – Rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration – motion curves – motion under gravity – relative motion – curvilinear motion of particles – projectiles – angle of projection – range – time of flight and maximum height.

UNIT V **BASICS OF DYNAMICS - KINETICS** **9+6 Periods**

Newton's second law of motion – linear momentum – D'Alembert's principle, Dynamics equilibrium — work energy equation of particles– law of conservation of energy – principle of work and energy. Principle of impulse and momentum – Equations of momentum – Laws of conservation of momentum. Impact – Time of compression, restitution, collision – Co-efficient of restitution – types of impact – collision of elastic bodies by direct central impact and oblique impact – collision of small body with a massive body – Kinetic energy of a particle.

Lecture: 45 Periods **Tutorial:30 Periods** **Practical: 0 Periods** **Total: 75 Periods**

TEXT BOOKS

AUTHOR NAME	**TITLE OF BOOK**	**PUBLISHER, YEAR OF PUBLICATION**
S.S. Bhavikatti and K.G. Rajasekarappa	*Engineering Mechanics*	*New Age International Pvt Ltd. 1999.*
S.C. Natesan	*Engineering Mechanics*	*Umesh Publications, 5-B north market, Naisarak, Delhi, 2002.*

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
F.B. Beer and E.R. Johnson	*Vector Mechanics for Engineers*	*Tata Mc.Graw Hill Pvt Ltd, 10th Edition, 2013.*
S. Timoshenko and Young	*Engineering Mechanics*	*Mc.Graw Hill, 4th Edition, 1995.*
Irving Shames and Krishna Mohana Rao	*Engineering Mechanics*	*Prentice Hall of India Ltd, Delhi, 2006.*
Domkundwar V.M and Anand V. Domkundwar	*Engineering Mechanics (Statics and Dynamics)*	*Dhanpat Rai and Co. Ltd, 1st Edition, 2006.*
Suhas Nitsure	*Engineering Mechanics*	*Technical Publications, Pune, 1st edition, 2006.*
R.C. Hibbeller	*Engineering Mechanics*	*Prentice Hall of India Ltd, 13th Edition, 2013.*
Vela Murali	*Engineering Mechanics*	*Oxford university Press,1st Edition,2010.*

COURSE OUTCOMES:

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

CO1: Analyze the problems related to force systems and friction

CO2: Apply concepts of centre of gravity and moment of inertia

CO3: Solve problems on dynamics, momentum and impulse

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	H	M	L	L	-	-	-	L	-	L	-	M	L	M
CO2	L	H	L	-	L	-	-	-	L	-	L	-	L	L	M
CO3	M	H	M	L	L	-	-	-	L	-	L	-	M	L	L
16EES206	M	H	M	L	L	-	-	-	L	-	L	-	M	L	M

L – Low, M – Moderate (Medium), H- High

16EBS207 **PHYSICS LABORATORY** **Category : BS**

(Common to EEE, ECE, CSE, EIE & IT branches)

L	T	P	C
0	0	4	2

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To have a practical knowledge about the concepts behind physics and the need to apply in the emerging technology.

LIST OF EXPERIMENTS

1. Spectrometer - Diffraction Grating Normal Incidence Method
2. Air Wedge –Determination of thickness of a paper
3. Young's Modulus – Cantilever Bending - Koenig's Method
4. a. Laser - Particle size Determination
   b. Optical fiber - Determination of NA & Acceptance angle
5. Ammeter and Voltmeter Calibration – Low Range
6. Resistance Of The Given Coil Of Wire – Carey Foster's Bridge
7. Determination of Band gap Energy of Semiconductor
8. Ultrasonic Interferometer - Velocity of sound & Compressibility of liquids.
9. Transistor Characteristics
10. Torsional pendulum –Determination of Rigidity Modulus & Moment of Inertia

Lecture: 0 Periods **Tutorial:0 Periods** **Practical:60 Periods** **Total: 60 Periods**

COURSE OUTCOMES:

Upon completion of this practical classes, the students will be able to

CO1: Determinate of all physical properties of any matter, basic idea of calibrating electrical measuring instruments and thereby effectively using it for particular applications.

CO2: Experiment intrinsic characteristic features of electronic devices for electrical and electronic applications.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	M	M	M	M	M	M	-	-	-	-	-	H	H	H
CO2	H	H	H	H	H	H	H	-	-	-	-	-	H	H	H
16EBS207	H	H	H	H	H	H	H	-	-	-	-	-	H	H	H

L – Low, M – Moderate (Medium), H- High

16EES208 **ENGINEERING GRAPHICS** **Category : ES**

(Common to EEE, ECE, EIE, CSE & IT branches)

L	T	P	C
2	0	4	4

PREREQUISTES: NIL

COURSE OBJECTIVES:

- Geometrical constructions
- Orthographic projections.
- Performing section of solids and development of the same.
- Interpretation of solids.
- Pictorial view of solids

UNIT I **GEOMETRICAL CONSTRUCTIONS** **15 Periods**

Dimensioning-Lettering-Types of Lines-Scaling conventions-Dividing a given straight line in to any number of equal parts- Bisecting a given angle- Drawing a regular polygon given one side-Special methods of constructing a pentagon and hexagon- Construction of curves like ellipse, parabola, cycloid and involute using one method.

UNIT II **ORTHOGRAPHIC PROJECTIONS** **25 Periods**

Introduction to Orthographic Projection-Projection of points-Projection of straight lines with traces-Projection of planes-Conversion of pictorial views to orthographic views-Projection of solids - Auxiliary projections.

UNIT III **SECTION OF SOLIDS AND DEVELOPMENT** **20 Periods**

Section of solids- Development of surfaces

UNIT IV **INTERPENETRATION OF SOLIDS AND PICTORIAL VIEWS** **20 Periods**

Cylinder and cylinder, cone and cylinder only Isometric projections - Conversion of orthographic views to pictorial views (simple objects).

UNIT V **INTRODUCTION TO AUTOCAD** **10 Periods**

Object Construction : Page layout – Layers and Line types – Creating, Editing and selecting the Geometric Objects. Viewing, Annotating, Hatching and Dimensioning the drawing –Creating Blocks and Attributes

Lecture: 30 Periods **Tutorial:0 Periods** **Practical: 60 Periods** **Total:90 Periods**

REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
K.Venugopal	*Engineering Graphics*	*New Age International (P) Limited, 2015.*
Dhananjay.A.Jolhe	*Engineering Drawing*	*Tata McGraw Hill Publishing Co., 2007.*
K.V.Nataraajan	*A text book of Engineering Graphics*	*Dhanalakshmi Publishers, Chennai, 2006.*
M.B.Shah and B.C. Rana	*Engineering Drawing*	*Pearson Education, 2005.*
Luzadder and Duff	*Fundamentals of Engineering Drawing*	*Prentice Hall of India Pvt Ltd, XIth Edition, 2001.*
K.L.Narayana and P.Kannaiah	*Text book on Engineering Drawing, 2nd Edition*	*SciTech Publications (India) Pvt. Ltd, Chennai, 2009.*

COURSE OUTCOMES:

Upon completion of this practical classes, the students will be able to

CO1: Represent planes and solids as per international standards.

CO2: Generate and interpret multiple views through development, interpretation and sectional views.

CO3: Generate and interrupt orthographic views.

CO4: Generate and interrupt pictorial views and interpenetration.

CO5: Generate and interrupt perspective views.

CO6: Apply the concept of AUTOCAD in engineering graphics.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	H	H	-	-	M	-	L	H	M	-	M	M	M	-
CO2	-	-	H	-	-	M	-	L	H	M	-	M	M	M	-
CO3	-	-	H	-	-	M	-	L	H	M	-	M	M	M	-
CO4	-	-	H	-	-	M	-	L	H	M	-	M	M	M	-
CO5	-	-	H	-	-	M	-	L	H	M	-	M	M	M	-
CO6	-	H	H	H	-	M	-	L	H	M	-	M	M	M	-
16EES208	-	L	H	L	-	M	-	L	H	M	-	M	M	M	-

L – Low, M – Moderate (Medium), H- High

16EES2Z9 **PROGRAMMING IN C LABORATORY** **Category : ES**

(Common to all branches)

L	T	P	C
0	0	4	2

PREREQUISITES: NIL

COURSE OBJECTIVES:

- Data types in C and Flow control statements
- Functions, Arrays, Pointers And Strings
- Dynamic memory allocation and command line arguments
- Bitwise Operators, Preprocessor Directives, Structures and Unions
- Structures, List Processing, Input And Output

PRACTICALS

EXERCISES ILLUSTRATING THE FOLLOWING CONCEPTS:

1. Operators , Expressions and IO formatting
2. Decision Making and Looping
3. Arrays and Strings
4. Functions and Recursion
5. Pointers
6. Dynamic Memory Allocation
7. Structures
8. Unions
9. Files
10. Command line arguments
11. Mini Project

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOMES:

Upon completion of this practical classes, the students will be able to

CO1: Use appropriate data types and flow control statements [Usage]

CO2: Write programs using functions, arrays, pointers and strings [Usage]

CO3: Write programs using dynamic memory allocation [Usage]

CO4: Implement programs using right storage classes, preprocessor directives, bitwise operators [Usage]

CO5: Work with command line arguments, structures, unions and files [Usage]

CO6: Develop applications using C [Usage]

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO2	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO3	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO4	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO5	H	H	M	H	H	-	-	M	M	M	H	H	M	M	L
CO6	H	H	H	-	M	-	H	-	-	L	-	H	H	M	L
16EES2Z9	H	H	M	H	H	-	-	M	M	M	M	M	M	M	L

L – Low, M – Moderate (Medium), H- High

16EBS3Z1 **ENGINEERING MATHEMATICS III** **Category: BS**

(Common to all Branches)

L	T	P	C
3	2	0	4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To gain the knowledge of formation of Fourier series.
- To familiarize with Infinite and finite Fourier transforms functions.
- To be familiar with solution of first and second order differential equations.
- To acquire knowledge of techniques to solve one and two dimensional partial differential equations concerning to engineering applications.

UNIT-I : FOURIER SERIES	**9+6 Periods**
Dirichlet's conditions - Full range Expansions - Odd and even functions - Half range sine and cosine series – Parseval's identity on a Fourier series - Harmonic analysis.	
UNIT-II : FOURIER TRANSFORMS	**9+6 Periods**
Fourier integral theorem (statement only) - Infinite Fourier transform pair - Fourier sine and cosine transform pair –Properties - Transforms of simple functions - Parseval's identity on a Fourier transform - Finite Fourier transforms.	
UNIT-III : PARTIAL DIFFERENTIAL EQUATIONS	**9+6 Periods**
Formation of partial differential equations - First order PDE - Standard types and Lagrange's type - Linear partial differential second and higher order with constant coefficients - Homogeneous and Nonhomogeneous types.	
UNIT-IV : BOUNDARY VALUE PROBLEMS	**9+6 Periods**
Method of separation of variables and Fourier series solution: One dimensional wave equation, one and two dimensional heat flow.	
UNIT-V : Z TRANSFORMS	**9+6 Periods**
Z transforms – Properties - Inverse Z transforms - Initial and final value theorems - Convolution theorem - Formation of difference equations - Solution to difference equations of second order difference equations with constant coefficients with Z transform.	

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial: 30 Periods** **Practical : 0 Periods** **Total: 75 Periods**

TEXT BOOKS:

1. *Veerarajan T "**Transforms and Partial Differential Equations**" Tata McGraw Hill Publishing Co., New Delhi, 2015.*
2. *Kandasamy, Thilagavathy and Gunavathy "Engineering Mathematics" for III Semester B.E/B.Tech" S.Chand& Co, Ramnagar, New Delhi, 2013.*

REFERENCE BOOKS :

1. *Grewal B .S "**Higher Engineering Mathematics**" Khanna Publishers, New Delhi, 43rd Edition,2014.*
2. *Ramana B. V "**Higher Engineering Mathematics**" Tata McGraw Hill Co. Ltd., New Delhi, 11th Edition, Reprint, 2010.*
3. *Bali N., Goyal M "**Transforms and Partial differential equations**" University Science Press,New Delhi, 2010.*
4. *Ray Wylie C and Louis C Barrett "**Advanced Engineering Mathematics**" McGraw Hill Education(India) Pvt Ltd, New Delhi, 6th Edition, Reprint, 2014.*
5. *Donald.A. McQuarrie "**Mathematical Methods for Scientists and Engineers**" Viva Books Pvt Ltd, New Delhi, Ist Edition, Reprint 2015.*

COURSE OUTCOME:

CO1: Understand the concepts of Fourier series and its construction when discrete and continuous form is known

CO2: Acquire fluency in Fourier transforms in order to solve improper integrals.

CO3: Understand the standard and special types of partial differential equations.

CO4: Gain fluency in solving boundary value problems.

CO5: Understand the Z transform methods to find solutions of difference equations.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	-	-	-	-	-	-	H	-	-	H	-	-
CO2	M	H	M	-	-	-	-	-	-	M	-	-	-	M	-
CO3	H	M	-	-	-	-	-	-	-	L	-	-	H	-	-
CO4	H	H	M	-	-	M	-	-	-	M	M	-	-	-	H
CO5	M	M	M	-	-	-	-	-	-	-	-	-	-	M	-
16EBS3Z1	H	H	M	-	-	-	-	-	-	M	L	-	-	-	-

L – Low, M – Moderate (Medium), H- High

16EPC302 **FIELD THEORY** **Category: PC**

L	T	P	C
2	2	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

* To possess exhaustive information on electromagnetic and apply knowledge to practical situation.

UNIT-I : ELECTROSTATIC POTENTIAL AND FIELD	**(6+6)**
Types of charges - Charge distribution - Coulomb's Law - Gauss' law - their applications - Potential - Electric field intensity - Boundary Conditions - Solutions of Laplace and Poisson's equations – Dielectric – Electrostatic energy.	
UNIT-II : MAGNETIC POTENTIAL AND FIELD	**(6+6)**
Biot-Savart's law - Ampere's law - Their applications - Scalar and Vector magnetic potentials - Magnetic torque - Force - Boundary conditions – Energy density in magnetic field – Lifting power of electromagnet.	
UNIT-III : ELECTRO MAGNETIC FIELDS	**(6+6)**
Problems in divergence and curl of vector fields in various co-ordinates - Faraday's laws - Maxwell's equations - Current densities - Time harmonics fields - Problem.	
UNIT-IV : ELECTRO MAGNETIC WAVES	**(6+6)**
Wave equations – Wave propagation in lossy dielectrics - Plane waves in lossless dielectrics – Plane wave in free space – Plane wave in good conductor - Poynting's theorem.	
UNIT-V : FIELD MODELING AND COMPUTATION	**(6+6)**
Field plotting - Laplace equation in rectangular coordinates – Separation of variables - Finite difference method - Finite element method - Infinite square through with lid – Infinite square through with different potentials on four sides – Moment method – Generalized multipole technique – Finite difference time domain.	

Contact periods:
Lecture: 30 Periods Tutorial: 30 Periods Practical : 0 Periods Total: 60 Periods

Text Books:

1. *John D. Kraus and Daniel A.Fleisch "**Electromagnetics with Applications**" McGrawHill International Ed., 1999*
2. *William H.Hayt "**Engineering Electromagnetics**" McGraw Hill Book Co., 2006*
3. *AshutoshPramanik "**Electromagnetism**" Prentice Hall of India Pvt. Ltd, 2003*

Reference Books :

1. *Dr.Dhananjayan.P. "**Engineering Electromagnetics**", Lakshmi Publications, 2001*
2. *Mathew N.D Sadiku, "**Elements of Electromagnetic**", Oxford university press, Fourth Ed., 2007*
3. *Joseph Edminister, "**Electromagnetics**", 2nd Ed., Tata McGraw Hill Book Co., 2006*
4. *Gangadhar K.A., "**Field Theory**", Khanna Publishers, 2002*

COURSE OUTCOME:

CO1: Grasp the information on electrostatic field.
CO2: Grasp the information on magnetic field.
CO3: Obtain the information on electromagnetic field.
CO4: Illustrate the knowledge gained to analyse electromagnetic waves
CO5: Estimate the field parameters for a given problem based on field modelling.
CO6: Enumerate the applications of FEM in Electrical Engineering

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	H	H	H	L	L	L	L	M	M	M	M	L
CO2	H	H	H	H	M	M	L	L	L	L	L	M	M	L	L
CO3	H	H	H	M	M	M	L	L	L	L	L	M	M	L	L
CO4	H	H	H	M	M	L	L	L	L	L	M	M	L	L	M
CO5	H	H	H	M	M	M	L	L	L	L	M	M	H	L	M
CO6	H	H	H	H	M	M	L	L	L	L	M	M	H	L	L
16EPC302	H	H	H	H	M	M	L	L	L	L	M	M	M	L	L

L – Low, M – Moderate (Medium), H- High

16EPC303 **ELECTRIC CIRCUIT THEORY** **Category : PC**

L	T	P	C
2	2	0	3

PRE-REQUISITES:
1.16EBS1Z2 Engineering Mathematics – I

COURSE OBJECTIVE:

- To gain knowledge on the basic laws and theorems of Circuit Theory
- Make competent in analysing electrical circuits and performing basic electrical measurements to verify circuit concepts experimentally.

UNIT-I : DC CIRCUIT ANALYSIS	**(6+6)**
Ohm's law and Kirchhoff's Laws – Classification of network elements – R, L, C parameters – Energy sources - series-parallel circuits - Star-delta transformation - Source transformations - Mesh and nodal methods – Problems. Introduction to graph theory – Tree – Co-tree – Incidence matrix – Tie-set matrix and cut-set matrix.	
UNIT-II : AC CIRCUIT ANALYSIS	**(6+6)**
Waveform representation – 'j' operator – Voltage and current values - Form Factor and Peak Factor for different patterns of alternating waveforms - Phase relation in Pure R, L & C - Power factor - Real, reactive and apparent powers - Impedance diagram – Phasor diagram – Series circuits – Parallel circuits – Compound circuits – Mesh and nodal methods - Problems	
UNIT-III : NETWORK THEOREMS	**(6+6)**
Superposition theorem – Thevenin's and Norton's theorems - Maximum power transfer theorem - Reciprocity theorem - Compensation theorem - Tellegen's theorem - Millman's theorem - Duals and Duality – Problems.	
UNIT-IV : COUPLED CIRCUITS AND TRANSIENTS	**(6+6)**
Introduction to coupled circuits – Mutual inductance – Coefficient of coupling - Ideal transformer - Dot rule - Single and double tuned circuits - Problems. Transient response – DC response of RL, RC, R L C circuits – Sinusoidal response of RL, RC, RLC circuits – Problems.	
UNIT-V : POLYPHASE CIRCUITS	**(6+6)**
Three phase system – Advantages - Interconnection of three- phase sources and loads - Balanced and unbalanced circuits - Power measurement by one, two and three wattmeter methods - Reactive power measurement - Problems.	

Contact periods:
Lecture: 30 Periods Tutorial: 30 Periods Practical : 0 Periods Total: 60 Periods

Text Books:
1. *Sudakar A. and Shyam Mohan S.Palli* ***"Circuits and Networks (Analysis and Synthesis)"*** *Tata McGraw Hill Book Co., New Delhi, III Ed., 2007*
2. *A.Chakrabarti* ***"Circuit Theory – Analysis and Synthesis"*** *Dhanpat Rai & Co. New Delhi, V Ed. 2006*

Reference Books :
1. *Arumugam and Prem Kumar, "**Electric Circuit Theory**", Khanna Publishers, New Delhi,2000*
2. *Joseph Edminister, "**Electric Circuits**", Schaum's outline series, Tata McGraw Hill Book Company, Third Ed., 1999*
3. *Hayt W.H and Kemmerley J.E, "**Engineering Circuit Analysis**", Tata McGraw Hill Book Co., V Ed., 2002*
4. *Gangadhar K.A., "**Circuit Theory**", Khanna Publishers, II Ed., 1997*

COURSE OUTCOME:

CO1: Identify the main circuit elements and apply Kirchhoff's Laws to calculate currents, voltages and powers in typical linear and nonlinear electric circuits using a variety of analytical methods for DC, AC, transient and nonlinear analyses.

CO2: Reduce more complicated circuits into the Thevenin's and Norton's equivalent circuits.

CO3: Describe circuit elements in phasor domain and perform steady-state analysis using phasors.

CO4: Connect correctly an electrical circuit according to a given circuit diagram and use the analogue and digital multimeters and oscilloscope to display and measure basic electrical signals.

CO5: Analyze more complicated circuits into equivalent circuits using theorems.

CO6: Evaluate the solution of three phase AC balanced and unbalanced circuits.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	L	L	H	H	M	-	H	H	H	H	M	H	H
CO2	H	H	M	L	H	H	M	-	H	H	H	H	M	M	M
CO3	H	M	M	L	H	H	H	-	H	H	H	H	M	M	M
CO4	H	L	L	L	H	H	H	-	H	H	H	H	M	H	H
CO5	H	H	M	L	H	H	H	-	H	H	H	H	M	M	M
CO6	H	H	M	M	H	H	H	H	H	H	H	H	M	M	H
16EPC303	H	H	M	L	H	H	H	H	H	H	H	H	M	M	M

L – Low, M – Moderate (Medium), H- High

16EPC304 **ELECTRONIC CIRCUITS – I** **Category: PC**

PRE-REQUISITES:

1. 16EPS2Z3 Materials Science

L	T	P	C
2	2	0	3

COURSE OBJECTIVE:

- To understand the working of electronic devices analyze and design the electronic circuits for various applications.

UNIT-I : DIODES, SPECIAL DIODES AND APPLICATIONS	**(6+6)**
PN diode: diode, biasing, voltage - Current characteristics, PN diode applications: Half-wave and Full-wave rectifiers with filters, clipper and clamping circuits. Zener diodes Avalanche and Zener breakdown – Applications - Uni-Junction Transistors - Photo diode	
UNIT-II : BI-POLAR JUNCTION TRANSISTORS AND BIASING	**(6+6)**
BJT, JFET and MOSFET: Structure, operation and characteristics with parameters; as an amplifier and switch. - Biasing: DC operating point - Other methods of biasing	
UNIT-III : AMPLIFIERS	**(6+6)**
BJT - BJT small signal model - CE, CC, CB, multistage, RC-coupled, transformer coupled, Darlington and differential amplifiers. MOSFET small signal model - Analysis of CS and Source follower	
UNIT-IV : FREQURNCY RESPONSE AND POWER AMPLIFIERS	**(6+6)**
BJT and FET amplifiers: basics of frequency response, Low, high and total Frequency response - Power amplifiers: operation, characteristics, parameters of Class A, AB, B & C amplifiers	
UNIT-V : FEEDBACK AMPLIFIERS AND OSCILLATORS	**(6+6)**
Basic concept of feedback - Effects of feedback - Voltage and current feedback circuits - Sine wave oscillators RC phase shift, Wein Bridge, Hartley and Colpitt's oscillators - Crystal oscillators	

Contact periods:
Lecture: 30 Periods Tutorial: 30 Periods Practical : 0 Periods Total: 60 Periods

Text Books:

1. *Thomas L.Floyd, **"Electronic Devices (Conventional Current flow version)"** 9th Ed., Prentice Hall, 2012*
2. *Robert L.Boylestad& Louis Nashelsky **"Electronic Devices and Circuit Theory"** 10thEd.,Prentice Hall, 2009*

Reference Books :

1. *Jacob Millman, Christos C Halkias and Satyabrata JIT, "**Electron Devices and Circuits**", 2nd Ed., Tata McGraw Hill, 2008*
2. *Allen Mottershead, "**Electronic Devices and Circuits, An Introduction**", Eastern Economy Ed., Prentice-Hall of India, 2009*

COURSE OUTCOME:

CO1: To learn the construction and working of semiconductor devices.
CO2: Determination of characteristics of various devices.
CO3: To investigate different configurations of devices and their parameters.
CO4: Response of electronic circuits under diverse operating conditions.
CO5: Design of circuits for real time applications.
CO6: Improvement of functioning of circuits using specific techniques.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	M	-	-	-	-	-	-	-	M	-	-
CO2	H	H	M	M	M	-	-	-	-	-	-	-	H	-	-
CO3	M	M	M	H	M	-	-	-	-	-	-	M	H	H	M
CO4	M	H	M	M	M	-	-	-	-	-	M	-	M	H	M
CO5	H	H	M	H	M	-	M	-	-	-	M	M	-	H	M
CO6	M	H	H	H	M	-	M	-	-	L	-	H	-	H	H
16EPC304	M	H	M	H	M	-	M	-	-	L	M	M	M	H	M

L – Low, M – Moderate (Medium), H- High

16EES305 THERMAL ENGINEERING AND FLUID MECHANICS CATEGORY:ES

(Common to EIE)

PRE- REQUISITE:

L	T	P	C
4	0	0	4

1 16EES105 Basics of Civil and Mechanical Engineering

COURSE OBJECTIVES

* To identify, formulate and solve engineering problems in classical thermodynamics involving closed and open systems for both steady state and transient processes.
* To analyze problems using fluid mechanics.

SECTION A: THERMAL ENGINEERING

UNIT - I : BASIC CONCEPTS OF THERMODYNAMICS	**10**
Basic definitions of thermodynamics - Point and Path functions – Study of Closed and Open systems, Steady flow processes – Applications - Kelvin Plank and Clausis statements, Heat engines, Refrigerators, Heat pumps, Efficiency and COP.	
UNIT - II : THERMODYNAMIC CYCLES	**10**
Otto, Diesel, Dual and brayton cycles, Air-Standard efficiency, Mean effective pressure PV and TS diagrams - Applications. Performance testing of I.C Engines – Applications.	
UNIT - III : AIR COMPRESSORS	**10**
Reciprocating compressors - effect of clearance - multi staging - optimum intercooler pressure and perfect intercooling - rotary compressors - centrifugal, axial flow compressors- problems	

CONTACT PERIODS

Lecture : 30 periods Tutorial : 0 Periods Practical : 0 Periods Total : 30 periods

Text Books:

1. Nag, P.K "***Engineering Thermodynamics***", Tata McGraw Hill Publishing Company, New Delhi.
2. Domkundwar and Kothandaram "***Thermal Engineering***", S. Chand and Co., 1996.

Reference Books:

1. Rajput R.K "***Thermal Engineering***" Laxmi Publications (P) Ltd.
2. Rai, K.S. & Sarao, "***Thermal Engineering***" Satya Prakashan 1990.
3. Sarkar, B.K, "***Thermal Engineering***" Tata McGraw Hill Co., Ltd.1998.
4. Ramalingam, K.K., "***Internal Combustion Engines-Theory and Practice****"* Scitech Publications 1999.
5. Ganesan V "***Internal Combustion Engines***" Tata McGraw Hill, New Delhi, 1994.

SECTION B: FLUID MECHANICS

UNIT - I : FLUID PROPERTIES	08
Units and Dimensions – Fluid properties – Density, Specific gravity, Viscosity, Surface tension, capillarity – Pascal's law – Pressure measurements – Piezometer, Manometers	
UNIT - II : EQUATIONS OF FLUID FLOW	**12**
Types of fluid flow – Types of flow line – Control volume – Continuity equation – One dimensional and three dimensional form – Energy equation – Euler and Bernoulli's equations – Applications – Impulse momentum equation (principle only)	
UNIT - III : INTRODUCTION TO HYDRAULIC MACHINES	**10**
Hydraulic Turbines – Classifications – Constructions and working principles of Pelton wheel, Francis and Kaplan Turbines – Specific speed - Pumps – Classifications – Centrifugal pump – Working principle – Performance curves – Specific speed - Reciprocation pump – Components and working – Jet pump – Gear pump – Submersible pump.	

Contact Periods:

Lecture : 30 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 30 Periods

Text Books:

1. Rajput.R.K. "***A Text Book of Fluid Mechanics and Hydraulic machines***" S.Chand and company, New Delhi,2002
2. Kumar.K.L. "***Engineering Fluid Mechanics***" Eurasia Publishing House (P) Ltd. New Delhi,2000.

Reference Books:

1. Ramamurtham.S and Narayanan. R "***Fluid Hydraulics and Fluid Machines***" Dhanpat Rai Publishing House (P) Ltd. New Delhi, 2000.
2. Streeter, Victor L, and Wylie, E. Benjamin "***Fluid Mechanics***" McGraw Hill Ltd.1998.
3. Natarajan.M.K. "***Fluid Machines***" Anuradha Agencies, Vidayal Karuppur, Kumbakonaam, 1995.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: To appreciate concepts of conservation of mass, conservation of energy, and the Laws of thermodynamics.

CO2: To determine the thermodynamic properties of simple compressible substances

CO3: To recognize the type of fluid flow that is occurring in a particular physical system

CO4: To choose the appropriate fluid mechanic principles needed to analyze fluid-flow Situations

CO5: To conduct the performance study of pumps and turbines

COURSE ARTICULATION MARTIX

CO	PO 1	PO 2	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	H	H	H	H	M	H	M	H	M	M	L	M	H	M	M
CO2	H	H	H	M	M	M	M	L	M	L	L	M	M	H	M
CO3	H	H	M	H	M	M	L	L	M	L	M	M	H	M	M
CO4	M	H	H	M	M	L	M	H	M	M	L	M	M	M	M
CO5	H	M	M	H	M	L	L	M	M	L	M	M	H	M	M
16EES305	H	H	M	M	M	M	M	M	M	L	L	M	M	M	M

L- Low, M-Moderate (Medium), H-High

16EES306 **OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES** **Category : ES**

PRE-REQUISITES:

1. 16EES2Z5 Programming in C

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To learn Object-Oriented programming concepts and technique also to write, test, and debug introductory level Object-Oriented programs as well as to introduce linear, non-linear data structures and their applications.

UNIT-I : DATA ABSTRACTION & OVERLOADING	**(09)**
Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables – Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function – Dynamic Memory Allocation – Static Class Members – Container Classes and Integrators – Proxy Classes – Overloading: Function overloading and Operator Overloading.	
UNIT-II : INHERITANCE & POLYMORPHISM	**(09)**
Base Classes and Derived Classes – Protected Members – Casting Class pointers and Member Functions – Overriding – Public, Protected and Private Inheritance – Constructors and Destructors in derived Classes – Implicit Derived – Class Object To Base – Class Object Conversion – Composition Vs. Inheritance – Virtual functions – This Pointer – Abstract Base Classes and Concrete Classes – Virtual Destructors – Dynamic Binding.	
UNIT-III : LINEAR DATA STRUCTURES	**(10)**
Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation — Singly linked lists –Polynomial Manipulation – Stack ADT – Queue ADT – Evaluating arithmetic expressions.	
UNIT-IV : NON-LINEAR DATA STRUCTURES	**(09)**
Trees – Binary Trees – Binary tree representation and traversals – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-First search – Depth-first search – Connected components.	
UNIT-V : SORTING and SEARCHING	**(08)**
Sorting algorithms: Insertion sort – Quick sort – Merge sort – Searching: Linear search – Binary Search.	

Contact periods:
Lecture: 45 Periods **Tutorial: Nil** **Practical: Nil** **Total: 45 Periods**

Text Books:

1. *Deitel and Deite **"C++, How To Program"** Fifth Edition, Pearson Education, 2005.*
2. *Mark Allen Weiss **"Data Structures and Algorithm Analysis in C++"** Third Edition, Addison-Wesley, 2007*

Reference Books :

1. *Bhushan Trivedi, "**Programming with ANSI C++, A Step-By-Step approach**", Oxford University Press, 2010.*
2. *Goodrich, Michael T., Roberto Tamassia, David Mount, "**Data Structures and Algorithms in C++**", 7th Edition, Wiley. 2004.*
3. *Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "**Introduction to Algorithms**", Second Edition, Mc Graw Hill, 2002.*
4. *Bjarne Stroustrup, "**The C++ Programming Language**", 3rd Edition, Pearson Education, 2007.*
5. *Ellis Horowitz, SartajSahni and Dinesh Mehta, "**Fundamentals of Data Structures in C++**", Galgotia Publications, 2007.*

COURSE OUTCOME:

CO1: Apply the concept of objects and their significance in real world also Write simple applications using C++.

CO2: Investigate software problem in terms of objects and entities.

CO3: Correlate relationship among different entities involved in a system and find dependency and roles in an environment.

CO4: Develop software in terms of objects, associations, and integrity constraints

CO5: Identify, understand and analyze various sample development models.

CO6: Discuss the different methods of organizing large amount of data.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	M	M	-	M	-	-	-	M	M	-	M	M	-	-
CO2	M	H	H	H	M	M	M	M	M	M	L	M	M	-	-
CO3	L	-	-	-	M	-	-	-	M	M	-	M	L	-	-
CO4	L	M	L	M	M	M	L	L	M	M	L	M	L	-	-
CO5	M	L	-	-	M	-	-	-	M	M	-	M	L	M	M
CO6	H	H	H	H	H	M	M	M	H	H	M	H	M	M	M
16EES306	M	M	H	H	M	M	M	M	M	M	L	M	L	M	M

L – Low, M – Moderate (Medium), H- High

16EPC307 CIRCUITS AND ELECTRONIC DEVICES LABORATORY Category: PC

L	T	P	C
0	0	4	2

PRE-REQUISITES: Nil

COURSE OBJECTIVE:

* To verify the basic laws and theorems of circuit theory and characteristics of semiconductor devices.

LIST OF EXPERIMENTS:

1. Verification of Ohm's Law and Kirchhoff's laws
2. Verification of Thevenin's theorem
3. Verification of Superposition theorem
4. Verification of Maximum Power Transfer theorem
5. Verification of Reciprocity theorem
6. Determination of parameters of coupling circuits
7. Parameters of Fluorescent light circuit.
8. Measurement of three phase power by two wattmeter method
9. Semiconductor diode characteristics
10. Zener diode characteristics and voltage regulation
11. Transistor characteristics - common emitter mode
12. Transistor characteristics - common base mode
13. Characteristics of UJT and generation of saw tooth waveforms
14. Characteristics of FET
15. Circuit analysis using PSIM

Contact periods:
Lecture: Nil Tutorial: Nil Practical: 60 Periods Total: 60 Periods

COURSE OUTCOME:

CO1: Verification the basic laws of circuit theory and various network theorems.
CO2: Infer the characteristics of signal level semiconductor devices.
CO3: Measurement of real and reactive power in three phase network
CO4: Analysis of the behaviour of semiconductor devices in various applications using simulation tool
CO5: Determination of parameters of electronic circuits
CO6: Design of gating circuit for semiconductor devices

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	M	-	-	-	-	-	-	-	H	-	-
CO2	M	H	M	M	M	-	-	-	-	-	-	-	H	-	-
CO3	H	M	H	H	M	-	-	-	-	-	-	-	H	H	M
CO4	H	M	H	M	M	-	-	-	-	M	-	L	-	H	M
CO5	M	H	H	M	M	-	-	-	-	-	-	L	-	H	M
CO6	M	M	H	M	H	-	M	-	-	-	-	L	-	H	M
16EPC307	M	M	H	M	M	-	L	-	-	L	-	L	H	H	M

L – Low, M – Moderate (Medium), H- High

16EEC308 **OBJECT ORIENTED PROGRAMMING USING C++ LABORATORY** **Category : EEC**

L	T	P	C
0	0	4	2

PRE-REQUISITES: Nil

COURSE OBJECTIVE:

- To implement the basic concepts of object oriented programming such as variables, conditional and iterative Execution, invoking methods and functions, etc.

LIST OF EXPERIMENTS:

1. Classes and Objects
2. Arrays and Structures
3. Functions
4. Inheritance
5. Operator Overloading
6. Function Overloading
7. Virtual Functions
8. Pointers
9. Templates
10. Files and Streams
11. Exception handling
12. Mini project

CONTACT PERIODS:

Lecture: Nil **Tutorial: Nil** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOME:

CO1: Apply the concepts of data encapsulation, inheritance, and polymorphism to large-scale software

CO2: Discuss the different data structures to represent real world problems

CO3: Apply the concepts of Graphical User Interfaces

CO4: To design and develop programs with Graphical User Interfaces capabilities

CO5: Explain the principles of the object oriented programming paradigm specifically including abstraction, encapsulation, inheritance and polymorphism

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	L	M	M	M	M	M	M	M	M	M	-	-
CO2	M	H	M	L	M	M	-	-	M	M	L	M	M	-	-
CO3	M	H	H	H	M	L	M	-	M	M	L	M	H	H	M
CO4	M	M	M	M	M	M	-	-	M	M	-	M	M	-	-
CO5	M	L	M	L	M	L	M	M	M	M	M	M	M	-	-
16EEC308	M	H	M	L	M	M	M	M	M	M	L	M	M	H	M

L – Low, M – Moderate (Medium), H- High

16EES309 **THERMAL ENGINEERING AND FLUID MECHANICS LABORATORY** **Category: ES**

L	T	P	C
0	0	4	2

PRE- REQUISITE: Nil

COURSE OBJECTIVES

- To draw the valve and port timing diagrams of I.C engine.
- To estimate the speed of engine by various instruments.

LIST OF EXPERIMENTS:

SECTION A: THERMAL ENGINEERING

1. Valve timing and Port timing diagrams for I.C. engines.
2. Engine performance evaluation using DC generator as loading device.
3. Performance evaluation using Rope Brake dynamometer.
4. Performance evaluation of engine using Swinging field dynamometer.
5. Estimation of frictional power by fuel consumption measurement and verification by retardation test.
6. Estimation of economical load and economical speed of engine.
7. Test on reciprocating air compressor.
8. Test on constant speed air blower.
9. Fan laws verification on variable speed air blower.

SECTION B: FLUID MECHANICS

1. Determination of Darcy's friction factor.
2. Calibration of Flow Meters – Venture meter and Orifice meter.
3. Performance of Rotodynamic pumps.
4. Performance of positive displacement pumps.
5. Performance of Jet pumps.
6. Load test on Pelton Wheel turbine, Kaplan turbine
7. Verification of Bernoulli's theorem.

Contact Periods :

Lecture: Nil **Tutorial: Nil** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOMES:

Upon completion of the course, the student will be able

CO1 : To evaluate the performance of engine using dynamometer.

CO2 : To estimate the power and speed of engine by suitable methods.

CO3 : To perform operations of different types of pumps

CO4 : To calibrate the flow meter using proper designs

COURSE ARTICULATION MARTIX

CO	PO 1	PO 2	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	H	H	H	H	M	L	M	L	M	M	M	M	H	M	M
CO2	H	H	H	H	M	L	M	L	M	M	M	M	H	M	M
CO3	H	H	H	H	M	L	M	L	M	M	M	M	H	M	M
CO4	H	H	H	H	M	L	M	L	M	M	M	M	H	M	M
16EES309	H	H	H	H	M	L	M	L	M	M	M	M	H	M	M

L – Low, M – Moderate (Medium), H- High

16EBS401 **NUMERICAL METHODS** **Category : BS**

(*Common to Civil, Mech. & Electrical Engg.)*

PREREQUISITES: NIL

L	**T**	**P**	**C**
3	**2**	**0**	**4**

COURSE OBJECTIVES:

- To familiarize with numerical solutions of equation with one variable and system of equations.
- To obtain the knowledge of numerical interpolation, numerical differentiation and numerical integration.
- To acquire knowledge of numerical solution to first order ordinary differential equations using single and multi step techniques.
- To gain the knowledge of numerical solution to second order partial differential equations using explicit and implicit methods.

UNIT-I : SOLUTIONS OF EQUATIONS AND EIGEN VALUE PROBLEMS	**(9+6)**
Iterative method - Newton Raphson method for single variable and simultaneous equations with two variables-Solutions of linear system of equations - Gauss Elimination, Gauss Jordan, Gauss Seidel method - Eigen value of Matrix by Power method.	
UNIT-II : INTERPOLATION	**(9+6)**
Operators - Relation between the operators - Newton's divided difference formula - Lagrange's and Hermite's polynomials - Newton Forward and backward difference formula - Stirling's and Bessel's central difference formulae.	
UNIT-III : NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	**(9+6)**
Numerical approximation of derivatives using interpolation polynomials - Numerical integration by Trapezoidal, Simpson's one third and Simpson's three eighth rules - Two point and three point Gaussian quadrature formula - Double integration using Trapezoidal and Simpson one third rule - Difference equation	
UNIT-IV : NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	**(9+6)**
Taylor series method - Euler method - Modified Euler method - Fourth order RungeKutta method for solving first order equations - Predictor and corrector methods: Milne's and Adam Bashforth methods	
UNIT-V : NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS	**(9+6)**
Finite difference solutions for the second order ordinary differential equations - Finite difference solutions for one dimensional Heat Equation (Both Explicit and Implicit Methods) – One dimensional wave equation - Laplace and Poisson equation.	

Contact periods:

Lecture: 45 Periods **Tutorial: 30 Periods** **Practical: 0 Periods** **Total: 75 Periods**

Text Books:

1. *Kandasamy P, Thilagavathy K and Gunavathy K **"Numerical Methods"** S.Chand& Co, Ramnagar, New Delhi, Reprint 2013.*
2. *Veerarajan T and Ramachandran T **"Numerical Methods with Programming in C"** McGraw Hill Education Pvt Ltd, New Delhi, Ist Edition, Reprint,2016.*

Reference Books:

1. *Grewal B S **"Higher Engineering Mathematics"** Khanna Publishers, New Delhi, 43rd Edition,2014.*
2. *Balagurusamy E **"Numerical Methods"** McGraw Hill Education Pvt Ltd, New Delhi, I Edition Reprint, 2016.*
3. *Dr. Manish Goyal **"Statistics and Numerical Methods"** University Science Press, New Delhi, 2010.*
4. *Dr. J.S. Chitode **"Numerical Methods"** Technical Publications, Pune, 2010.*
5. *Ken F.Riley , Mike P.Hobson and Stephen J. Bence **"Fundamentals of Engineering Numerical Analysis"** Cambridge University Press, New Delhi, 2015.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the numerical solutions to algebraic, exponential, logarithmic, transcendental and linear system of simultaneous equations.

CO2: Acquire fluency in numerical interpolation techniques with equal and unequal intervals.

CO3: Understand the techniques of finite differences to apply for numerical differentiation, numerical quadrature and numerical cubature.

CO4: Understanding numerical solution to first order ordinary differential equations by different methods like single step and multistep etc.,

CO5: Understanding numerical solution to second order partial differential equations by different methods using finite differences.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	L	-	-	-	-	-	-	-	M	-	-	H	M	M
CO2	H	-	-	H	-	-	-	-	-	H	-	-	H	H	H
CO3	H	M	M	-	-	L	-	-	-	H	M	-	H	H	M
CO4	H	H	-	-	-	-	-	-	-	H	H	-	H	M	M
CO5	H	H	-	-	-	-	-	-	-	H	H	-	H	H	H
16EBS401	H	H	M	H	-	L	-	-	-	H	H	-	H	H	M

L – Low, M – Moderate (Medium), H- High

16EPC402 **NETWORK ANALYSIS AND SYNTHESIS** **Category: PC**

L	T	P	C
2	2	0	3

PRE-REQUISITES:

1. 16EPC303 Electric Circuit Theory

COURSE OBJECTIVES:

- To gain thorough knowledge on analysis, design and synthesis of electrical networks.

UNIT-I : ONE PORT AND TWO PORT NETWORKS	**(5+6)**
Driving point impedance and admittance of one port network - Two port networks - Open circuit impedance and short circuit admittance parameters – Transmission and inverse transmission parameters – Hybrid and inverse hybrid parameters- Image parameters-Application.	
UNIT-II : NETWORK FUNCTIONS	**(6+6)**
Network functions: Singularity functions – Unit functions – Shifter functions – Gate function. Transfer Functions of Two-port network –Poles and Zeros – Necessary conditions for Driving point and Transfer functions – Time domain response from pole – zero plot – Amplitude and phase response from pole zero plot – Stability criterion for active network – Routh criteria.	
UNIT-III : RESONANCE	**(6+6)**
Series resonance – Impedance, phase angle voltages and currents – BW of an RLC circuit - Q factor and its effect on bandwidth – Magnification in resonance – Parallel Resonance – Resonant frequency for a tank circuit – Variation of impedance with frequency – Q factor of parallel resonance- Pole zero configuration in parallel resonance circuits – Multiple resonance in high –Q circuits.	
UNIT-IV : FILTERS AND ATTENUATORS	**(7+6)**
Classification of filters - Low pass and high pass filters - Band pass and Band stop filters- Constant K and m-derived filters. Attenuators – Types of Attenuators – T-type – Π-type – Lattice – Bridged T and L-Type Attenuator.	
UNIT-V : ELEMENTS OF REALIZABILITY AND NETWORK SYNTHESIS	**(6+6)**
Hurwitz polynomials - Positive real function – Frequency response of reactive one-port networks - Synthesis of reactive one port RL, RC networks using Cauer and Foster methods.	

Contact Periods:
Lecture: 30 Periods Tutorial: 30 Periods Practical: 0 Periods Total: 60 Periods

Text Books:

1. *C.L.Wadhwa "**Network Analysis**" New Age International Publishers, Delhi, 2004*
2. *Sudakar A. and Shyam Mohan S.Palli "**Circuits and Networks (Analysis and Synthesis)**" Tata McGraw Hill Book Co., New Delhi, Third Ed., 2007*

Reference Books:

1. *C.P. Kuriakose, "**Circuit Theory: Continuous and Discrete – time systems – Elements of Network Synthesis** " PHI, Delhi, 2005*
2. *A.Chakrabarti , "**Circuit Theory – Analysis and Synthesis**" , Dhanpat Rai & Co. New Delhi, Fifth Ed. 2006*
3. *M.E.Van Valkenburg, "**Network Analysis**", PHI, Delhi, 2003*

COURSE OUTCOME:

CO1: Analyze the concepts of resonance and network functions
CO2: Design filter circuits and synthesize electric networks from network functions.
CO3: Apply the fundamental concepts in solving and analyzing different Electrical networks
CO4: Select appropriate and relevant technique for solving the Electrical network in different conditions
CO5: Apply mathematics in analyzing and synthesizing the networks in time and frequency domain
CO6: Estimate the performance of a particular network from its analysis

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	-	L	L	L	L	L	M	M	M	L	L	L	L
CO2	L	M	H	L	H	L	M	H	H	L	H	H	M	H	L
CO3	H	H	L	M	L	H	L	M	M	L	L	L	H	M	M
CO4	M	M	H	H	L	L	H	H	L	M	M	H	M	L	H
CO5	H	M	L	H	H	M	L	L	L	L	L	L	H	L	M
CO6	L	-	H	M	M	H	H	L	H	M	H	H	L	H	L
16EPC402	H	M	H	M	L	L	H	M	M	M	M	H	H	L	M

L – Low, M – Moderate (Medium), H- High

16EPC403 **DC MACHINES AND TRANSFORMERS** **Category :PC**

L	T	P	C
2	2	0	3

PRE-REQUISITES:

1. 16EPC303 Electric Circuit theory
2. 16EPC302 Field theory

COURSE OBJECTIVES:

- To understand the working of DC machines and transformers using principles of electromagnetism and electromechanical energy conversion and to study the characteristics and testing of DC machines and transformers

UNIT-I : PRINCIPLES OF ELECTROMECHANICAL ENERGY CONVERSION	**(5+6)**
Energy in magnetic system – Field energy and co energy - Force and torque equations – Singly and multiply excited magnetic field systems - mmf of distributed ac windings – Winding Inductances - Rotating Magnetic Field and mmf waves - Magnetic saturation and leakage fluxes.	
UNIT-II : DC GENERATORS	**(6+6)**
Constructional details and principle of operation - Emf equation – Types of dc generators - Commutation – Armature reaction – Effects of armature reaction – Characteristics of DC generators - Parallel operation of dc generators	
UNIT-III : DC MOTORS	**(6+6)**
Constructional details and principle of operation – Types of dc motors - Torque equation – Electrical and mechanical characteristics of different types of DC motors — DC motor Starters – Speed control methods - Electric braking: Plugging, Dynamic and Regenerative Braking	
UNIT-IV : TRANSFORMERS	**(7+6)**
Principle of operation – Types and constructional features of single phase and three phase transformers –EMF equation - Phasor diagram – Transformers on load - Equivalent circuit – Voltage Regulation and efficiency- All day efficiency – Three phase transformer connections – Scott connection – Parallel operation of three phase transformers – Inrush current phenomenon and its prevention - Auto transformers, Off-load and on-load tap changing transformer	
UNIT-V : TESTING OF DC MACHINES AND TRANSFORMERS	**(6+6)**
DC machines: Brake test, field test, Retardation test - Swinburne's test - Hopkinson's test. Transformers: Open Circuit and Short Circuit Tests-– Phasing, Identification and Polarity of transformer winding - Sumpner's test	

Contact Periods :
Lecture: 30 Periods **Tutorial: 30 Periods** **Practical: 0 Periods** **Total: 60 Periods**

Text Books:

1. *Kothari D.P. and Nagrath I.J **"Electric Machines"** Tata McGraw Hill, Fourth Ed., 2010*
2. *Fitzgerald A.E., Charles Kingsly C. Stephen D. Umans **"Electric Machinery"** Tata McGraw Hill, 6th Ed., 2013*

Reference Books :

1. *Bimbhra P.S., "**Electrical Machinery**", Khanna Publishers, New Delhi, 7TH EDITION, 2011*
2. *Sen S.K., "**Electric Machinery**", Khanna Publishers, New Delhi, 2008*
3. *Say M.G., "**Alternating Current Machines**", 5th Ed., Pitman Publishing,1984*
4. *Irving. L. Kosow, "**Electrical Machines and Transformers**", PHI, 2 nd Ed., 2007*
5. *Theraja B.L. and Theraja A.K., "**A Text Book of Electrical Technology**", Vol. II, S.Chand & Co. Ltd., New Delhi,23rd edition, 2007*

COURSE OUTCOME:

CO1: Apply basic laws of electromagnetic principles for static and dynamic electric machines
CO2: Analyze the performance of electrical machines for the different level of utilization in Industries
CO3: Identify suitable machine for any specific application
CO4: Perform testing of the electrical machines
CO5: Evaluate the performance of electrical machines

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	M	M	L	L	M	L	L	M	H	L	H	M	M
CO2	H	H	H	H	M	L	M	H	M	M	H	H	M	H	M
CO3	M	M	H	H	L	L	M	H	M	M	H	H	M	H	M
CO4	M	M	H	H	L	M	M	L	L	M	M	M	M	H	M
CO5	M	M	H	H	L	L	M	H	M	M	H	H	M	H	M
16EPC403	H	H	H	H	L	L	M	M	M	M	H	M	M	H	M

L – Low, M – Moderate (Medium), H- High

16EPC404 **ELECTRONIC CIRCUITS – II** **Category: PC**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

16EPC304 - Electronic Circuits - I

COURSE OBJECTIVE:

- To examine the response and design of electronic circuits for diverse utilization.

UNIT-I : IC FABRICATION	**(09)**
IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realization of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance and FETs.	
UNIT-II : OPERATIONAL AMPLIFIERS CHARACTERISTICS	**(09)**
Functional block diagram - Ideal op-amp - Open loop and closed loop operation – CMRR - Input bias and offset currents - Input and output offset voltages - Compensation techniques - Frequency response of op-amp - Transfer characteristics - Slew rate - Bandwidth.	
UNIT-III : APPLICATIONS OF OPERATIONAL AMPLIFIERS	**(09)**
Inverting and Non Inverting amplifiers – Differential amplifiers - Integrator and differentiator - Active Filters – Voltage to frequency converters – Sample and Hold circuits – Instrumentation amplifiers – Comparators – Zero crossing detectors – Square and triangular waveform generator	
UNIT-IV : 555 TIMERS, A/D AND D/A CONVERTERS	**(09)**
555 timer – Functional block diagram - Astable and monostable operation of 555 timer – Applications - Frequency counters – A/D converters (Flash and successive approximation types) - D/A converters(R- 2R ladder and weighted resistor types)	
UNIT-V : APPLICATION ICs	**(09)**
Positive and negative voltage regulators (IC723) Adjustable voltage regulators (LM117/LM317) – Dual tracking regulators (78xx & 79xx Series) – Programmable supply – SMPS - LM 380 power amplifier - ICL 8038 function generator IC.	

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Roy Choudhry D. and Shail Jain "**Linear Integrated Circuits**" New Age international, New Delhi, 5th Ed., 2014*
2. *David A.Bell **"Op-amp & Linear ICs'"** Oxford, 2013.*

Reference Books :

1. *RamakantA.Gayakwad, "**OPAMPs and Linear Integrated Circuits**", Prentice Hall of India Pvt.Ltd. New Delhi, 4th Ed. 2010*
2. *Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system',Tata McGraw Hill, 2003.*

COURSE OUTCOME:

CO1: Understand the fabrication of semiconductor devices and circuits.

CO2: Analyze working of circuits in practical conditions.

CO3: Identification of suitable solutions to real time problems.

CO4: Application of circuits for interfacing and generation of waveforms.

CO5: Use of general purpose circuits to specific applications.

CO6: Utility of devices in regulated supply for electronic circuits.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	M	M	M	-	-	-	-	-	-	-	H	-	-
CO2	M	M	H	M	H	-	-	-	-	-	-	-	H	H	-
CO3	H	M	H	M	M	M	M	L	-	M	-	-	H	H	-
CO4	H	M	M	M	H	M	M	-	-	M	-	-	-	M	H
CO5	H	H	H	M	M	M	-	L	-	-	-	L	-	M	H
CO6	H	H	M	M	M	M	-	-	-	M	-	-	-	M	H
16EPC404	H	M	H	M	M	M	M	L	-	M	-	L	H	M	H

L – Low, M – Moderate (Medium), H- High

16EPC405 **DIGITAL CIRCUITS** **Category :PC**

L	T	P	C
2	2	0	3

PRE-REQUISITES:

1. 16EPC303 Electric Circuit Theory
2. 16EPC304 Electronic Circuits - I

COURSE OBJECTIVES:

- To introduce number systems, codes, basic postulates of Boolean algebra and show the correlation between Boolean expressions.

UNIT-I : BOOLEAN ALGEBRA AND LOGIC GATES	**(5+4)**
Binary Systems, Boolean Algebra and Logic gates – Boolean functions - Canonical and Standard Forms - Digital Logic gates – Integrated circuits. Gate level minimization – Map methods- NAND and NOR Implementation – Hardware Description Language.	
UNIT-II : COMBINATIONAL LOGIC	**(6+6)**
Combinational circuits - Analysis and Design Procedure- Binary adder subtractor - Decimal adder – Binary multiplier – Magnitude comparator – Decoders – Encoders – Multiplexers - HDL for Combinational Circuits	
UNIT-III : SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL LOGIC	**(7+8)**
Sequential circuits- Latches – Flip flops – Analysis of Clocked Sequential Circuits – HDL for Sequential Circuits - State Reduction and Assignment - Design Procedure. Asynchronous Circuits - Analysis Procedure - Circuits with Latches – Reduction of State Flow Tables – Race Free State Assignment – Hazards - Design Example.	
UNIT-IV : REGISTERS, COUNTERS AND MEMORY	**(6+6)**
Registers, Shift Registers, Ripple Counters, Synchronous Counters, Random Access Memory, Memory Decoding, Error Detection and Correction, Read Only Memory, Programmable Logic Array. Register Transfer Level Introduction, Algorithmic State Machines, Binary Multiplier.	
UNIT-V : DIGITAL INTEGARTED CIRCUITS	**(6+6)**
Bipolar Transistor Characteristics, RTL and DTL Circuits, Transistor – Transistor Logic (TTL) – Emitter –Coupled Logic (ECL) - Metal – Oxide Semiconductor (MOS) – Complementary MOS (CMOS) – CMOS Transmission Gate circuits - Switch Lever Modeling with HDL.	

Contact periods:
Lecture: 30 Periods Tutorial: 30 Periods Practical: 0 Period Total: 60 Periods

Text Books:

1. *Charles H.Roth **"Fundamentals of Logic Design"** SixthEd., Jaico Publishing House, 2000*
2. *Morris Mano,M **"Digital Design"** Pearson Education,New Delhi, 4th Ed., 2011*

Reference Books :

1. *Ronald J. Tocci, Neal S Widmer,Gregory L Moss, "**Digital Systems: Principles andApplications**", Pearson/Prentice Hall,2004*
2. *Floyd,Floyd Thomas L.,**"Digital fundamentals"** Pearson Education, New Delhi9th Ed.,2006*

COURSE OUTCOME:

CO1: Apply the fundamentals of digital circuits
CO2: Design combinational, sequential digital logic circuits and integrated circuits
CO3: Study the applications of registers, counters and memory.
CO4: Outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
CO5: Understand the operation of all types of digital circuits,
CO6: Analyse the application areas of digital circuits.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	H	H	L	L	L	-	L	M	M	H	L	L
CO2	H	H	H	H	H	M	L	-	-	-	M	H	H	L	M
CO3	M	H	H	H	M	L	L	-	L	-	M	H	M	L	M
CO4	H	H	H	H	H	L	L	-	-	L	H	M	H	L	M
CO5	H	H	M	H	M	L	L	-	-	-	M	M	M	L	L
CO6	H	H	M	H	H	M	L	L	L	L	H	H	H	L	M
16EPC405	H	H	H	H	H	M	L	L	L	L	M	H	H	L	M

L – Low, M – Moderate (Medium), H- High

16EPC406 ELECTRICAL AND ELECTRONIC MEASUREMENTS Category: PC

	L	T	P	C
PRE-REQUISITES: NIL	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the operation and construction of all types of electrical and electronics measuring instruments and the importance of instruments in measurements.

UNIT-I : MEASUREMENTS OF ELECTRICAL QUANTITIES AND ERROR ANALYSIS	**(10)**
Functional elements of Instruments, Limiting errors of instruments - Combination of limiting errors – Gross, systematic and random errors in measurements - Statistical analysis of errors-Standards and calibrations - Principle of operation of permanent magnet moving coil, moving iron, dynamometer, induction, thermal and rectifier instruments - Extension of instrument ranges.	
UNIT-II : MEASUREMENTS OF R, L AND C USING BRIDGES	**(09)**
Wheatstone, Kelvin, Wein, Hay's, Maxwell, Anderson and Schering bridges - Q meter - Measurement of self and mutual inductances - Wagner earthing device - Megger.	
UNIT-III : MEASUREMENTS OF MAGNETIC QUANTITIES AND INSTRUMENT TRANSFORMERS	**(09)**
DC ballistic and vibration galvanometers – Flux meters – B-H curve and permeability measurements on ring and bar specimens – Iron loss measurement by magnetic squares – Instrument transformers - Instrument transformer errors - Instruments for measurement of frequency and power factor - KVAR meters - Synchroscope .	
UNIT-IV : ELECTRONIC INSTRUMENTATION	**(09)**
Sensors and Transducers – Signal Conditioning - Digital voltmeter – DMM – Digital Clamp meter - True RMS meter - Standard signal generators - Function generator - Spectrum analyzer - Power Quality analyzer- Network analyzer - Distortion factor meter - Frequency meters.	
UNIT-V : DISPLAY DEVICES AND RECORDERS	**(08)**
Digital storage oscilloscope - Sampling Oscilloscope - Active and passive probes - Errors in measurement – calibration of probes - Seven segment display – LED, LCD, Dot matrix - Strip-chart and X-Y recorders – Introduction to Smart meters.	

Contact Periods :
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Sawhney A.K., "**A Course in Electrical and Electronics Measurements and Instrumentation**" Dhanpat Rai & Sons,19th edition 2011*
2. *Rangan C.S., Sharma G.R and Mani V.S.V "**Instrumentation Devices and Systems**" Tata McGraw Hill Book Co., New Delhi, 2004*

Reference books:

1. *Golding E.W. and Widdis F.G., "**Electrical Measurements and Measuring Instruments**", A.H. Wheeler & Co., Ahmedabad , 2011.*
2. *Terman F.E. and Pettit J.M., "**Electronic Measurements**", Tata McGraw Hill Book Co., New Delhi, 1984.*
3. *Alan S.Morris, "**Principles of Measurements and Instruments**", Prentice Hall of India Pvt.Ltd., New Delhi 1999.*
4. *Doebelin E.O., "**Measurement systems - Applications and Design**", Tata McGraw Hill Publishing Company, 2007.*

COURSE OUTCOME:

CO1: Define measurement parameters, standards, characteristics and errors

CO2: Demonstrate the operation of all electrical and electronics measuring instruments

CO3: Analyze the Performance characteristics of each instrument

CO4: Identify the kind of instrument suitable for typical measurements

CO5: Measure the parameters using electrical and electronics instruments

CO6: Analyse and calculate all the parameters related to measurements

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	-	L	-	-	-	L	-	L	H	M	H
CO2	H	M	M	M	L	L	-	-	-	L	-	L	H	M	M
CO3	M	H	M	M	-	-	-	-	-	-	-	-	M	H	M
CO4	M	H	M	M	-	L	-	L	-	L	L	L	H	H	H
CO5	M	H	M	H	-	L	-	-	-	-	L	L	H	H	M
CO6	M	H	M	H	-	L	-	L	-	-	L	L	M	H	H
16EPC406	M	H	M	H	L	L	-	L	-	L	L	L	H	H	H

L – Low, M – Moderate (Medium), H- High

16EPC407 ANALOG AND DIGITAL IC LABORATORY Category :PC

L	T	P	C
0	0	4	2

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* Design and development of various electronic circuits for real time applications

LIST OF EXPERIMENTS:

1. Design of Rectifier and Filter Circuits.
2. Clipper and Clamper circuits.
3. Design of Oscillator circuits.
4. Design of Transistor amplifiers.
5. Application of Timer IC. (NE/SE 555).
6. Applications of Operational Amplifier.
7. Realization of a V-to-I & I-to-V converter using Op-Amps
8. A/D and D/A Converters.
9. Study of VCO and PLL ICs.
10. Simulation of above circuits using software packages.
11. Design of Logic and Arithmetic Circuits.
12. Code Converters
13. Flip-flops and Registers.
14. Design of Counters.
15. Encoder and Decoder.
16. Multiplexer and Demultiplexer
17. Synchronous / Asynchronous circuit design.
18. PAL / PLA implementation.
19. Design Entry and simulation of combinational and Sequential logic circuits (4 bit adders, Sequential Counter) using VHDL language

Contact Periods :
Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOME:

CO1: Acquired knowledge about internal circuitry and logic behind any digital system

CO2: Fabricate any electronic circuit depends on applications

CO3: Use various electronic components and test equipments like Multimeter, function generator, DSO etc., to measure passive components and observe the waveforms

CO4: Design the analog and digital control circuits efficiently

CO5: Analyse and modify the circuits for energy efficient design

CO6: Develop and demonstrate troubleshooting ability in electronic technology

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	-	L	-	-	-	-	-	-	H	M	M
CO2	M	M	H	H	-	L	L	L	L	L	M	L	M	H	H
CO3	M	M	H	M	H	L	-	L	L	L	M	L	H	M	H
CO4	M	M	H	M	M	L	-	L	L	L	L	L	H	H	H
CO5	M	H	M	H	L	L	-	L	L	L	L	L	M	M	M
CO6	M	H	M	H	-	M	-	L	L	L	L	L	M	H	M
16EPC407	M	M	H	H	L	L	L	L	L	L	L	L	H	H	H

L – Low, M – Moderate (Medium), H- High

16EPC408 ELECTRICAL MACHINES LABORATORY – I CATEGORY: PC

	L	T	P	C
PRE-REQUISITES: NIL	**0**	**0**	**4**	**2**

COURSE OBJECTIVES:

* To give hands on training for evaluating the performance and characteristics of various types of static and dynamic electric machines

LIST OF EXPERIMENTS:

1. Swinburne's test and Speed control of d.c. shunt motor.
2. Open circuit characteristics and load test on d.c. shunt generator.
3. Open circuit characteristics and load test on d.c. compound generator.
4. Open circuit characteristics and load test on separately excited d.c. generator.
5. Load test on d.c. shunt motor.
6. Load test on d.c. series motor.
7. Load test on d.c. compound motor.
8. Hopkinson's Test
9. OC and SC tests on single phase transformer.
10. Load test on single phase transformer.
11. Sumpner's test.
12. Separation of losses in transformer.
13. Three phase transformer connections.

Contact Periods :
Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOME:

CO1: Apply the knowledge of electromagnetism and electromechanical energy conversion
CO2: Suggest suitable test for performance determination of electrical machines
CO3: Analyze and evaluate the performance of static and rotating machines from their characteristics
CO4: Identify suitable speed control method of rotating machines
CO5: Develop the model of static machine and perform analysis

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	M	M	L	L	M	L	L	M	H	L	H	L	M
CO2	M	M	H	H	L	M	M	L	L	M	M	M	M	H	M
CO3	H	H	H	H	M	L	M	H	M	M	H	H	M	H	M
CO4	M	M	H	H	L	L	M	H	M	M	H	H	M	H	H
CO5	H	H	H	H	M	L	M	H	M	M	H	H	M	H	H
16EPC408	H	H	H	H	L	L	M	M	M	M	H	M	M	H	M

L – Low, M – Moderate (Medium), H- High

16EEC409 COMMUNICATION SKILLS LABORATORY Category: EEC

PRE-REQUISITES: **L T P C**

1. 16EHS1Z1 Communication skills in English **0 0 4 2**

COURSE OBJECTIVES:

- To provide opportunities to learners to practice their communicative skills to make them become proficient users of English.
- To enable learners to fine-tune their linguistic skills (LSRW) with the help of technology to communicate globally.
- To enhance the performance of learners at placement interviews and group discussions and other recruitment procedures.

UNIT-I : LISTENING/VIEWSING	**(10)**
Listening and note-taking – Listening to telephonic conversations – Ted talks – Inspiring Speeches – Watching documentaries on personalities, places, socio-cultural events, TV news programmes and discussions to answer different kinds questions, vix., identifying key idea and comprehension questions…. So on.	
UNIT-II : SPEAKING	**(12)**
Conversation practice – Interview – Group Discussion – Introducing oneself and others – Role play – Debate – Presentation – Panel discussion – Neutral accent.	
UNIT-III : READING	**(10)**
Different genres of text (literature, media, technical) for comprehension – Reading strategies like note-making – reading graphs, charts and graphic organizer – Sequencing sentences – reading online sources like e-books, e-journals and e-newspapers.	
UNIT-IV : WRITING	**(12)**
Blogs – Tweets – online resume – e-mails – SMS and online texting – Report writing – Describing charts and tables – Writing for media on current events.	
UNIT-V : VOCABULARY	**(16)**
Idioms and phrases – Proverbs – Collocations – Chunks of language. **Grammar:** Sentence structures – Subject-verb agreement – Pronoun-Antecedent agreement - Tense forms – Active and passive voices - Direct and Indirect speeches - Cohesive devices.	

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

Text books:

1. *Anderson, P.V, " **Technical Communication**", Thomson Wadsworth , Sixth Edition, New Delhi, 2007.*
2. *Prakash, P, "**Verbal and Non-Verbal Reasoning**", Macmillan India Ltd., Second Edition, New Delhi, 2004.3.*

Reference Books:

1. *Thorpe, E, and Thorpe, S, "**Objective English, Pearson Education**", Second Edition, New Delhi, 2007.*
2. *Turton, N.D and Heaton, J.B, "**Dictionary of Common Error's**, Addison Wesley Longman Ltd., Indian reprint 1998.*lly answer questions in interviews.

TEACHING METHODS:

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for graining proficiency and better participation in the class.

COURSE OUTCOMES:

Students will be able to attain:

CO1: Better understanding of nuances of English language through audio -visual experience and group activities.

CO2: Neutralization of accent for intelligibility

CO3: Speaking skills with clarity and confidence which in turn enhances their employability skills.

CO4: Take international examination such as IELTS and TOEFL

CO5: Make presentations and Participate in Group Discussions.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	-	-	-	-	M	M	-	M	H	-	L	-	-	H
CO2	-	-	-	-	-	H	M	-	L	L	-	M	-	-	H
CO3	-	-	-	-	-	H	-	-	-	H	-	M	-	-	H
CO4	-	-	-	-	-	-	H	-	H	H	-	H	-	-	H
CO5	-	-	-	-	-	H	-	-	H	H	-	H	-	-	H
16EEC409	-	-	-	-	-	H	M	-	H	H	-	H	-	-	H

L – Low, M – Moderate (Medium), H- High

16EPC501 POWER GENERATION AND UTILIZATION Category : PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16EPC403 DC Machines and Transformers
2. 16EPC406 Electrical & Electronics Measurements

COURSE OBJECTIVES:

- To gain knowledge on various power generation techniques, ways of proper utilization of electrical power through analysis and synthesis of electrical apparatus.

UNIT-I : CONVENTIONAL ENERGY GENERATION	**(09)**
Different types of conventional energy sources – Prediction of load and energy requirements – Hydro electric plant – Large hydro plants – Mini Hydel schemes – Pumped storage plant – Thermal energy production – Heating value – Coal combustion mechanism – Thermal power plant – Super thermal plant – Nuclear power plant – Fast breeder reactors – Gas power plant - Co generation.	
UNIT-II : NON - CONVENTIONAL ENERGY GENERATION	**(09)**
Solar Energy - Photo voltaic: p-n junctions - Solar cells - Solar PV systems – Standalone, Grid connected solar power system (Three Phase and Single Phase rooftop system) – merits. Wind Energy - Basic principle of wind energy conversion system, wind data and energy estimation, site selection, components of wind energy conversion system, merits and limitations- application - Fuel Cells – Introduction to Batteries - Study of different types of Batteries for plug in electric vehicles.	
UNIT-III : TRACTION ENGINEERING	**(08)**
Traction mechanics – Tractive effort – Speed time curves – Power output and maximum speed – Specific energy output – Traction motors – Control of motors – Electric braking – Traction supply system – Negative boosters.	
UNIT-IV : ILLUMINATION, HEATING AND WELDING	**(10)**
Definitions and lighting calculations – Interior and exterior illumination systems – Design of lighting schemes – Energy efficient Lighting system. Direct and indirect heating methods – Types of furnaces – Heat control – High frequency heating methods – Induction furnace – Dielectric heating – Welding and its classification – Electric arc welding – Electronic welding control.	
UNIT-V : ENERGY CONSERVATION AND ENERGY AUDIT	**(09)**
Introduction: Energy audit strategy – Instruments for energy audit – Energy audit of Illumination system, electrical systems, heating, ventilations air conditioning systems, compressed air system – Buildings, steam generation, distribution and utilization system – Economic analysis -Energy conservation principles and planning – Energy conservations in heating industries, small scale industries, electrical generators, transmission and distribution system – Household and commercial sector – Transport and agricultural sector – Energy conservations – Legislations – Power Analyzer.	

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text Books:

1. *Soni M.L., Gupta P.V., Bhatnagar U.S "**A Course in Electric Power**" DhanpatRai and Sons, New Delhi, 2005*
2. *B.R. Gupta "**Generation of Electrical Energy**" Eurasia Publishing House (Pvt.) Ltd.*
3. *Despande M.V "**Elements of Electrical Power Station Design**" Pitman, 2010*
4. *Rai , G.D., "**Non Conventional sources of Energy**", Khanna Publishers , IV Ed.,2009*

Reference books:

1. *Taylor E.O. and VVL Rao, "**Utilization of Electric Energy**", Orient Longman, New Delhi, 2007*
2. *Uppal S.L., "**Electric Power**", Khanna Publishers, New Delhi, 2004*
3. *Garg G.C., "**Utilisation of Electric Power and Electric Traction**", Khanna Publishers, New Delhi, 2004*
4. *Rajput R.K., "**Utilization of Electrical Power**", Laxmi Publications Pvt. Ltd, New Delhi, 2008*
5. *Rao. S. and Dr. Pamlekar B.B "**Energy Technology**" Khanna Publishers, Second Ed. 1997*
6. *Pai and Ramaprasad "**Power Generation through Renewal sources**" Tata McGraw Hill – 1991*

COURSE OUTCOME:

CO1: Apply knowledge for electrical power generation from various resources available.
CO2: Apply the concepts for effective utilization of electrical energy for various applications.
CO3: Study the heating, welding and electrolytic processes.
CO4: Gain information on energy conservation.
CO5: Obtain knowledge on Energy auditing.
CO6: Evaluate the performance of electrical apparatus through analysis and synthesis.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	H	H	M	M	L	L	L	M	H	H	M	M
CO2	H	H	H	H	H	M	M	M	L	L	H	H	H	M	M
CO3	H	H	M	M	M	M	M	L	L	L	L	M	H	M	M
CO4	H	M	M	M	M	L	L	L	L	L	L	M	M	L	M
CO5	H	M	M	L	L	L	L	L	L	L	L	M	L	L	M
CO6	H	H	H	H	H	M	M	L	L	L	M	M	H	M	L
16EPC501	H	H	H	H	H	M	M	L	L	L	L	M	H	M	M

L – Low, M – Moderate (Medium), H- High

16EPC502 **MICROPROCESSOR, MICROCONTROLLER AND APPLICATIONS** **Category : PC**

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

- To learn the basic concepts of microprocessor and microcontroller, assembly language programming, interfacing techniques and applications.

UNIT-I : 8085 AND ARM ARCHITECTURE	**(09)**
Architecture and Addressing modes of 8085 processors - Instruction set of 8085 - ARM architecture – ARM organization and implementation – The ARM instruction set - Basic ARM Assembly language program.	
UNIT-II : PIC16F877 MICRO CONTROLLER	**(09)**
Architecture - Instruction set - Memory organizations - Register file structure - CPU registers - Addressing modes - Assembly language programming - Interrupt structure - Interrupt logic- Interrupt service routine - Interrupt constraints - Critical regions – Shortening an interrupt handler - Timers -0-1-2 and uses – Timer External event counter - PWM outputs.	
UNIT-III : PERIPHERALS OF PIC MICROCONTROLLER	**(09)**
I^2C bus for peripherals chip access - I^2C Bus operation - A/D converters- overview - ADC characteristics ADC use - UART wave forms and baud rate accuracy – UART data handling circuitry - UART uses	
UNIT-IV : ARM AND MICRO CONTROLLER APPLICATIONS	**(09)**
LEDs, push buttons, relays and latch connection - Key board interfacing-interfacing 7segment displays - LCD interfacing - ADC/DAC Interfacing - Measurement applications - Automation and control applications.	
UNIT-V : FPGA AND DSP CONTROLLERS	**(09)**
Programmable Logic Devices – PALs, PLDs, CLPDs and FPGAs – Introduction to FPGA – Basic FPGA Structure – VHDL Programming DSP: Special Instructions of DSP – Architecture of TMS320C5X – Replication – On –Chip Memory – Assembly Language – Instructions of TMS320C5X – Simple programs.	

Contact Periods :

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

Text Books:

1. *Ramesh. S. Gaonkar* ***"Microprocessor Architecture, Programming and Applications of 8085****"Penram International Pvt. Ltd., 6th Ed., 2016*
2. *Steave Furber "****ARM system – on – chip architecture****" ARM system – on – chip architecture*
3. *John B.Peatman* ***"Design with PIC Microcontroller****" Pearson Education, Asia 2004*

Reference books:

1. *Vijayendran.V, "****Fundamentals of Microprocessor-8085: Architecture, Programming & Interface****", Vijay Nicole Pvt. Ltd, 2009*
2. *John Crisp, "****Introduction to Microprocessors and Microcontrollers****", Newnes publications (Imprint of Elsevier), 2nd Ed., 2004*
3. *MykePredko, "****Programming and Customizing the PIC Microcontroller****", Tata McGraw Hill, Third Edition.*
4. *N Senthil Kumar, M Saravanan, S Jeevananthan, and Satish Shah* ***"Microprocessors and interfacing****" Oxford University press, 2012*
5. *Venkatramani B. and Bhaskar M,. "****Digital Signal processors: Architecture and Programming****" Tata McGraw Hill publishing Co,Ltd., New Delhi,2008*
6. *Cem Unsalan, Bora Tar, "****Digital System Design with FPGA Implementation using verilog and VHDL****", McGraw Hill, 2017*

COURSE OUTCOME:

CO1: To illustrate the architecture of processors and employ assembly language programming.
CO2: Create interface between digital system and input/output devices.
CO3: Design and develop microcontroller based real-time applications.
CO4: Understand the architecture of 8085 and 8051.
CO5: Impart the knowledge about the instruction set.
CO6: Develop skill in simple program writing for 8051&8085 applications.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	H	M	H	M	M	M	L	L	M	H	H	H	M	L
CO2	H	H	H	H	H	M	M	M	M	M	H	H	H	M	H
CO3	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CO4	H	H	M	M	M	M	M	M	M	M	H	H	M	M	H
CO5	H	H	H	M	M	L	L	L	L	M	M	M	H	L	L
CO6	H	H	M	H	M	H	M	M	M	M	H	H	M	M	H
16EPC502	H	H	H	H	M	M	M	M	M	M	H	H	H	M	H

L – Low, M – Moderate (Medium), H- High

16EPC503 ROTATING AC MACHINERY AND SPECIAL MACHINES Category: PC

PRE-REQUISITES:

L	T	P	C
2	2	0	3

1. 16EPC403 DC Machines and Transformers

COURSE OBJECTIVES:

- To understand the working of rotating AC machinery and special machines using principles of electromagnetism and electromechanical energy conversion

UNIT-I : SYNCHRONOUS GENERATOR	**(7+6)**
Types and constructional features - Emf equation - Synchronous reactance - Armature reaction - Phasor diagrams of non salient pole synchronous generator connected to infinite bus - Parallel operation – Synchronizing torque - Change of excitation and mechanical input - Voltage regulation – EMF, MMF, ZPF and A.S.A methods – Steady state power angle characteristics – Two reaction theory – Slip test - Short circuit transients - Capability Curves – Construction and operation of PMSG	
UNIT-II : SYNCHRONOUS MOTOR	**(6+6)**
Construction - Principle of operation - Torque Equation-Synchronous machines on infinite bus bars - V and inverted V curves - Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed - Hunting – Damper windings - Synchronous condenser.	
UNIT-III : THREE PHASE INDUCTION MACHINE	**(6+6)**
Types and constructional features - Principle of operation - Equivalent circuit - Torque - Slip characteristics -Losses and efficiency - Load test - No load and blocked rotor tests - Circle diagram - Separation of losses - cogging and crawling – Braking - Double cage induction motors – Squirrel cage Induction generator – Doubly fed Induction Generator	
UNIT-IV : STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR	**(6+5)**
Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star – Delta starters- Speed control – Voltage control, Frequency control and pole changing – Cascaded connection-V/f control	
UNIT-V : SPECIAL ELECTRICAL MACHINES	**(6+6)**
Single phase induction motor – Constructional details - Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor Construction, operation and applications : Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor - Switched Reluctance Motor - Servo motors - Stepper motors –PMDC motor - Introduction to magnetic levitation systems – BLDC Motors	

Contact Periods :

Lecture: 30 Periods Tutorial: 30 Periods Practical: 0 Periods Total: 60 Periods

Text books:

1. *Kothari D. P. and Nagrath I. J "**Electric Machines**" Tata McGraw Hill, 4 TH Ed., 2010*
2. *Bimbhra P.S "**Electrical Machinery**" Khanna Publishers, New Delhi, 7TH Edition, 2011*
3. *Sen. S. K, "**Electric Machinery**", Khanna Publishers, New Delhi, 2008*

Reference Books:

1. *Fitzgerald A.E., Charles Kingsly C. Stephen D. Umans "**Electric Machinery**" Tata McGraw Hill, 6th Ed., 2013*
2. *Langsdorf A. S., "**Theory of A.C Machinery**", Tata McGraw Hill, 2001*
3. *Say M.G., "**Alternating Current Machines**", 5th Ed., Pitman Publishing, 1986*
4. *Theraja B. L and Theraja A. K., "**A Textbook of Electrical Technology**", Vol. II, S Chand & Co. Ltd., New Delhi, 2009*

COURSE OUTCOME:

- **CO1:** Understand the operating principles of rotating AC machines
- **CO2:** Familiarize the characteristics of synchronous and induction machines
- **CO3:** Select suitable machine for specific application
- **CO4:** Execute speed control and starting methods for various AC motors
- ***CO5:*** Categorize the special electrical machines and their applications.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	M	M	L	L	M	L	L	M	H	L	H	M	M
CO2	H	H	M	M	M	L	M	H	M	M	H	M	M	M	M
CO3	M	M	H	H	L	L	M	H	M	M	H	H	M	H	M
CO4	M	M	H	H	L	M	M	L	L	M	M	M	M	H	M
CO5	M	M	H	H	L	L	M	H	M	M	H	H	M	H	H
16EPC503	M	M	H	H	L	L	M	M	M	M	H	M	M	H	M

L – Low, M – Moderate (Medium), H- High

16EPC504 **CONTROL SYSTEMS ENGINEERING** **Category : PC**

	L	T	P	C
PRE-REQUISITES:	**2**	**2**	**0**	**3**

1. Engineering Mathematics – I
2. Engineering Mathematics – II

COURSE OBJECTIVE:

- To understand the fundamental concepts of Control systems and analyse signals of the system in time and frequency domain including stability aspects

UNIT-I : CONTROL SYSTEM MODELING	**(06)**
Basic Elements of Control System – Open loop and Closed loop systems - Transfer function - Modelling of Electric systems, Mechanical systems - Block diagram reduction Techniques - Signal flow graph.	
UNIT-II : TIME DOMAIN AND FREQUENCY DOMAIN ANALYSIS	**(07)**
Time response analysis - Step Response analysis of First Order Systems and second order systems – Time domain specifications - Frequency Response analysis - Frequency Domain specifications - Bode Plot, Polar Plot, Nyquist Plot - Constant M and N Circles - Nichol's Chart	
UNIT-III : STABILITY ANALYSIS AND COMPENSATORS	**(07)**
Stability - Routh - Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Application of Root Locus Diagram - Nyquist Stability Criterion - Relative Stability - Series, Parallel, Series - Parallel Compensators – Design of Lead, Lag, and Lead Lag Compensators.	
UNIT-IV : STATE SPACE ANALYSIS	**(06)**
State model – Decomposition of transfer function – Canonical state model – Transfer function from state model – Solution of state model – State transition matrix – Controllability and Observability.	
UNIT – V : SENSORS, CONTROLLERS AND ACTUATORS	**(04)**
Potentiometer – Error detector – Magnetic amplifier – Hydraulic elements – Synchros – Stepper motors – Tacho generators – Servomechanisms – Modulators and demodulators – PID controllers – Servo motors – Hall effect sensors – Smart sensors.	

Contact Periods :
Lecture: 30 Periods Tutorial: 30 Periods Practical: 0 Periods Total: 60 Periods

Text books:

1. *Sivanandam S.N "**Control Systems Engineering**" using MATLAB 2nd Ed. Vikas Publishing House Pvt. Ltd., New Delhi, NOV2009*
2. *Nagrath I.J. and Gopal M "**Control Systems Engineering**" Wiley Eastern Limited, New Delhi, 5th Ed. 2008*

Reference Books:

1. *Katsuhiko Ogata, "**Modern Control Engineering**", Pearson Education, New Delhi, 5th Ed. 2011*
2. *Gopal M., "**Control systems – Principles and Design**", Third Ed., Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2008*
3. *Richard C. Dorf and Robert H. Bishop, "**Modern Control Systems**", Pearson Education Pvt. Ltd., New Delhi,12th Ed., 2011*

COURSE OUTCOME:

CO1: Apply the fundamental concepts of Control systems and mathematical modelling of the system
CO2: Illustrate the Concept of time and frequency response of the system
CO3: Analyse the system stability and design of compensators
CO4: Design compensators in frequency domain
CO5: Express all types of physical systems into its mathematical model
CO6: Examine stability analysis techniques with appropriate compensators

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	M	H	M	L	L	M	M	M	H	H	M	L
CO2	M	M	M	H	M	M	L	L	L	L	M	H	M	L	M
CO3	H	H	H	M	M	M	M	M	M	L	L	H	H	M	L
CO4	H	H	H	H	H	L	L	L	L	L	M	H	H	L	L
CO5	H	H	M	M	L	L	L	M	L	M	L	H	M	L	M
CO6	H	H	H	H	H	M	L	L	L	L	M	H	H	L	L
16EPC504	H	H	H	H	M	M	L	L	L	L	M	H	H	L	L

L – Low, M – Moderate (Medium), H- High

16EPC505 TRANSMISSION AND DISTRIBUTION Category: PC

PRE-REQUISITES:

1. 16EPC303 Electric Circuit Theory
2. 16EPC302 Field Theory

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To acquire idea about designing of electric utility substation with respect to electrical and mechanical point of view and can assess the new plan of power system.

UNIT-I : INTRODUCTION	**(09)**
Structure of electric power system – Different operating voltages of generation, transmission and distribution – Advantage of higher operating voltage for AC transmission. An introduction to EHV AC transmission, HVDC transmission and FACTs. Mechanical design of transmission line between towers – Sag and tension calculations using approximate equations taking into account the effect of ice and wind.	
UNIT-II : TRANSMISSION LINE PARAMETERS	**(09)**
Parameters of resistance, inductance and capacitance calculations – Single and three phase transmission lines – 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.	
UNIT-III : MODELLING AND PERFORMANCE OF TRANSMISSION LINES	**(09)**
Transmission line classification – 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 circle diagrams – Shunt and series compensation. An introduction to power angle diagram – Surge – Impedance loading, loadability limits based on thermal loading; angle and voltage stability considerations.	
UNIT-IV : INSULATORS AND CABLES	**(09)**
Classification of insulators for transmission and distribution purpose – Voltage distribution in insulator string and grading – Improvement of string efficiency. Underground cables – Constructional features of LT and HT cables – Insulation resistance, capacitance, dielectric stress and grading – Tan δ and power loss – Thermal Characteristics.	
UNIT-V : SUBSTATION, GROUNDING SYSTEM AND DISTRIBUTION SYSTEM	**(09)**
Classification, functions and major components of substations. Bus-bar arrangements – Substation bus schemes – Single bus, double bus with double breaker, double bus with single breaker, main and transfer bus, ring bus, breaker-and-a-half with two main buses, double bus-bar with bypass isolators. Importance of earthing in a substation. Qualitative treatment to neutral grounding and earthing practices in substations. 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.	

Contact Periods :
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text books:

1. *Soni M.L., Gupta P.V., Bhatnagar U.S "**A Course in Electric Power**" Dhanpat Rai and Sons, New Delhi, 2005*
2. *S.N. Singh "**Electric Power Generation, Transmission and Distribution**" Prentice Hall of India Pvt.Ltd, New Delhi, 2002.*

Reference Books:

1. *D.P.Kothari and I.J.Nagrath, "**Power System Engineering**", Tata McGraw Hill, Third Reprint 2008*
2. *Wadhwa C.L, "**High Voltage Engineering**", New Age International Pvt. Ltd., New Delhi, 3rd Ed., 2010*
3. *Mehta V.K., RohitMehta.,"**Principles of Power Systems**", S.Chand and Co., Fourth Revised Ed., 2008*
4. *Luces M. Fualkenberry, Walter Coffer, "**Electrical Power Distribution and Transmission**", Pearson Education, 1996*
5. *"**Tamil Nadu Electricity Board Handbook**", 2003*
6. *Central Electricity Authority (CEA), "**Guidelines for Transmission System Planning**", New Delhi.*

COURSE OUTCOME:

CO1: Understand the structure of power system with component features
CO2: Analyze the transmission and distribution components
CO3: Evaluate the performance of transmission and distribution network
CO4: Design transmission and distribution network with respect to electrical and mechanical aspects
CO5: Derive methods of determining the electrical parameters of the T&D network.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	-	H	-	-	-	-	-	-	-	-	H	L	L
CO2	H	H	L	H	H	-	M	H	-	-	H	M	M	H	M
CO3	L	H	H	H	M	M	-	H	-	H	H	H	M	H	H
CO4	-	H	H	H	-	M	M	H	H	H	H	H	M	H	H
CO5	-	M	L	H	-	-	M	-	-	-	M	M	H	M	M
16EPC505	L	H	M	H	L	L	L	M	L	L	M	M	M	M	M

L – Low, M – Moderate (Medium), H- High

16EEC507 **SKILL DEVELOPMENT PRACTICE** **Category: EEC**

L	T	P	C
0	0	4	2

PRE-REQUISITE: NIL

COURSE OBJECTIVE:

* To learn the Skill Development Practice

UNIT-I : INTERPERSONAL SKILLS	**(10)**
Gratitude Understanding the relationship between Leadership Networking & Team work. Assessing Interpersonal Skills Situation description of Interpersonal Skill. **Team Work:** Necessity of Team Work Personally, Socially and Educationally	
UNIT-II : LEADERSHIP	**(04)**
Skills for a good Leader, Assessment of Leadership Skills	
UNIT-III : STRESS MANAGEMENT	**(08)**
Causes of Stress and its impact, how to manage & distress, Circle of control, Stress Busters. **Emotional Intelligence** What is Emotional Intelligence, emotional quotient why Emotional Intelligence matters, Emotion Scales. Managing Emotions.	
UNIT-IV : CONFLICT RESOLUTION	**(04)**
Conflicts in Human Relations – Reasons Case Studies, Approaches to conflict resolution.	
UNIT-V : DECISION MAKING	**(04)**
Importance and necessity of Decision Making, Process and practical way of Decision Making, Weighing Positives & Negatives.	

Contact Periods :

Practical: 60 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 60 Periods**

Text books:

1. ***"Soft Skills"*** *Career Development Centre, Green Pearl Publications.*

Reference Books:

1. *Covey Sean, "**Seven Habit of Highly Effective Teens"**, New York, Fireside Publishers, 1998.*
2. *Carnegie Dale, "**How to win Friends and Influence People**", New York: Simon & Schuster, 1998.*
3. *Thomas A Harris, "**I am ok, You are ok**" , New York-Harper and Row, 1972*
4. *Daniel Coleman, "**Emotional Intelligence**", Bantam Book, 2006*

COURSE OUTCOME:

CO1: Trainee identifies his/her own strengths and makes maximum use for success in tasks.

CO2: Trainee would be able to manage the events-social, cultural, co-curricular for school/community.

CO3: Achieve better management control.

CO4: Simplify operations and minimize computational errors.

CO5: Improve quality of output in terms of presentation and reduction in processing time.

CO6: Assess skills development activities.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	-	-	-	-	M	L	-	M	M	-	M	-	-	H
CO2	-	-	-	-	-	M	M	-	L	-	-	L	-	-	H
CO3	-	-	-	-	-	H	-	-	-	-	-	-	-	-	M
CO4	-	-	-	-	-	-	M	-	M	-	-	M	-	-	H
CO5	-	-	-	-	-	H	-	-	H	-	-	H	-	-	H
16EEC507	-	-	-	-	-	H	M	-	M	M	-	H	-	-	H

L – Low, M – Moderate (Medium), H- High

16EPC508 MICROCONTROLLERS AND PROCESSORS LABORATORY Category : PC

PRE-REQUISITES:

1. 16EPC502 Microprocessor, Microcontroller and applications

L	T	P	C
0	0	4	2

COURSE OBJECTIVE:

- *To learn the practical aspects of Microprocessors and Microcontroller*

LIST OF EXPERIMENTS:

1. 8085 MicroProcessor Programming
2. ARM processor Programming
3. PIC Micro Controller Programming
4. Interfacing of switches and display devices using MicroProcessors and Micro Controllers
5. Interfacing of D/A and A/D converters using MicroProcessors and Micro Controllers
6. Interfacing of key board and display using MicroProcessors and Micro Controllers
7. Interfacing of Stepper Motor using MicroProcessors and Micro Controllers
8. Programming of MPPT algorithms for solar PV system using Microprocessors and Microcontroller
9. PIC Microcontroller- Study and applications
10. Interfacing of DC and AC Motors Using DSP Controllers
11. Interfacing of DC and AC Motors Using FPGA Controllers

Contact Periods:
Practical: 60 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 60 Periods

COURSE OUTCOME:

CO1: Employ the programming concepts in practical platforms get exposure to wide range of interface applications
CO2: Analyse various platforms for programming by knowing the complete hardware configurations
CO3: To familiarize with the assembly level programming
CO4: Design circuits for various applications using microcontrollers
CO5: Analyze abstract problems and apply a combination of hardware and software to address the problem
CO6: An in depth knowledge of applying the concepts on real time applications

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	M	L	M	M	L	L	L	M	M	M	H	M	M
CO2	H	H	H	H	H	M	M	M	L	M	H	H	H	M	M
CO3	H	H	M	L	M	M	M	L	M	M	H	M	H	M	M
CO4	H	H	H	H	M	M	M	L	M	L	M	H	H	M	L
CO5	H	H	H	H	H	M	M	H	M	M	M	H	H	M	L
CO6	H	H	M	M	L	M	L	M	M	L	H	H	H	L	H
16EPC508	H	H	H	H	M	M	M	M	M	M	H	H	H	M	M

L – Low, M – Moderate (Medium), H- High

16EPC509 ELECTRICAL MACHINES LABORATORY - II Category: PC

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1. 16EPC503 Rotating AC machinery and Special machines

COURSE OBJECTIVES:

* To give hands on training for evaluating the performance and characteristics of various types of rotating AC machines.

LIST OF EXPERIMENTS:

1. Regulation of Alternator by EMF and MMF Methods
2. Load test on three phase Alternator
3. Regulation of salient pole Alternator by Slip Test
4. Regulation of Alternator by ZPF method
5. V and Inverted V curves of Synchronous Motor
6. Equivalent Circuit of three phase Induction Motor
7. Load Test on three phase Induction Motor
8. Load Test and V curves of Synchronous Induction motor
9. Performance characteristics of three phase Induction Motor by Circle Diagram
10. Load Test on single phase Induction Motor
11. Speed control of Slip Ring Induction Motor
12. Study of different types of starting of Induction Motors
13. Characteristics of DFIG Based wind turbine
14. Characteristics of PMSG Based wind turbine

Contact Periods :

Practical: 60 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 60 Periods

COURSE OUTCOME:

Apply the knowledge of electromagnetism and electromechanical energy conversion

CO1: Suggest suitable test for performance determination of Rotating AC Machines

CO2: Analyse and evaluate the performance of a.c. rotating machines

CO3: Identify suitable speed control method of rotating machines

CO4: Ability to model the electrical apparatus and their application to power system

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	M	M	L	L	M	L	L	M	H	L	H	L	M
CO2	M	M	H	H	L	M	M	L	L	M	M	M	M	H	M
CO3	H	H	H	H	M	L	M	H	M	M	H	H	M	H	H
CO4	M	M	H	H	L	L	M	H	M	M	H	H	M	H	H
CO5	H	H	H	H	M	L	M	H	M	M	H	H	M	H	H
16EPC509	H	H	H	H	L	L	M	M	M	M	H	M	M	H	H

L – Low, M – Moderate (Medium), H- High

16EEC510 PRESENTATION SKILLS AND TECHNICAL SEMINARS Category: EEC

L	T	P	C
0	0	4	2

PRE-REQUISTIE: NIL

COURSE OBJECTIVES:

- To encourage the students to study advanced engineering developments
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as over head projectors, power point presentation and demonstrative models.

METHOD EVALUATION:

During the seminar session each student is expected to prepare and present a topic on engineering/technology, for a duration of about 8 to 10 minutes. In a session of three periods per week, 15 students are expected to present the seminar. Each student is expected to present atleast twice during the semester and the student is evaluated based on that. At the end of the semester, he/she can submit a report on his/her topic of seminar and marks are given based on the report. A faculty guide is to be allotted and he/she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

Contact Periods:

Practical: 60 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 60 Periods

COURSE OUTCOME:

CO1: Ability to review, prepare and present technological developments

CO2: Ability to face the placement interviews

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	L	L	M	L	-	M	M	M	H	H	H	H	L	L	H
CO2	-	-	H	H	M	-	M	M	H	H	H	H	M	M	H
16EEC510	L	L	H	H	M	M	M	M	H	H	H	H	M	M	H

L – Low, M – Moderate (Medium), H- High

16EPC601 POWER ELECTRONIC DEVICES AND CIRCUITS Category: PC

PRE-REQUISITES:

L	T	P	C
2	2	0	3

1.16EPC304 Electronic Circuits-I

COURSE OBJECTIVES:

- To design and analyse various power electronic circuits for industrial drives applications.

UNIT-I : INTRODUCTION	**(6+6)**
Basic structure and switching characteristics of Power diode - Power transistor - SCR- Triac – GTO - MOSFET and IGBT- Ratings of SCR - Series Parallel operation of SCR - di/dt and dv/dt protection - Introduction of ICT - SIT - SITH and MCT - IGCT - Gate driving circuits.	
UNIT-II : CONTROLLED RECTIFIERS	**(6+6)**
Operation of 1-phase Half Wave and Full Wave Rectifiers with R- RL and RLE load (Fully controlled and Half controlled) operation and analysis of rectifiers - Operation of 3-phase Half Wave Rectifier and Full Wave Rectifier with R and RL loads - Effect of source impedance in 1-phase Full converter - 1-phase Dual Converter operation.	
UNIT-III : DC CHOPPERS	**(6+6)**
Classification and operation of different types of choppers - Control strategies – Forced commutation- Operation of voltage - Current and load commutated choppers - Multiphase chopper operation - SMPS.	
UNIT-IV : INVERTERS	**(6+6)**
Types of inverters - Operation of 1-phase - 3 phase bridge inverters (120^o and 180^o modes) with for R- load operation of CSI with ideal switches - 1-phase ASCSI, basic series Inverter - Modified series and Improved series inverter - 1-phase parallel inverter - 1-phase basic McMurray inverter – Grid tied inverter - Introduction to Multilevel inverter – Types – Operation - Applications(Qualitative treatment only)	
UNIT-V : AC VOLTAGE CONTROLLERS	**(6+6)**
Types of control (Phase and Integrated cycle control) - Operation of 1-phase voltage regulator with R-RL loads - Operation of 3-phase AC voltage controller with R load - 1-phase step up and step down cyclo converters - 3-phase cyclo converter with R, RL loads.	

Contact Periods:

Lecture: 30 Periods Tutorial: 30 Periods Practical: 0 Periods Total: 60 Periods

Text Books:

1. *Muhammad H. Rashid **"Power Electronics - Circuits- Devices and Applications**" Prentice Hall of India- New Delhi- Fourth Ed.- 2014*
2. *Ned Mohan **"Power Electronics-Converter Applications and Design Wiley"**, 3rd Ed., Reprint 2009*
3. *Dr. P.S.Bhimbra **"Power Electronics"** Khanna Publishers, 3rd Ed., Reprint 2014*

Reference Books:

1. *Singh. M.D and Khanchandani. K.B "**Power Electronics**" Tata McGraw Hill Publishing Co. Ltd,New Delhi- 3rd Reprint 2012*
2. *Dubey- G.K., Doradla.S.R., Joshi.A., Sinha.R.M.K- " **Thyristorised Power Controllers**"- New Age International Publishers Ltd.-1st Ed., Reprint 2012*
3. *Vedam Subramaniam- "**Power Electronics**"- New Age International (P) Publishers Ltd. - 2nd Ed.,Reprint, 2012.*

COURSE OUTCOME:

On completion of this course, students will be able to

CO1: Examine the operation of various Power Electronic circuits.

CO2: Analyse the operation of various power switches and their applications.

CO3: Examine Power Electronic circuits for their suitable nature of applications.

CO4: Design a suitable power supplies for different applications.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	H	-	M	-	-	-	-	-	L	-	-	-	L	-
CO2	H	L	M	L	L	-	L	-	-	-	L	-	M	M	-
CO3	L	M	-	-	L	L	-	-	L	H	L	M	-	L	M
CO4	-	H	H	L	-	M	L	L	H	L	M	L	-	M	-
16EPC601	L	M	L	L	L	L	L	L	L	M	L	L	L	L	L

L- Low, M – Moderate (Medium), H – High

16EPC602 **POWER SYSTEM ANALYSIS** **Category: PC**

L	T	P	C
2	2	0	3

PRE-REQUISITES:

1. 16EPC303 Electric Circuit Theory
2. 16EPC401 Numerical Methods
3. 16EPC505 Transmission and Distribution

COURSE OBJECTIVES:

- To analyse power system problems under normal and abnormal conditions.

UNIT-I : INTRODUCTION	**(09)**
Need for system planning and operational studies – Basic components of a power system. - Introduction to restructuring – Single line diagram – Per phase and per unit analysis – Generator – Transformer – Transmission line and load representation for different power system studies - Primitive network – Construction of Y-bus using inspection and singular transformation methods – z-bus-Building algorithm.	
UNIT-II : POWER FLOW ANALYSIS	**(09)**
Importance of power flow analysis in planning and operation of power systems – Statement of power flow problem – Classification of buses – Development of power flow model in complex variables form – Iterative solution using Gauss-Seidel method – Q-limit check for voltage controlled buses – Power flow model in polar form – Iterative solution using Newton-Raphson method.	
UNIT-III : FAULT ANALYSIS – BALANCED FAULTS	**(09)**
Importance of short circuit analysis – Assumptions in fault analysis – Analysis using Thevenin's theorem – Z-bus building algorithm – Fault analysis using Z-bus – Computations of short circuit capacity, post fault voltage and currents.	
UNIT-IV : FAULT ANALYSIS – UNBALANCED FAULTS	**(09)**
Introduction to symmetrical components – Sequence impedances – Sequence circuits of synchronous machine, transformer and transmission lines – Sequence networks analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem and Z-bus matrix.	
UNIT-V : STABILITY ANALYSIS	**(09)**
Importance of stability analysis in power system planning and operation – Classification of power system stability – Angle and voltage stability – Single Machine Infinite Bus (SMIB) system: Development of swing equation – Equal area criterion – Determination of critical clearing angle and time – Solution of swing equation by modified Euler method and Runge - Kutta fourth order method.	

Contact Periods:

Lecture: 30 Periods **Tutorial: 30 Periods** **Practical: 0 Periods** **Total: 60 Periods**

Text Books:

1. *John J Grainger and William D Stevenson J R "**Power System Analysis**" Tata MC Graw Hill, 6th Reprint, 2007.*
2. *Nagrath I.J. and Kothari D.P "**Modern Power System Analysis**" Tata MCGraw Hill,Publishing Co. Ltd., New Delhi, 3rd Edition 2004.*
3. *P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan "**Electrical Power Systems-Analysis, Security and Deregulation**" PHI Learning Private Limited, New Delhi, 2012*

Reference Books:

1. *Gangadhar K.A, "**Power System Analysis and Stability**", KP, New Delhi, 1998.*
2. *Wadhwa C.L, "**Electrical Power Systems**", Wiley Eastern Ltd., New Delhi, 2006.*
3. *Olle. I. Elgerd, "**Electric Energy Systems Theory – An Introduction**", Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2012.*
4. *HadiSaadat, "**Power System Analysis**", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.*
5. *Pai M A, "**Computer Techniques in Power System Analysis**", Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.*

COURSE OUTCOME:

CO1: Model the power system under steady state operating condition.
CO2: Illustrate numerical methods to solve the power flow problem.
CO3: Model and analyze the system under faulted conditions.
CO4: Model and analyze the transient behavior of power system when it is subjected to a fault.
CO5: Evaluate the power system network for the reliable operation

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	-	H	-	-	-	-	-	-	-	-	H	M	L
CO2	H	H	-	H	H	-	M	H	M	-	H	M	H	H	M
CO3	M	H	H	H	M	M	L	H	M	H	H	H	M	H	M
CO4	-	H	H	H	-	M	M	H	H	H	M	H	M	H	H
CO5	M	M	L	H	M	-	M	-	-	-	M	M	M	H	H
16EPC602	M	H	L	H	L	L	L	M	L	M	M	M	M	H	M

L- Low, M – Moderate (Medium), H – High

16EPC603 **ELECTRICAL MACHINE DESIGN** **Category: PC**

L	T	P	C
2	2	0	3

PRE-REQUISITES:

1. 16EPC403 DC Machines and Transformers
2. 16EPC503 Rotating AC Machinery and Special Machines

COURSE OBJECTIVES:

- To impart knowledge on designing of Static and Rotating machines based upon fundamental theories

UNIT-I : INTRODUCTION	**(6+6)**
Major considerations in Electrical Machine Design - Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings - Thermal considerations - Heat flow – Temperature rise and Insulating Materials - Rating of machines – Standard specifications.	
UNIT-II : DC MACHINES	**(6+6)**
Output Equations – Main Dimensions – Choice of Specific Electric and Magnetic Loading – Magnetic Circuits Calculations - Carter's Coefficient - Net length of Iron – Selection of number of poles – Design of Armature, commutator and brushes – Performance prediction using design values	
UNIT-III : TRANSFORMERS	**(6+6)**
Output Equations – Main Dimensions - kVA output for single and three phase transformers – Window space factor – Design of core and winding – Overall dimensions – Operating characteristics – No load current – Temperature rise in Transformers – Design of Tank - Methods of cooling of Transformers.	
UNIT-IV : INDUCTION MOTORS	**(6+6)**
Output equation of Induction motor – Main dimensions – Choice of Average flux density – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars, slots and end rings – Design of wound rotor – Magnetic leakage calculations – Leakage reactance of polyphase machines - Magnetizing current - Short circuit current – Operating characteristics - Losses and Efficiency.	
UNIT-V : SYNCHRONOUS MACHINES	**(6+6)**
Output equations – Choice of Electrical and Magnetic Loading – Design of salient pole machines – Short circuit ratio – Shape of pole face – Armature design – Estimation of air gap length – Design of rotor and damper winding – Determination of full load field mmf – Design of field winding – Design of turbo alternators – Rotor design.	

Contact Periods :
Lecture: 30 Periods **Tutorial: 30 Periods** **Practical: 0 Periods** **Total: 60 Periods**

Text books:

1. *A.K Sawhney and A Chakrabarthi "**A Course in Electrical Machine Design**" Dhanpat Rai and Co, New Delhi, 6th Ed., 2014.*
2. *M.V.Deshpande "**Design and Testing of Electrical Machine**" PHI Publications, 3rd edition, 2010*

Reference Books:

1. *R.K.Agarwal " **Principles of Electrical Machine Design**" s k kataria sons, 5th Ed,2014.*
2. *Sen S.K., "Principles of Electrical Machine Design With Computer Programs", Oxford and IBH Publishing Company, 2nd Ed., 2009.*
3. *Shanmuga Sundaram A., Gangadharan G., and Palani R., "**Electrical Machine Design Data Book**", New Age International Publishers, Reprint 2005*

COURSE OUTCOME:

CO1: Illustrate the design procedure of rotating machines and transformers.

CO2: Familiarize the importance of magnetic, thermal and electric loadings.

CO3: Identify suitable materials according to design criteria

CO4: Develop model and analyze the Static and Rotating machines

CO5: Evaluate the optimal design of electrical power apparatus

CO6: Examine the design of electrical machines according to standards

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	H	L	L	M	H	M	M	H	H	H	M	M
CO2	H	H	L	L	L	L	L	L	L	L	L	L	H	M	M
CO3	M	M	H	H	L	L	M	H	M	M	H	H	M	H	M
CO4	H	H	H	H	M	L	M	H	M	M	H	H	M	H	M
CO5	M	M	H	H	L	L	M	H	M	M	H	H	M	H	H
CO6	M	M	H	H	L	L	M	H	M	M	H	H	M	M	H
16EPC603	H	H	H	H	L	L	M	H	M	M	H	H	M	H	H

L – Low, M – Moderate (Medium), H- High

16EPC606 **CONTROL ENGINEERING AND SIMULATION LABORATORY** **Category : PC**

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1. 16EPC504 Control systems engineering

COURSE OBJECTIVE:

- To acquire knowledge on designing, analyzing and synthesizing about open loop and closed loop control systems and to assess the behaviour of control systems.

LIST OF EXPERIMENTS:

1. Open loop and closed loop position control system.
2. Open loop and closed loop speed control system.
3. Digital position control system.
4. Simulation of second order system with dead time.
5. Transfer function of armature controlled DC motor.
6. Root locus from a transfer function using MATLAB.
7. Bode plot from a transfer function using MATLAB
8. Design and Simulation of PI and PID controllers for a second order system.
9. Design and Simulation of PI and PID controllers for a first order system with dead time.
10. Design and Simulation of LAG, LEAD compensators using MATLAB.
11. Water level control using industrial PLC

Contact Periods :

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOME:

CO1: Analyze and synthesize open loop and closed loop control systems by remembering previously learned information from Control System Engineering

CO2: Evaluate the behavioral performance of various control systems with respect to stability

CO3: Apply control system in real time applications

CO4: Ability to apply what they have learned theoretically in the field of control engineering using both analog and digital technique

CO5: Ability to interact and communicate effectively with needs in the group

CO6: Ability to design and determine control system's parameters and transfer functions by combining both theoretical and applied. Analysis that they have acquired

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	M	M	M	L	L	L	L	L	M	H	M	L	L
CO2	H	H	H	H	H	M	M	L	L	M	M	H	H	M	L
CO3	H	H	H	M	M	M	M	L	L	L	M	M	H	M	L
CO4	H	H	H	H	M	M	M	M	L	L	H	H	H	M	M
CO5	H	H	H	H	H	M	M	M	M	M	M	M	H	M	M
CO6	H	M	M	L	M	L	L	M	L	L	M	H	M	L	L
16EPC606	H	H	H	H	H	M	M	M	L	L	M	H	H	M	L

L – Low, M – Moderate (Medium), H- High

16EPC607 POWER ELECTRONICS AND DRIVES LABORATORY Category: PC

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1.16EPC601 Power Electronic Devices and Circuits

COURSE OBJECTIVES:

- To study the characteristics of the power electronic devices, applying them in converters / inverter circuits and motor control applications.

LIST OF EXPERIMENTS:

1. V-I characteristics of SCR and TRIAC
2. V-I characteristics of MOSFET and IGBT
3. Power electronic devices- triggering circuits
4. Single phase half controlled rectifier
5. Single phase fully controlled bridge rectifier
6. Thyristorised / Transistor based DC chopper
7. Single phase thyristorised / Transistor based inverter
8. Series inverter
9. AC phase control using SCRs, DIAC and TRIAC
10. Speed control of separately excited chopper fed DC drive
11. V/f speed control method of the three-phase Induction Motor
12. Speed control of BLDC Motor
13. Speed control of Switched Reluctance Motor

Contact Periods :

Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOME:

On completion of this course, students will be able to

CO1: Perform various static and dynamic measurements of current and voltage on power electronic devices

CO2: Analyse the issues when current and voltage applied to power electronic devices and circuits

CO3: Build and test various power electronic converters

CO4: Build and test various inverters and different types of motor controllers.

CO5: Prepare and Maintain a comprehensive experimental reports that presents and Analyses the laboratory work

CO6: Demonstrate teamwork for planning and carrying out experimental activities.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	L	M	-	L	-	L	-	-	-	-	-	-	-	L	-
CO2	L	L	M	-	L	-	L	-	-	-	-	-	M	-	-
CO3	L	L	M	-	L	L	L	-	-	M	L	L	-	L	H
CO4	L	-	L	L	M	L	M	L	L	M	L	M	L	-	H
CO5	H	M	L	M	L	L	L	-	L	M	L	L	-	M	-
CO6	-	-	-	-	L	-	L	-	H	L	M	M	-	-	L
16EPC607	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

L – Low, M – Moderate (Medium), H- High

16EEC608 **MINI PROJECT** **Category: EEC**

PRE-REQUISTE: NIL

L	T	P	C
0	0	8	4

COURSE OBJECTIVE:

* To acquire practical knowledge within the chosen area of technology.

SYLLABUS:

* Project to be developed based on one or more of the following concepts.
* Electric Circuits, Electronics Circuits, DC Machines, AC machines, Eliminator transformer, Using Diode Transistor, Diode and power devices, Applications of Electronic circuits,
* Astable mulivibrator, hobby circuits, Control of Electrical, Electronics and measuring instruments. Intelligent devices, software based control.
* A project report is required at the end of the semester.

Contact Periods :

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 120 Periods** **Total: 120 Periods**

Reference books:

1. Electronics for you
2. Electronics projects

COURSE OUTCOME:

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach.
3. Contribute as an individual or in a team in development of technical projects.
4. Develop effective communication skills for presentation of project related activities

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	H	H	H	M	H	H	H	H	H	M	H	H
CO2	M	H	H	M	H	M	M	-	H	H	H	H	M	H	H
CO3	-	-	-	-	-	H	-	-	H	H	H	H	-	H	H
CO4	-	-	-	-	-	-	-	-	H	H	H	H	-	-	H
16EEC608	H	H	H	H	H	H	M	H	H	H	H	H	M	H	H

L – Low, M – Moderate (Medium), H- High

16EHS701 INDUSTRIAL MANAGEMENT AND ECONOMICS Category: HS

(Common to EIE)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the concepts of micro economics
- To study the concepts of macro economics
- To understand the basic concept of management thought
- To study the different functions of management
- To study the organizational behaviour

UNIT-I	**MICRO ECONOMICS**	**(09)**
Definition of Economics, Scope; Demand – Curve, Schedule, Factors affecting demand, Elasticity of Demand; Supply – Curve, Factors influencing supply, Elasticity, Supply behavior in different time periods**.**		
UNIT-II	**MACRO ECONOMICS**	**(09)**
Money – Evolution, Functions: Central Bank and Commercial Banks Functions; Inflation – Definition, Types, Methods of correcting, Impact; Deflation – Definition, Methods of correcting, Impact**.**		
UNIT-III	**BASICS OF MANAGEMENT THOUGHT**	**(09)**
Evolution of Management, Management – Definition, Levels, Principles, Differences with administration, Roles of Managers, Contributions of Henry Fayol, Taylor and Ducker to Management, External environment of business, Social responsibility of business**.**		
UNIT-IV	**FUNCTIONS OF MANAGEMENT**	**(09)**
Planning – Premises, Process, Types of Plans; Organizing – Departmentation, Authority – Responsibility relationship, Span of Management; Staffing – Manpower Planning (Manpower Planning Chart and Process), Staffing (Systems approach to staffing), Directing – Leadership theories, Motivation theories and Communication (Process, Barriers, Guidelines for effective communication).		
UNIT-V	**ORGANIZATION BEHAVIOUR**	**(09)**
Individual behavior – Values (Types, Formation), Personality, Learning; Group behavior – (Types of groups, Stages of group formation, Reasons for joining groups); Organization culture (Origin, Modes of transmission**).**		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text books:

1. Koontz **"Essentials of Management"** McGraw Hill, 2006
2. Prasad L.M **"Principles and Practice of Management"** Sultan Chand and Sons, 7th Ed., 2008
3. Varshney.R.I, Maheshwary K.**L "Managerial Economics"** Sultan Chand and Sons, 2006

Reference Books:

1. *Stephen P Robbins, "**Organizational Behavior**", Prentice Hall of India, New Delhi, 2007 Samuelson and Nordhaus, **"Economics**", McGraw Hill Ltd., 2009*

COURSE OUTCOME:

Upon successful completion of the course the student will be able

CO1: The concepts of micro economics, macroeconomics.

CO2: The basic concept of management thought.

CO3: The different functions of management and the organizational behaviour.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	-	-	H	-	H	H	-	H	-	-	-	-	-	-
CO2	H	H	-	-	-	H	H	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	H	H	-	-	-	-	-	-	-	-
16EHS701	H	H	-	H	-	H	H	-	H	-	-	-	-	-	-

L- Low, M-Moderate (Medium), H-High

16EPC702 **PROTECTION AND SWITCHGEAR** **Category: PC**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1.16EPC501 Power Generation and Utilization,

2.16EPC602 Power System Analysis

COURSE OBJECTIVES:

- To learn the actuating circuits through designing, analyzing and synthesizing protective schemes for the protection of power system components

UNIT-I : PROTECTIVE RELAYS	**(09)**
Introduction - Types of electromagnetic relays-Construction, operation, and applications- Differential relay-Distance Relay-Over current relay-Impedance relay-Principles of operation of static relays - Static over current relays – Numeric Relays – Smart Relays	
UNIT-II : APPARATUS PROTECTION	**(09)**
Protective relays for the protection of generators – Motors – Transformers – Bus and Lines including parallel feeders – Effect of current and potential transformers on the performance of relays.	
UNIT-III : CIRCUIT BREAKERS	**(09)**
Elementary principles of arc extinction – Arc control devices – Restriking and recovery voltages – Bulk oil, minimum oil, air blast, vacuum circuit breakers – SF_6 – Rating – speed of operation – Selection and testing of circuit breakers – Fuses – HRC fuses.	
UNIT-IV : PROTECTION AGAINST OVER VOLTAGES	**(09)**
Lightning – Switching – Insulation failure – arcing grounds – Methods of protection – ground line – Peterson coil – surge absorbers and diverters – Location of protective apparatus.	
UNIT-V : SUBSTATION PROTECTION	**(09)**
Substation types – General arrangement of equipments – Earthing – Backup protection – Isolating schemes – Smart communications – Substation Automation	

Contact Periods :

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

Text books:

1. *Sunil S.Rao* "**Switchgear protection and power systems**" Khanna Pub.,13th Ed., 2008
2. *Y.G.Paithankar and S.R.Bhide "**Fundamentals of power system protection**" Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi – 2010*
3. *Badri Ram , B.H.Vishwakarma "**Power System Protection and Switchgear**" New Age International Pvt Ltd Publishers, Second Edition 2011.*

Reference Books:

1. *Uppal S.L. "**Electric Power**" , Khanna Publishers, New Delhi, 13th Edn, 2003*
2. *Soni M.L., Gupta P.V. and Bhatnagar U.S. and Bhatacharya,"**Power system Protection**",1998*
3. *Ravindranath B. and Chander M., "**Power System Protection and Switchgear**",1st Ed. Reprint 2005*
4. *C.L.Wadhwa, Electrical Power Systems, 6 th Edition, New Age International (P) Ltd., 2010*

COURSE OUTCOME:

CO1: Illustrate the operation and performance of various protective relays through previously learned principles.

CO2: Analyze various protection techniques for protecting power system components against faults.

CO3: Synthesize existing protection schemes for protecting power system components against faults.

CO4: Evaluate modern protection schemes to comply with the requirement of protection

CO5: Clarify the operation and suggest suitable Circuit Breaker among many options

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	L	M	L	-	L	L	-	-	-	M	L	L	H	M	L
CO2	H	M	L	M	M	M	L	-	L	M	L	-	H	M	M
CO3	H	H	M	M	L	L	M	L	-	-	-	-	M	H	H
CO4	L	H	-	H	M	-	M	L	-	-	M	L	M	H	H
CO5	-	-	L	M	H	H	M	M	L	M	-	L	M	H	H
16EPC702	M	M	L	M	M	L	L	L	-	L	L	L	M	H	M

L – Low, M – Moderate (Medium), H- High

16EPC707 ADVANCED MEASUREMENTS LABORATORY Category: PC

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1.16EPC406 Electrical and Electronic Measurements

COURSE OBJECTIVES:

* To provide practical experience to supplement the theoretical knowledge gained in the field of advanced measurements.

LIST OF EXPERIMENTS:

1. Calibration of Ammeter, Voltmeter, Wattmeter and Energy meter.
2. Measurement of High Resistance by Loss of Charge method.
3. Burden Characteristics of Current Transformers.
4. Measurement of Sequence Impedances of Synchronous Machines.
5. Instrumentation Amplifier.
6. Phase angle Measurement.
7. Measurement of Frequency, Voltage and Current.
8. Measurements using VI programming.
9. Creating Virtual Instrumentation for simple applications
10. Data Acquisition through Virtual Instrumentation
11. GPIB and Serial Interfaces based Instrument Communication.
12. Strain and Temperature measurement Using NI ELVIS.
13. DC Motor Control with ELVIS Module.
14. Power Quality Measurement
15. MULTISIM based Circuit Analysis.

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOME:

CO1: Demonstrate the usage of measuring instruments

CO2: Experiment the various types of measuring devices for physical quantity

CO3: Analyze and calculate all the parameters related to measurements.

CO4: Perform measurement precisely and interpret the results

CO5: Operate and calibrate measuring devices

CO6: Compare and contrast the measuring equipment required for various applications in industry

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	M	H	M	L	L	-	L	L	L	L	L	H	H	H
CO2	M	M	H	H	L	-	L	L	L	L	L	L	M	H	M
CO3	M	M	M	H	L	L	L	L	L	L	L	L	M	H	M
CO4	M	M	M	H	-	L	L	L	L	L	L	L	M	H	H
CO5	M	H	M	M	L	L	-	L	L	L	L	L	H	H	M
CO6	H	H	M	M	L	L	L	L	L	L	L	L	H	H	H
16EPC707	M	H	H	H	L	L	L	L	L	L	L	L	H	H	H

L – Low, M – Moderate (Medium), H- High

16EPC708 **POWER SYSTEM LABORATORY** **Category: PC**

L	T	P	C
0	0	4	2

PRE-REQUISITES:

1. 16EPC505 Transmission and Distribution
2. 16EPC602 Power System Analysis

COURSE OBJECTIVES:

- To remember previously learned information, grasp the meaning of information about power system problem and apply to practical situations for planning and evaluating.

LIST OF EXPERIMENTS:

1. Electromechanical Relays.
2. Microcontroller based Relays.
3. AC Transmission line Analyser.
4. DC network analyser.
5. Generator protection simulation.
6. Feeder protection simulation.
7. Study of FACTS devices in power systems.
8. Study of unbalanced circuits using Symmetrical components.
9. Computation of Parameters and Modelling of Transmission Lines.
10. Formation of Bus Admittance and Impedance Matrices.
11. Load Flow Analysis Using Gauss-Seidel Method.
12. Load Flow Analysis Using Newton- Raphson and Fast-Decoupled Methods.
13. Fault Analysis.
14. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System.
15. Transient Stability Analysis of Multi-machine Power Systems.
16. Electromagnetic Transients in Power Systems.
17. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems.
18. Economic Dispatch in Power Systems.

Contact Periods :

Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOME:

CO1: Demonstrate the various Power System Analysis, Control, Operation and Protection problems virtually through simulation and hardware setup

CO2: Apply the concepts described in various power system theories to actual situation.

CO3: Summarize ideas learnt through various power system concepts in designing/planning a new one.

CO4: Evaluate the existing power system for its reliable operation

CO5: Propose modern technologies for the enhanced operation of power system

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	-	H	M	-	-	-	-	-	-	L	H	M	H
CO2	H	H	-	H	H	-	M	H	M	-	H	L	H	M	M
CO3	M	H	H	H	M	M	L	H	M	H	H	H	H	M	M
CO4	H	H	H	H	-	M	M	H	H	H	M	H	M	H	H
CO5	M	M	H	H	M	-	M	-	H	-	H	H	M	H	H
16EPC708	H	H	M	H	M	L	L	M	M	L	M	M	H	M	H

L – Low, M – Moderate (Medium), H- High

16EEC801 **PROJECT WORK** **Category : EEC**

L	T	P	C
0	0	16	8

PRE-REQUISITE : NIL

COURSE OBJECTIVES:

- To use the knowledge acquired in various subjects of Electronics and Electronics Engineering.
- To motivate students to come up with new designs, Fabrication, Developing algorithms and software programs expressing their ideas in a novel way.
- To learn methodology to select a good project and able to work in a team leading to development of hardware/software product.

PROJECT:

- A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design, fabrication of Sensor/Activator/Controller, a research investigation, or a design problem. The progress of the project is evaluated based on a minimum of two reviews.
- A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners based on oral presentation and the project report.

Contact Periods:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical : 240 periods** **Total : 240 periods**

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Select a good project and able to work in a team leading to development of hardware/software product.

CO2: Prepare a good technical report and able to present the ideas with clarity.

CO3: Gain Knowledge on various terminologies related to industrial environment.

CO4: Able to work efficiently as a member of different teams related to multidisciplinary projects.

CO5: Acquire skills to communicate efficiently and gain management skills related to industry / research organizations.

COURSE ARTICULATION MARTIX

CO	PO 1	PO 2	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	M	M	H	H	M	H	H	H	M	H	H	M	M	M	H
CO2	H	M	H	H	M	M	M	L	M	M	H	M	H	M	M
CO3	H	M	L	M	L	M	M	M	M	M	H	H	H	L	M
CO4	H	H	H	H	M	M	M	L	M	M	H	H	H	M	M
CO5	M	H	H	M	M	M	L	M	M	H	H	H	M	M	H
16EEC801	M	M	H	M	M	M	M	M	M	M	H	H	H	M	M

L – Low, M – Moderate (Medium), H- High

16EPEX01 PRINCIPLES OF VIRTUAL INSTRUMENTATION Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To understand the Virtual instrumentation concepts towards measurements and control

UNIT-I : INTRODUCTION	**(09)**
Virtual Instrumentation and LabVIEW - Evolution of LabVIEW - Difference between LabVIEW and conventional languages - Sequencing and data flow - Graphical programming.	
UNIT-II : LABVIEW PROGRAMMING TECHNIQUES	**(09)**
Front panel - Block diagram - VIs - Sub-VIs - Simple examples - Looping: For loop, while loop - Shift registers - case and sequence; structures, formula nodes. Arrays - Clusters, charts and graphs - Local and global variables - Property node, string and file I/O. publishing measurement data in the web .	
UNIT-III : DATA ACQUISITION	**(09)**
DAQ – Components - Buffers - Triggering - Analog I/O - Digital I/O - Counters and timers - DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.	
UNIT-IV : INSTRUMENT CONTROL	**(09)**
VI Chassis requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, compact RIO - Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office - Industrial applications, VISA and IVI.	
UNIT-V : APPLICATION OF VIRTUAL INSTRUMENTATION	**(09)**
VI toolsets, Distributed I/O modules Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control	

Contact Periods :

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text books:

1. *Sanjay Gupta and Joseph John "**Virtual Instrumentation using LabVIEW**" Tata McGraw-Hill, Second Ed. 2010*
2. *Jovitha Jerome "**Virtual Instrumentation Using LabVIEW**" PHI Learning Pvt. Ltd 1st Ed., 2010*

Reference books:

1. *Lisa K Wells and Jeffrey Travels, "**Labview for everyone**", Prentice Hall, 3rd Ed. 2009*
2. *S. Gupta, J.P. Gupta, "**PC interfacing for data acquisition and process control**", 2nd Ed., Instrument Society of America, 1994*
3. *Gary Johnson, Richard Jennings "**Lab view graphical programming**", Tata McGraw Hill, 2011*

COURSE OUTCOME:

- **CO1:** Explain the concepts of virtual instruments
- **CO2:** Apply the programming concepts using LabVIEW
- **CO3:** Create simple measurement system using LABVIEW programs
- **CO4:** Demonstrate the program in LabVIEW for system monitoring, processing and controlling operations
- **CO5:** Comply the basics of interfacing and programming using related hardware
- **CO6:** Develop real time applications using LabVIEW

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	H	-	-	-	-	-	L	L	H	M	M
CO2	M	H	M	M	H	L	-	-	-	-	L	L	H	H	M
CO3	M	H	H	H	H	L	-	L	L	L	L	L	H	H	H
CO4	M	H	H	H	H	L	L	L	-	L	L	L	H	H	H
CO5	H	M	M	M	H	-	-	-	-	-	L	L	H	H	M
CO6	M	H	H	H	H	L	L	L	L	L	L	L	H	H	H
16EPEX01	M	H	H	H	H	L	L	L	L	L	L	L	H	H	H

L – Low, M – Moderate (Medium), H- High

16EPEX02 **NEURAL AND FUZZY SYSTEMS** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

- To apply the intelligent human characters such as generalization, learning and vagueness in to artificial intelligent systems for betterment of engineering.

UNIT-I : INTRODUCTION TO NEURAL NETWORKS	**(09)**
Introduction – Biological and Artificial neural networks - Learning rules – Training - ADALINE - MADALINE – BAM – Discrete Hopfield networks.	
UNIT-II : ARTIFICIAL NEURAL NETWORKS	**(09)**
Theory, Architecture and Applications of Back propagation network – Counter propagation network – Kohenen's Self Organising Maps.	
UNIT-III : INTRODUCTION TO FUZZY	**(09)**
Fuzzy sets and membership – Chance Vs ambiguity – Classical sets – Fuzzy sets – Fuzzy relations – Tolerance and Equivalence relations – Value assignments.	
UNIT-IV : FUZZIFICATION AND DEFUZZIFICATION	**(09)**
Fuzzification – Membership value assignments – Fuzzy to Crisp conversions - Lambda – Cuts for Fuzzy sets and relations – Defuzzification methods.	
UNIT-V : FUZZY ARITHMETIC, NUMBERS, VECTORS AND EXTENSION PRINCIPLE	**(09)**
Extension principle – Fuzzy numbers – Interval analysis in arithmetic – Approximate methods of extension: Vertex method, DSW algorithm, Restricted DSW algorithm – Fuzzy vectors – Classical predicate logic – Approximate reasoning – Fuzzy tautologies, contradictions, Equivalence and Logical proofs.	

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text books:

1. *LaureneFausett "**Fundamentals of Neural Networks**" Prentice Hall, New Jersey, 2004*
2. *Timothy J.Ross "**Fuzzy logic with Engineering Applications**" Wiley India Pvt. Ltd., 3rd Ed., 2010*

Reference books:

1. *Robert .J.Schalkoff," **Artificial Neural Networks**", McGraw Hill, Singapore, 2011*
2. *Driankov D., Helledorn H., M.Reinframe, "**An Introduction to fuzzy control**", Narosa Publishing Co., New Delhi, 1996*
3. *Kosko.B," **Neural Network and fuzzy systems**"- Prentice Hall of India Pvt. Ltd., New Delhi, 2007*
4. *S N Sivanandam., S N Deepa, "**Principles of Soft Computing**", Wiley India Pvt. Ltd., 2nd Ed., 2011*

COURSE OUTCOME:

CO1: To understand the human neural network and concept of fuzziness.
CO2: To explore the methods of training of artificial intelligent (AI) systems
CO3: Implementation of human intelligent concepts in AI.
CO4: Methods to formulate the input and to evaluate the output of the AI systems.
CO5: Learning the different architectures and able to differentiate them
CO6: To choose right AI technique for engineering applications.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	M	-	-	-	-	-	H	L	H	-	-
CO2	H	M	M	H	-	-	-	-	M	-	-	M	H	-	-
CO3	H	M	H	M	-	M	-	-	-	-	-	-	M	H	M
CO4	M	H	M	H	-	-	-	-	-	M	-	-	-	H	M
CO5	M	M	H	H	-	-	-	-	-	-	-	-	-	M	H
CO6	H	M	H	M	-	M	-	-	-	-	-	M	-	H	M
16EPEX02	H	M	H	M	M	M	-	-	L	L	L	M	M	H	M

L – Low, M – Moderate (Medium), H- High

16EPEX03 **POWER SYSTEM ECONOMICS** **Category : PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16EPC602 Power System Analysis

COURSE OBJECTIVES:

- To acquire knowledge on analyzing, synthesizing various methods of achieving economic operation of power generating plants in power system.

UNIT-I : CHARACTERISTICS AND OPERATION OF POWER PLANTS	**(09)**
Characteristics operation of Power Plants – Choice of Power Plants – Hydro, thermal and Nuclear-Size of Plant – Input / Output Curves – Review of Economic dispatch and loss formula calculations.	
UNIT-II : OPTIMAL SYSTEM OPERATION OF POWER PLANTS	**(09)**
Economics Scheduling – Cost and Loss Calculation for Optimum Economy – Practical Calculation – Evaluation and application of Generation – Simple problems.	
UNIT-III : HYDRO THERMAL COORDINATION	**(09)**
Long range and short range hydro scheduling – A gradient approach – hydro units in series – Evaluation and applications of Economic Scheduling of generation – Thermal and Hydro Thermal Stations.	
UNIT-IV : UNIT COMMITMENT	**(09)**
Constraints in unit commitment – thermal unit constraints – hydro constraints – solution methods – priority list methods – dynamic programming solution.	
UNIT-V : GENERATION SYSTEM RELIABILITY ANALYSIS	**(09)**
Load forecasting and system reliability – load Forecasting – Generation system reliability – Co-ordination methods – economic operation of power systems – Deregulated power system – Unbundling – Hedging – Power market - Simple problem.	

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text books:

1. *Kirchmayer E. K "**Economic Operation of Power Systems**" John Wiley and sons, New Delhi, 1985*
2. *Elgerd O.I "**Electric Energy System Theory an Introduction**" Tata McGraw Hill, New Delhi, 2008*
3. *Murthy P.S.R "**Power System Operation and Control**" Tata McGraw Hill Book Co., New Delhi, 1984*

Reference books:

1. *Sullivan R.L., "**Power System Planning**", McGraw Hill, New York, 1977*
2. *Hawany E.L., and Christensen G.S.,"**Optimal Economic Operation of Electric Power Systems**", Academic Press, New York, 1979*
3. *Allen Wood J. and Wollenberg B.F.,"**Power Generation Operation and Control**", John Wiley and sons, New Delhi, 2007*

COURSE OUTCOMES:

CO1: To make students express Economic operation of power system and importance of LFC control.

CO2: To allow students discuss about thermal and hydro power plants operation in meeting the load demand optimally. (State and central wide installation). Also expressing importance of reactive power control through seminars.

CO3: To improve student's ability in solving problems (numerical problems at present) by posing different problem models related to Economic Load Dispatch, Load Frequency Control and reactive power control.

CO4: Apply their knowledge in PSE for competitive exams like GATE, IES, and Public sector etc.

CO5: Ability to discuss single area load frequency control and two area load frequency control.

CO6: Ability to model and design turbine and Automatic controller and to express variation of Frequency in the power system with varying load.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	M	-	L	M	-	-	H	L	L	L	M	M	M	L
CO2	L	M	L	H	M	M	L	M	M	M	L	L	H	H	L
CO3	M	H	M	H	M	M	H	M	L	L	H	H	H	H	M
CO4	H	H	M	H	M	M	L	-	-	-	-	L	M	L	L
CO5	-	H	M	H	M	L	L	-	L	L	L	M	M	L	M
CO6	-	M	L	M	M	H	L	L	M	L	M	M	M	-	L
16EPEX03	H	H	M	H	M	M	L	M	L	L	L	M	M	H	L

L – Low, M – Moderate (Medium), H- High

16EPEX04 **POWER QUALITY ENGINEERING** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16EPC505 Transmission and Distribution

COURSE OBJECTIVES:

- To acquire knowledge on power quality issues, monitoring equipment and mitigation techniques.

UNIT-I : INTRODUCTION TO POWER QUALITY	**(09)**
Terms and definitions: Overloading - Under voltage - Sustained interruption - Sags and swells; waveform distortion - Total Harmonic Distortion (THD) – Computer Business Equipment Manufacturers Associations (CBEMA) curve.	
UNIT-II : VOLTAGE SAGS AND INTERRUPTIONS	**(09)**
Sources of sags and interruptions - Estimating voltage sag performance - Motor starting sags - Estimating the sag severity mitigation of voltage sags - Active series compensators - Static transfer switches and fast transfer switches.	
UNIT-III : OVERVOLTAGES	**(09)**
Sources of over voltages: Capacitor switching – Lightning - Ferro resonance - Mitigation of voltage swells - Surge arresters low pass filters - Power conditioners – Lightning protection- Shielding - Line arresters - Protection of transformers and cables computer analysis tools for transients - PSCAD and EMTP.	
UNIT-IV : HARMONICS	**(09)**
Harmonic distortion: Voltage and current distortion - Harmonic indices - Harmonic sources from commercial and industrial loads - Locating harmonic sources - Power system response characteristics – Resonance - Harmonic distortion evaluation - Devices for controlling harmonic distortion - Passive filters - Active filters - IEEE and IEC standards.	
UNIT-V : POWER QUALITY MONITORING	**(09)**
Monitoring considerations: Power line disturbance analyzer - Power quality measurement equipment - Harmonic / spectrum analyzer - Flicker meters - Disturbance analyzer - Applications of expert system for power quality monitoring.	

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 45 Periods**

Text books:

1. *Roger.C.Dugan, Mark.F.McGranagham, Surya Santoso, H.Wayne Beaty "**Electrical Power Systems Quality**" McGraw Hill, 2003*
2. *Kusko Alexander Thomson Marc. T "**Power Quality in Electrical Systems**" McGraw Hill, Professional, 2007*
3. *Mat H. J. Bollen and Ireen G.U "**Signal Processing of Power Quality Disturbance**" Willey, IEEE press, 2006.*

Reference books:

1. *PSCAD User Manual*

COURSE OUTCOME:

On completion of this course, students will be able to

CO1: Study and understand the basics and necessity of power quality

CO2: Understand the basics of voltage sag and interruption

CO3: Examine and compute the harmonic distortion

CO4: Identify methods to manage the overvoltage

CO5: Understand and design the active and passive filters

CO6: Understand and design the power quality monitoring equipment

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	L	L	L	-	-	-	-	-	-	-	H	L	-
CO2	M	M	L	-	-	-	-	-	-	-	-	-	H	M	-
CO3	L	H	L	-	M	-	L	-	-	-	-	-	-	L	M
CO4	H	L	M	-	-	-	-	-	-	-	-	-	L	M	-
CO5	L	L	M	H	M	-	-	-	-	L	L	L	M	M	-
CO6	-	-	-	L	L	-	-	-	-	M	M	H	M	H	-
16EPEX04	M	M	L	L	L	-	L	-	-	L	L	L	L	L	L

L – Low, M – Moderate (Medium), H- High

16EPEX05 **HVDC TRANSMISSION SYSTEM** **Category: PE**

PRE-REQUISITES:

1. 16EPC505 Transmission and Distribution

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand about HVDC transmission system and its control.

UNIT-I : GENERAL ASPECTS OF HVDC AND HVAC TRANSMISSIONS	**(09)**
Introduction - Comparison between AC and DC transmissions - DC links - DC cables and line insulators - Comparison between ac and dc cables - Important HVDC projects - Components of a HVDC system.	
UNIT-II : CONVERTER CIRCUITS AND ANALYSIS	**(09)**
Three Phase bridge converter using SCRs - Operating principles - Waveforms - Gate control and overlap – Voltage, current and power factor relations – Commutating resistance – Inversion – Equivalent circuits – Analysis and charts only for overlap less than 60º – Three phase bridge converters using IGBT – Recent development in IGBT - Simple problems.	
UNIT-III : CONVERTER CONTROL	**(09)**
Principle of control – Manual control – Desirable features of control - Control characteristics – Constant minimum firing angle control – Constant current control – Constant extinction angle control – Tap changer control – Power and frequency control – Stability control – Compounding control and regulation – Reactive power requirement – Simple problems	
UNIT-IV : FAULTS AND PROTECTION	**(09)**
Bypass valve – SCR valves malfunctions – Over voltage and current oscillations – DC circuit breakers – DC lightning arrestors – Simple problems**.**	
UNIT-V : HARMONICS, FILTERS AND GROUND RETURN	**(09)**
Characteristic and uncharacteristic harmonics – Harmonic ac and dc filters – Interference with communication systems – Ground return – land, shore and sea electrodes – Cathodic protection – DC corona.	

Contact Periods:

Lecture : 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text books:

1. *Kimbark E.W "**Direct Current Transmission**" Vol I, Wiley – Interscience,New york,1971*
2. *Padiyar K.R "**HVDC Transmission Systems**" New Age International Pvt.Ltd, 2008*

Reference books:

1. *Adamson and Hingorani H.G., "**High Voltage DC Power Transmission**", Garaway Ltd. England 1960.*
2. *Wadhwa C.L.,"**Electrical Power Systems**", New Age International Pvt. Ltd, New Delhi, 1995*
3. *Arillaga J., "**High Voltage Direct Current Transmission**", Peter Peregrinus, London, 1998*

COURSE OUTCOME:

CO1: Identify the merits and necessity of HVDC transmission.
CO2: Analysis about the converter circuits.
CO3: Concepts of converter control and power flow.
CO4: Ability to discuss firing angle control.
CO5: Illustrate about the protection in HVDC systems..
CO6: Illustrate about harmonic filtering in HVDC systems.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	M	H	M	L	L	M	L	M	H	H	M	L
CO2	H	H	M	M	H	M	L	L	L	L	L	M	H	H	M
CO3	H	M	M	M	H	M	L	L	L	L	M	H	M	M	M
CO4	H	M	H	M	M	M	L	L	L	L	L	H	L	M	H
CO5	H	M	H	M	M	M	L	L	M	L	M	H	H	H	H
CO6	H	M	H	H	M	L	L	L	M	L	M	H	H	H	H
16EPEX05	H	M	H	M	H	M	L	L	M	L	M	H	H	H	H

L – Low, M – Moderate (Medium), H- High

16EPEX06 **FACTS CONTROLLERS** **Category: PE**

PRE-REQUISITES:

1. 16EPC505 Transmission and Distribution

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To enhance the transmission capability of transmission system by shunt and series compensation using static controllers.

UNIT-I : INTRODUCTION	**(09)**
The concept of flexible AC transmission - Reactive power control in electrical power transmission lines -Uncompensated transmission line – Series and shunt compensation. Overview of FACTS devices - Static Var Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified Power Flow controller (UPFC) - Integrated Power Flow Controller (IPFC).	
UNIT-II : STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS	**(09)**
Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage. Applications - Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping – Prevention of voltage instability.	
UNIT-III : THYRISTOR CONTROLLED SERIES CAPACITOR(TCSC) AND APPLICATIONS	**(09)**
Operation of the TCSC - Different modes of operation – Modeling of TCSC – Variable reactance model – Modeling for stability studies. Applications - Improvement of the system stability limit – Enhancement of system damping – Voltage collapse prevention.	
UNIT-IV : EMERGING FACTS CONTROLLERS	**(09)**
Static Synchronous Compensator (STATCOM) – Operating principle – V-I characteristics Unified Power Flow Controller (UPFC) – Principle of operation - Modes of operation – Applications – Modeling of UPFC for power flow studies.	
UNIT-V : CO-ORDINATION OF FACTS CONTROLLERS	**(09)**
FACTs Controller interactions – SVC–SVC interaction - Co-ordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination.	

Contact Periods:

Lecture : 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text books:

1. *Mohan Mathur, R., Rajiv. K. Varma "**Thyristor – Based Facts Controllers for Electrical Transmission Systems**" IEEE press and John Wiley & Sons, Inc.*

Reference books:

1. *A.T.John, "**Flexible AC Transmission System**", Institution of Electrical and Electronic Engineers (IEEE), 1999.*
2. *Narain G.Hingorani, Laszio. Gyugyl, "**Understanding FACTS Concepts and Technology of Flexible AC Transmission System**", Standard Publishers, Delhi 2001.*

COURSE OUTCOME:

CO1: Understand the concept of flexible AC transmission and the associated problems.
CO2: Describe the principles, operation and control of UPFC and IPFC.
CO3: Review the static devices for series and shunt control.
CO4: Know the significance of shunt, series compensation and role of FACTS devices on system control.
CO5: Analyze the functional operation and control of TCSC.
CO6: Study the operation of controllers for enhancing the transmission capability.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	M	L	M	M	L	L	M	M	H	L	L
CO2	M	M	H	L	M	M	L	M	L	L	H	M	M	M	M
CO3	M	M	H	M	L	L	L	M	L	L	H	M	M	M	M
CO4	H	M	H	H	L	M	L	L	M	L	M	M	H	H	H
CO5	H	H	H	M	M	L	L	L	L	L	M	H	L	H	H
CO6	M	M	H	H	M	M	M	L	L	L	M	M	M	M	H
16EPEX06	H	M	H	M	M	M	L	M	L	L	M	M	M	M	H

L – Low, M – Moderate (Medium), H- High

16EPEX07 **ENERGY AUDITING AND MANAGEMENT** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16EPC505 Transmission and Distribution
2. 16EPC501 Power Generation and Utilization

COURSE OBJECTIVES:

* To acquire knowledge on energy audit and management to exhibit the intellectual skills to provide economical solutions.

UNIT-I : BASIC PRINCIPLES OF ENERGY AUDIT	**(09)**
Energy audit – Definition, concept, type of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes – Energy audit of industries – Energy saving potential, energy audit of process industry, thermal power station, building energy audit.	
UNIT-II : ENERGY MANAGEMENT AND ENERGY INSTRUMENTS	**(09)**
Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting – Energy Auditor and Energy Manager – Eligibility, Qualification and functions - Questionnaire and check list for top management - Measuring Instruments – Wattmeter, data loggers, thermocouples, pyrometers, lux meters, tong testers.	
UNIT-III : ENERGY EFFICIENT MOTORS AND PUMPS	**(09)**
Factors affecting efficiency - Energy efficient motors - Constructional details, characteristics – Variable speed, variable frequency drives - VSD driven pumps, fans and compressors - Voltage variation – Voltage unbalance – Over motoring – Motor energy audit.	
UNIT-IV : POWER FACTOR IMPROVEMENT AND LIGHTING SYSTEM	**(09)**
Power factor - Methods of improvement, location of capacitors, p.f with non-linear loads, effect of harmonics on p.f,- p.f motor controllers – Energy efficient lighting system design and practice - Lighting control–application of PLCs.	
UNIT-V : ECONOMIC ASPECTS AND ANALYSIS	**(09)**
Economics analysis – Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Calculation of simple payback method, net present worth method.	

Contact Periods:

Lecture : 45 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 45 Periods**

Text books:

1. *Murphy W.R. and G.Mckay Butter worth "**Energy Management**" Heinemann Publications 2007*
2. *Paul o' Callagham "**Energy Management**" Mc-Graw Hill Book Company – 1st Ed., 1998*

Reference books:

1. *John.C.Andreas, "**Energy Efficient Electric Motors**", Marcel Dekker Inc Ltd – 3rd Ed., 2005*
2. *W.C.Turner Steve Doty, "**Energy Management Handbook**", John Wiley and Sons, 7th Ed., 2009*

COURSE OUTCOME:

CO1: Emphasize the importance of energy management on various electrical equipment..
CO2: Analyze the concepts behind economic analysis and load management.
CO3: Evaluate the energy management methods for lighting systems and drives.
CO4: Study energy efficient motors.
CO5: Study the effects of power factor improvement.
CO6: Learn the economic aspects and methods of cost analysis.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	H	H	L	M	M	M	L	M	M	H	M	M
CO2	H	H	H	H	H	M	M	M	M	L	M	M	H	M	M
CO3	H	M	H	H	H	L	M	M	M	L	M	L	M	L	H
CO4	H	H	H	M	H	L	M	M	M	L	L	M	H	L	L
CO5	M	H	M	M	M	M	M	M	L	M	M	M	M	M	L
CO6	M	M	H	H	M	M	L	M	L	M	M	M	M	H	L
16EPEX07	H	H	H	H	H	M	M	M	M	L	M	M	H	M	M

L – Low, M – Moderate (Medium), H- High

16EPEX08 **AUTOMOTIVE ELECTRONICS FOR ELECTRICAL ENGINEERING** **Category: PE**

(Common to EIE)

L	T	P	C
3	0	0	3

PRE- REQUISITE : NIL

COURSE OBJECTIVES

* To familiarize the fundamentals of automotive electronics.
* To explain the fuel injection and ignition systems.
* To illustrate sensors used in automobiles.
* To facilitate the analysis and design of control systems in automobiles.
* To teach the different safety systems used in automobiles.

UNIT - I : FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS	**(09)**
Evolution of electronics in automobiles, emission laws, introduction to Euro standards, equivalent Bharat standards, Charging systems: Working and design of charging circuit, alternators, requirements of starting system, starter motors and starter circuits.	
UNIT - II : IGNITION AND INJECTION SYSTEMS	**(09)**
Ignition systems: Ignition fundamentals, Electronic Ignition system, programmed ignition, distribution less ignition, direct ignition, spark plugs, Electronic fuel control, basics of combustion, engine fuelling and exhaust emission, electronic control of carburetion, petrol fuel injection, diesel fuel injection	
UNIT - III : SENSORS AND ACTUATORS	**(09)**
Working principle and characteristics of airflow rate, engine crank shaft angular position, hall effect, throttle angle, temperature, exhaust gas oxygen sensors. Fuel injector, exhaust gas recirculation actuators, stepper motor actuator and vacuum operated actuator.	
UNIT - IV : ENGINE CONTROL SYSTEM	**(09)**
Control modes for fuel control, engine control subsystems, ignition control methodologies, different ECUs used in engine management. In vehicle networks: CAN standard. Diagnostic systems in modern automobiles – Power Electronics control for motors, drive motors - Batteries	
UNIT - V : CHASSIS AND SAFETY SYSTEMS	**(09)**
Traction control system, cruise control system, electronic control of automatic transmission, antilock braking system, electronic suspension system, working of airbag, centralised door locking system, climate control of cars.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total : 45 Periods

Text Books

1. *Tom Denton "**Automobile Electrical and Electronic Systems**" Arnold Publishers, Fourth Edition 2012.*
2. *William B Ribbens "**Understanding Automotive Electronics**" Sixth Edition, Newnes Pubilishers, sixth Edition, 2003.*

Reference Books

1. *V A W Hillier "**Fundamentals of Automotive Electronics**" OUP Oxford, Second Edition 2001.*
2. *Ronald K Jurgen "**Automotive Electronic Handbook**" McGraw Hill, Second Edition, 1999.*
3. *Robert Bosch "**Automotive Electrics and Automotive Electronics**" Springer, Fifth Edition, 2014.*
4. *Bogdan M. Wilamowski, J. David Irwin, "**The Industrial Electronics Handbook**" CRC Press, Second Edition, 2011.*
5. *NPTEL Lecture.*

COURSE OUTCOMES:

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

- **CO1:** Perceive the electronics involved in automotive systems
- **CO2:** Understand the fundamentals involved in ignition systems
- **CO3:** Choose appropriate sensors for automobiles based on applications
- **CO4:** Work as a team and implement simple and safe control systems in automobiles
- **CO5:** Analyse the safety issues that occur in automotive systems

COURSE ARTICULATION MARTIX

CO	PO 1	PO 2	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	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CO2	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CO3	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CO4	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CO5	M	M	L	L	L	L	L	L	L	L	L	L	L	L	L
16EPEX08	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L

L- Low, M-Moderate (Medium), H-High

16EPEX09 **POWER SYSTEM STABILITY** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16EPC505 Transmission and Distribution
2. 16EPC602 Power System Analysis

COURSE OBJECTIVES:

- To equip knowledge and analyze about various stability problems in electrical power system.

UNIT-I : INTRODUCTION TO STABILITY	**(09)**
Stability of power system – Simple two machine stability problems – Mechanical Analogy of power transmission systems – Impedance of stability to system operation and design – Effect on instability – Representation of power system components – Stability studies on network analysis	
UNIT-II : STEADY STATE STABILITY	**(09)**
Introduction to stability of electric power systems – Significance of steady state stability – Power limit of transmission system – Two machine system with negligible losses – Clarke diagram for two machine system with negligible losses – Power angle characteristic and steady state stability limit of salient pole synchronous machines – Two machine system with losses – Clarke diagram for two machine system with resistance – Steady state stability with automatic voltage regulators.	
UNIT-III : TRANSIENT STABILITY	**(09)**
Swing equation and its solution – General background - Swing equation for synchronous machine – Numerical solution of swing equation – Multi machine stability – Factors affecting transient stability	
UNIT-IV : EQUAL AREA CRITERION	**(09)**
Concepts of equal area criterion – Application of equal area criterion to stability studies under fault conditions – Determination of critical clearing angle – Reduction of a power system to a single equivalent machine connected to infinite bus – Equivalent power angle curve of two finite machines – Graphical integral method of swing curve determination.	
UNIT-V : EXCITATION SYSTEM AND ITS EFFECT ON STABILITY	**(09)**
Introduction – Definition of terms – Quick response excitation systems – Compounding the excitation of generators – Modern trend in excitation systems – Voltage regulator capability to improve transient stability – Super-excitation for stability – Two axis excitation control – High initial response excitation systems – Exciter response - Determination by graphical integration – Point by point method of calculation.	

Contact Periods:

Lecture: 45periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text books:

1. *Gangadhar K.A "**Power System Analysis and Stability**" Khanna Publishers, New Delhi, 6th reprint 2004.*
2. *Kimbark E.W "**Power System Stability**" Volume III, Wiley – IEEE Press Thrid Reprint*

Reference books:

1. *P. Kundur, "**Power System Stability and Control**", Tata Mc Graw Hill, 3rd reprint, 2007.*
2. *M.A.Pai,K.Sengupta and K. R.Padiyar, Tata- McGraw hills."**Topics on small signal stability analysis**".*
3. *Paul M.Anderson and A.A. Fouad, "**Power system stability**" Wiley-interscience.*

COURSE OUTCOME:

CO1: Analyze the stability of simple power systems using linear analysis methods and the equal area method.

CO2: Apply computer simulation tools for dynamic analysis of large power systems.

CO3: Establish the differential equations describing simple one machine infinite bus systems and perform detailed analyses of such systems.

CO4: Use control engineering methods for design and tuning of turbine governors and voltage controllers.

CO5: Perform analysis related to frequency control and reserve requirements in a synchronously interconnected power grid.

CO6: Perform dynamic power system analysis, including steady state and transient stability.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	M	-	M	M	-	M	M	-	M	M	M	H	M	L
CO2	H	M	M	-	M	-	M	M	-	M	M	M	H	M	M
CO3	M	H	H	M	M	-	M	-	M	H	M	M	M	H	H
CO4	M	H	H	H	M	-	M	-	M	H	M	M	M	H	H
CO5	M	M	-	M	H	M	M	M	M	H	M	M	M	H	H
16EPEX09	M	M	M	M	M	-	M	L	L	H	M	M	M	H	M

L – Low, M – Moderate (Medium), H- High

16EPEX10 POWER SYSTEM OPERATION AND CONTROL Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16EPC406 Power Generation and Utilization
2. 16EPC602 Power System Analysis

COURSE OBJECTIVES:

- To study the different types of power system control and their requirement for proper operation.

UNIT-I : INTRODUCTION	**(09)**
System load variation: System load characteristics, load curves - daily, weekly and annual, load-duration curve, load factor, diversity factor. Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Overview of system operation: Load forecasting, unit commitment, load dispatching. Overview of system control: Governor control, LFC, EDC, AVR, system voltage control, security control.	
UNIT-II : REAL POWER CONTROL	**(09)**
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, Economic Dispatch Control. Multi-area systems: Two-area system modeling; static analysis, uncontrolled case; tie line with frequency bias control of two area system derivation, state variable model	
UNIT-III : REACTIVE POWER CONTROL	**(09)**
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; methods of voltage control - shunt reactors – shunt capacitors – series capacitors – synchronous condensers – static var systems- Tap-changing transformer - System level voltage control.	
UNIT-IV : UNIT COMMITMENT AND ECONOMIC DISPATCH	**(09)**
Statement of Unit Commitment (UC) problem; constraints in UC: spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints; UC solution methods: Priority-list method, forward dynamic programming approach, Incremental cost curve, co-ordination equations without loss and with loss, solution by direct method and λ-iteration method. Base point and participation factors. Economic dispatch controller added to LFC control.	
UNIT-V : OPERATION OF DEREGULATED POWER SYSTEM	**(09)**
Energy control centre: Functions – Monitoring, data acquisition and control. System hardware configuration – SCADA and introduction to EMS functions: Network topology determination, state estimation, security analysis and control. Various operating states - State transition diagram - control strategies – Introduction to deregulated power system	

Contact Periods:
Lecture: 45 Periods Total: 45 Periods

Text books:

1. *Olle. I. Elgerd "**Electric Energy Systems Theory – An Introduction"** Tata McGraw Hill Publishing Company Ltd, New Delhi, Second Ed., 30th Reprint 2008*
2. *Allen.J.Wood and Bruce F.Wollenberg "**Power Generation, Operation and Control**" John Wiley & Sons, Inc., 2003*
3. *P. Kundur "**Power System Stability & Control**" Tata McGraw Hill Publishing Company Ltd., USA, 5th Reprint 2008*

Reference books:

1. *D.P. Kothari and I.J. Nagrath, "**Modern Power System Analysis**", Third Ed., Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.*
2. *L.L. Grigsby, "**The Electric Power Engineering**", Hand Book, CRC Press & IEEE Press, 2001*

COURSE OUTCOME:

CO1: Model the various power system components.
CO2: Analyze the dynamics and stability issues in power system.
CO3: Realize stabilized interconnected power systems.
CO4: Analyse the issues in real power and reactive power control.
CO5: Differentiate unit commitment and economic dispatch.
CO6: Study the computer control of power systems.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	H	H	M	M	M	M	M	H	H	H	H	M
CO2	H	H	H	H	H	M	M	M	M	M	H	H	H	M	M
CO3	M	H	M	H	M	H	H	M	M	M	L	L	M	H	L
CO4	H	H	H	H	H	M	M	L	L	L	M	H	H	M	L
CO5	M	M	M	M	H	M	M	M	L	L	M	H	M	M	L
CO6	M	H	M	M	M	M	L	M	M	L	L	L	M	L	L
16EPEX10	M	H	M	H	H	M	M	M	M	M	H	H	H	M	L

L – Low, M – Moderate (Medium), H- High

16EPEX11 DIGITAL SIGNAL PROCESSING AND PROCESSORS Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1.16EBS2Z2 Engineering Mathematics- II

COURSE OBJECTIVES:

- To acquire knowledge of digital filters and DSP hardware.

UNIT-I : INTRODUCTION	**(09)**
Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Digital signal representation, analog to digital conversion.	
UNIT-II : DISCRETE TIME LINEAR SYSTEMS	**(10)**
Discrete linear systems - Time invariance - Causality, stability, difference equations Z-transforms and inverse Z-transforms - Transfer function of linear discrete systems - Impulse response, step response, frequency response - Recursive, non-recursive filters - Digital filter realization - Direct, canonic, cascade, parallel and ladder realizations.	
UNIT-III : DIGITAL FILTERS	**(08)**
Approximation of analog filters - Butterworth and Chebyshev - Frequency transformation - Properties of IIR filters – IIR filter design – Bilinear transformation and impulse invariant methods - Digital transformation - Characteristics of FIR filters - Frequency response of linear phase FIR filters - Design of FIR filters - Fourier series method - Window function.	
UNIT-IV : DISCRETE FOURIER TRANSFORM	**(10)**
DFT - Definition – Properties - Convolution of sequences - Linear convolution - Introduction to radix-2 FFT – Properties - Decimation in time-Decimation in frequency - Data shuffling and bit reversal- Computation of IDFT using DFT.	
UNIT-V : HARDWARE FOR DSP	**(09)**
Harvard architecture – Pipelining - Hardware MAC unit- Special instructions of DSP - Architecture of TMS320C5X – Replication - On-Chip memory - Assembly language instructions of TMS320C5X - Simple programs.	

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text books:

1. *John G. Proakias, Dimitris G. Manolakis "**Digital Signal Processing: Principles, Algorithms and Applications**" Pearson Education Pvt. Ltd., New Delhi, 3rd Edition 2009*
2. *Venkatramani B. and Bhaskar M "**Digital Signal Processors: Architecture and Programming**" Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2010*
3. *Sanjit K. Mitra "**Digital Signal Processing - A Computer Based Approach**" Tata McGraw-Hill Publishing Co. Ltd.,New Delhi, 3rd Edition 2011*

Reference books:

1. *Oppenheim and Schafer, "**Discrete Time Signal Processing**", Prentice Hall of India Pvt. Ltd., New Delhi, 3rd Edition2010.*
2. *Ludeman L. C., "**Fundamentals of Digital Signal Processing**", John Wiley and Sons, New York, 2009.*

COURSE OUTCOME:

On completion of this course, students will be able to

CO1: Understand the discrete time liner systems DFT and Z Transform

CO2: Examine the properties of different systems and signals

CO3: Realization of spectral estimation of signals.

CO4: Analyse and solve problems on FFT

CO5: Analyse and solve problems on design of digital filters

CO6: Examine the basic DSP hardware and execute simple program

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	-	L	L	-	-	-	-	-	-	-	-	L	-
CO2	M	H	L	-	L	-	L	-	L	M	L	-	L	M	-
CO3	L	H	L	-	M	-	L	-	-	-	-	-	-	L	M
CO4	-	L	M	H	M	-	-	-	-	-	-	L	L	M	-
CO5	-	L	M	H	M	-	-	-	-	-	-	L	-	M	-
CO6	H	L	M	-	-	-	-	-	-	-	-	-	L	-	H
16EPEX11	M	M	L	L	L	-	L	-	L	L	L	L	L	L	L

L – Low, M – Moderate (Medium), H- High

16EPEX12 **INTERNET OF EVERYTHING** **Category: PE**

PRE- REQUISITES : NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the basic issues, policy and challenges in the Internet and to understand the components and the protocols in Internet.

UNIT-I : INTRODUCTION	**(09)**
Definition – Phases – Foundations – Policy – Challenges and Issues – Identification – Security – Privacy. Components in internet of things: Control Units – Sensors – Communication modules – Power Sources –Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – Rflink – Mobile Internet – Wired Communication	
UNIT-II : PROGRAMMING THE MICROCONTROLLER FOR IOT	**(09)**
Basics of Sensors and actuators – Examples and working principles of sensors and actuators – Cloud computing and IoT – Arduino/Equivalent Microcontroller platform – Setting up the board - Programming for IoT – Reading from Sensors Communication: Connecting microcontroller with mobile devices – Communication through bluetooth and USB – Connection with the internet using wifi / Ethernet.	
UNIT-III : RESOURCE MANAGEMENT IN THE INTERNET OF THINGS	**(09)**
Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines - Software Agents for Object - Data Synchronization - Types of Network Architectures - Fundamental Concepts of Agility and Autonomy –Enabling Autonomy and Agility by the Internet of Things - Technical Requirements for Satisfying the New Demands in Production - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things - Agents for the Behaviour of Objects.	
UNIT-IV: BUSINESS MODELS FOR THE INTERNET OF THINGS	**(09)**
The Meaning of DiY in the Network Society – Sensor-actuator Technologies and Middleware as a Basis for a DiY Service Creation Framework – Device Integration - Middleware Technologies Needed for a DiY Internet of Things Semantic Interoperability as a Requirement for DiY Creation – Ontology - Value Creation in the Internet of Things-Application of Ontology Engineering in the Internet of Things -Semantic Web-Ontology - The Internet of Things in Context of EURIDICE - Business Impact.	
UNIT-V : WEB OF THINGS	**(09)**
Resource - Oriented Architecture and Best Practices - Designing RESTful Smart Things - Web-enabling Constrained Devices - The Future Web of Things - Set up cloud environment – Send data from microcontroller to cloud – Case studies – Open Source e-Health sensor platform – Be Close Elderly monitoring – Other recent projects.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text Books:

1. *Charal ampos Doukas "**Building Internet of Things with the Arduino**" Create space, April 2002*
2. *Dieter Uckelmann et.al " **Architecting the Internet of Things"** Springer, 2011*
3. *Luigi Atzor et.al "**The Internet of Things: A survey**" Journal on Networks, Elsevier Publications, October, 2010*

Reference Books:

1. *http://postscapes.com/*
2. *http://www.theinternetofthings.eu/what-is-the-internet-of-things*

COURSE OUTCOME:

On completion of this course, students will be able to

CO1: Build a small low cost embedded system with the internet

CO2: Understand the various modes of communications with internet.

CO3: Learn to manage the resources in the Internet

CO4: Learn to deploy the resources into business

CO5: Understand and design the cloud and internet environment.

CO6: Understand and design the open source environment

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	-	-	-	-	L	L	-	M	L	L	H	-	L	-
CO2	-	-	-	-	L	M	L	L	M	-	L	-	L	M	-
CO3	-	-	-	-	-	L	-	L	-	L	-	L	-	L	H
CO4	-	-	-	-	-	-	L	-	-	L	M	H	L	-	-
CO5	-	-	-	M	L	-	L	L	-	-	-	L	-	H	-
CO6	-	-	-	-	-	-	-	-	M	L	M	H	L	H	-
16EPEX12	-	-	-	L	L	L	L	L	L	L	L	M	L	M	L

L – Low, M – Moderate (Medium), H- High

16EPEX13 **PRINCIPLES OF EMBEDDED SYSTEMS** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16EES2Z5 Programming in C
2. 16EES306 Object Oriented Programming and Data structures
3. 16EPC502 Microprocessor, Microcontroller and Applications

COURSE OBJECTIVES:

- To impart the knowledge of embedded systems to develop efficient digital system.

UNIT-I : FUNDAMENTALS AND BUS PROTOCOLS	**(09)**
Classification of Embedded Systems - Embedded System on Chip - Structural Units in a Processor - Processor Selection - Memory Selection - Allocation of Memory to Segment - Block Memory Map of a System - Serial Communication using PC bus and CAN bus - Parallel Communication using ISA and PCI busses.	
UNIT-II : INTERRUPTS AND SOFTWARE ARCHITECTURES	**(09)**
Interrupt Basics - Shared Data Problem - Interrupt Latency - Round Robin Architecture - Round Robin with Interrupts - Function - Queues - Scheduling Architecture - Real Time Operating System Architecture - Selecting an Architecture.	
UNIT-III : REAL TIME OPERATING SYSTEMS	**(09)**
Tasks and Task States - Tasks and Data - Semaphores and Shared Data - Message Queues, Mailboxes and Pipes - Timer Functions – Events - Memory Management - Interrupt Routines in RTOS Environment	
UNIT-IV : DESIGN USING RTOS	**(09)**
Overview - Principles - Encapsulating Semaphores and Queues - Hard Real-time Scheduling Consideration - Saving Memory Space - Saving Power.	
UNIT-V : EMBEDDED SOFTWARE DEVELOPMENT TOOLS	**(09)**
Host and Target Machines - Linker / Locators for Embedded Software - Getting Embedded Software into Target - Testing on Host Machine - Instructions Set Simulators**.**	

Contact periods:

Lecture: 45periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text Books:

1. *David E. Simon "**An Embedded Software Primer**" Pearson Education, Reprint 2008*
2. *Raj Kamal "**Embedded Systems**" Tata McGraw-Hill, Second Ed. 2008*
3. *K.V.K Prasad, "**Embedded Real Time System Programming**", Wiley India Pvt. Ltd., 1st edition, 2008.*

Reference Books:

1. *Peckol, "**Embedded system Design**", John Wiley & Sons,2010*
2. *Lyla B Das, "**Embedded Systems-An Integrated Approach**", Pearson, 2013*
3. *Navabi "**Embedded Core Design with FPGA's**" Tata McGraw-Hill, First Ed. 2008*

COURSE OUTCOME:

CO1: To acquire the functional understanding of communication between digital system.

CO2: To be able to model the organization and understand the digital system.

CO3: Demonstrate the practical use embedded system.

CO4: To interpret the software and hardware components and their usage.

CO5: To provide in depth knowledge of embedded processor architecture behavior of Embedded system.

CO6: To explain the embedded software development tool

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	H	-	-	-	-	-	-	-	H	-	-
CO2	M	M	H	M	M	-	-	-	-	-	-	-	H	-	-
CO3	H	H	M	H	H	-	M	-	-	-	M	M	M	H	M
CO4	M	H	M	M	M	-	-	-	-	-	-	-	-	H	M
CO5	M	H	H	M	M	-	-	-	-	-	-	-	-	H	M
CO6	M	M	M	M	H	-	-	-	-	-	-	M	-	H	M
16EPEX13	M	M	M	M	M	-	L	-	-	-	L	L	H	H	M

L – Low, M – Moderate (Medium), H- High

16EPEX14 SPECIAL MACHINES AND CONTROLLERS Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16EPC302 Field theory
2. 16EPC503 Rotating AC Machinery and Special Machines

COURSE OBJECTIVE:

* To grasp the working of special electrical machines and to cater the knowledge to real world applications.

UNIT-I : STEPPING MOTORS	**(09)**
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.	
UNIT-II : SWITCHED RELUCTANCE MOTORS	**(09)**
Constructional features - Principle of operation - Torque equation - Power controllers - Characteristics and control - Microprocessor based controller.	
UNIT-III : SYNCHRONOUS RELUCTANCE MOTORS	**(09)**
Constructional features – Types - Axial and radial air gap motors – Phasor diagram – Characteristics - Vernier motor	
UNIT-IV : PERMANENT MAGNET BRUSHLESS DC MOTORS	**(09)**
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 equation - Torque – Speed characteristics - Microprocessor based controller.	
UNIT-V : PERMANENT MAGNET SYNCHRONOUS MOTORS	**(09)**
Principle of operation - EMF,power input and torque expressions - Phasor diagram - Power controllers – Torque - Speed characteristics - Self control - Vector control - Current control schemes.	

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text Books:

1. *Miller ,T.J.E "**Brushless Permanent Magnet and Reluctance Motor Drives**" Clarendon Press, Oxford, 1989*
2. *Kenjo.T and Naganori S "**Permanent Magnet and Brushless DC Motors**" Clarendon Press, Oxford, 1989*
3. *Kenjo.T "**Stepping Motors and their Microprocessor Control**" Clarendon Press, Oxford, 1994*

Reference Books:

1. *Ramakrishnan, "**Switched Reluctance Motor Drives**", CRC press, 2001*
2. *Jacek F Gieras and Micheal Wing, "**Permanent Magnet Motor Technology**", CRC press, 2002*
3. *P. P. Acarnely, "**Stepping Motors**", 4th Ed., IFT Publishers, 2002*

COURSE OUTCOME:

CO1: To develop the deep knowledge in concepts of electromechanical energy conversion.

CO2: To understand and determination of characteristics of special electrical machines.

CO3: Review of modern power electronic converter for special electrical machines.

CO4: Design of control circuits for power converters.

CO5: Able to choose the right machine for specific applications.

CO6: To explore the ideas to improve the shortcomings of performance of special electrical machines.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	H	M	-	-	-	-	-	-	-	-	H	-	-
CO2	H	H	M	M	M	-	-	-	-	-	-	-	H	-	-
CO3	H	M	M	M	H	L	-	-	-	-	-	-	H	-	-
CO4	M	M	H	M	M	-	-	-	-	-	-	L	-	H	M
CO5	M	M	M	H	-	-	L	-	-	M	-	-	-	H	M
CO6	M	H	M	H	M	-	M	-	-	M	-	M	-	M	H
16EPEX14	M	M	M	M	M	L	L	-	-	M	-	L	H	H	M

L – Low, M – Moderate (Medium), H- High

16EPEX15 LOGIC AND DISTRIBUTED CONTROL SYSTEMS Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16EPC504 Control Systems Engineering

COURSE OBJECTIVE:

- Study the fundamentals of PLC, exploring the intermediate and advanced functions, design and analysis of DCS with communication standards.

UNIT-I : PROGRAMMABLE LOGIC CONTROLLER (PLC) BASICS	**(09)**
Definition – Overview of PLC systems – Input and output modules – Power supplies – Isolators – General PLC programming procedures – Programming on-off outputs – Auxiliary commands and functions – Creating ladder diagrams from process control descriptions – Register basics – Timer functions – Counter functions	
UNIT-II : PLC INTERMEDIATE AND ADVANCED FUNCTIONS	**(09)**
Arithmetic functions – Number comparison functions – Skip and MCR functions – Data move systems – PLC advanced intermediate functions – Utilising digital bits – Sequencer functions – Matrix functions – Alternate programming languages – Analog PLC operation – Networking of PLC – PID control of continuous processes – PLC installation – Troubleshooting and maintenance – Controlling a Robot.	
UNIT-III : INTERFACE AND BACKPLANE BUS STANDARDS FOR INSTRUMENTATION SYSTEMS	**(09)**
Field bus: Introduction – Concept – International field bus standards – HART protocol: Method of operation – Structure – Operating conditions – Applications.	
UNIT-IV : DISTRIBUTED CONTROL SYSTEMS OPERATION	**(09)**
Evolution of DCS – Building blocks – Detailed descriptions and functions of field control units – Operator stations – Data highways – Redundancy concepts – DCS – Supervisory computer tasks and configuration – DCS – System Integration with PLC and computers	
UNIT-V : COMMUNICATION IN DCS	**(09)**
Special requirement of networks used for control – Protocols – Link access mechanisms – Manufacturers automation protocols – Case studies in DCS.	

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text Books:

1. *John. W. Webb and Ronald A. Reis "**Programmable Logic Controllers – Principles and Applications**" 4th Ed., Printice Hall Inc., New Jersy, 5th Ed. 2002*
2. *Frank D. Petruzella "**Programmable Logic Controllers**" McGraw Hill Book Company Book, third Ed. 2005*
3. *Lukcas M.P "**Distributed Control Systems**" Van Nostrand Reinhold Company, New York, 1986*

Reference Books:

1. *Krishna Kant, "**Computer based Industrial Control**", Prentice Hall of India, 10th Printing 2009*
2. *Curtis D.Johnson, "**Process control Instrumentation Technology**", 8th Ed. Pearson Education, 2006*

COURSE OUTCOME:

CO1: Recognize and develop ladder diagrams, testing the capability of PLC's control and troubleshooting of PLC.
CO2: Configure PLC's to perform various tasks in the process environment.
CO3: Configure and integrate DCS with PLC and Computers, developing software for these systems.
CO4: Identity Logical process control in automation.
CO5: Develop basic PLC Programmers.
CO6: Students will have the knowledge of data acquisition system.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	H	H	M	M	L	H	H	H	H	H	M	H
CO2	H	H	H	H	H	L	L	L	H	L	H	H	H	L	H
CO3	H	M	H	M	M	L	L	L	M	L	H	H	H	L	H
CO4	H	H	M	M	L	L	L	L	M	L	H	H	H	L	M
CO5	H	H	H	L	H	M	L	L	M	L	H	H	H	L	L
CO6	H	H	H	M	M	L	L	L	M	L	M	M	H	L	L
16EPEX15	H	H	H	M	H	L	L	L	M	L	H	H	H	L	H

L – Low, M – Moderate (Medium), H- High

16EPEX16 **INDUSTRIAL DRIVES AND CONTROL** **Category: PE**

L	T	P	C
3	0	0	3

PRE- REQUISITE:

1. 16EPC403 DC Machines and Transformers
2. 16EPC503 Rotating AC Machinery and Special Machines

COURSE OBJECTIVE:

- To learn the concepts of electrical drives and their applications in carrying out modern industry processes.

UNIT-I : SPEED CONTROL OF DC MOTORS	**(09)**
Concept of Electric Drive – Classification of Electric Drives – Speed/Torque characteristics – Braking methods – Methods of speed control – Ward Leonard drives – Dual converter –Thyristor converter fed DC drives – Single, Two and Four quadrant operations – Plugging – Regenerative braking.	
UNIT-II : DIGITAL CONTROL OF DC MOTORS	**(09)**
Digital technique in speed control of DC motors – Advantages – Limitations – Closed loop DC control – Analog, Digital and Hybrid speed control – Stepper motor and it's applications – Microprocessor applications to DC speed motor control.	
UNIT-III : SPEED CONTROL OF AC MOTORS	**(09)**
Speed control of AC motors – Speed / Torque characteristics – Braking methods – Thyristor control – Vector Control - Pulse Width Modulation – Current Source Inverter, Cycloconverter fed Induction motors.	
UNIT-IV : FREQUENCY CONTROLLED INDUCTION MOTOR DRIVES	**(09)**
Frequency control for constant Torque and Constant Power operation of Induction motors – Rotor side control of Slip ring Induction motor with thyristor chopper – Static control of Rotor resistance – Slip-Energy recovery scheme – Static Scherbius and Kramer systems – Applications of Microcontroller to AC motor speed control.	
UNIT-V : INDUSTRIAL APPLICATIONS	**(09)**
Choice of selection of motors – Electric drive applications – Steel rolling mills – Cement mills – Paper mills – Textile mills – Sugar mills – Coal mines – Machine Tools.	

Contact periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 45 Periods**

Text Books:

1. *Dubey G.K "**Fundamentals of Electrical Drives**" Narosa Publishing House, New Delhi, 2nd Ed. 2002.*
2. *B.K.Bose "**Modern Power Electronics And AC drives**" Printicehall of india pvt ltd, New Delhi,2002*

Reference Books:

1. *Vedam Subramaniam, **"Electrical Drives and Applications",** Tata McGraw Hill, New Delhi, 2nd 2010.*
2. *Murphy J.M.D., **"Thyristor Control of AC Motors"**, Pergamon Press, NewYork, 1973.*
3. *Krishnan R., **"Electric Motor and Drives: Modeling, Analysis and Control"**, Pearson Education, New Delhi, 2001.*
4. *Pillai S.K., **"A First Course on Electrical Drives"**, Wiley Eastern Ltd., Bombay, 2nd Ed. 2007*

COURSE OUTCOME:

CO1: Illustrate the role of power electronics in modern drives.

CO2: Design the digital control techniques for drives.

CO3: Design the speed control techniques for AC drives

CO4: Select the drive for particular application considering the present and future needs of industries.

CO5: Understand microprocessors in the control of electric drives.

CO6: An ability to use the techniques, skills, and modern engineering tools necessary for electrical engineering practice.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	L	M	L	L	M	L	M	M	L	H	M
CO2	H	H	H	M	M	L	L	L	L	L	M	H	M	M	H
CO3	H	H	H	M	M	L	L	L	L	L	M	H	H	M	H
CO4	H	M	M	M	H	M	H	L	H	L	M	M	M	M	H
CO5	H	M	L	M	M	L	M	L	L	L	M	M	H	L	L
CO6	H	M	M	H	H	L	L	M	L	M	M	H	M	H	M
16EPEX16	H	M	M	M	M	L	L	L	L	L	M	H	M	M	H

L – Low, M – Moderate (Medium), H- High

16EPEX17 **SOLID STATE RELAYS** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16EPC602 Power System Analysis
2. 16EPC702 Protection and Switchgear
3. 16EPC503 Rotating AC Machinery& Special Machines
4. 16EPC502 Microprocessor & Microcontroller Programming

COURSE OBJECTIVE:

* To gain knowledge on various protection design concepts, theory behind the operational characteristics of relays, analyze and synthesize the concepts of Static relay circuits designed using Analogue and Digital IC's and hence evaluate the performance of each one.

UNIT-I : INTRODUCTION TO STATIC RELAYS	**(09)**
Advantages of Static Relays - Generalized characteristics and operational equations of relays - Steady state and transient performance of signal driving elements - Signal mixing techniques and measuring techniques - CT's and PT's in relaying schemes - Saturation effects.	
UNIT-II : STATIC RELAY CIRCUITS I	**(09)**
Static relay circuits (Using Analog and Digital IC's) for over current, inverse – Time characteristics, differential relay and directional relay	
UNIT-III : STATIC RELAY CIRCUITS II	**(09)**
Static relay circuits for generator loss of field, under frequency, distance relays, impedance, reactance, mho, reverse power relays	
UNIT-IV : CARRIER CURRENT PROTECTION AND TESTING	**(09)**
Static relay circuits for carrier current protection - Steady state and transient behaviour of static relays - Testing and maintenance.	
UNIT-V : NUMERICAL RELAYS	**(09)**
Hardware and software for the measurement of voltage, current, frequency, phase angle - Microcontroller implementation of over current relays - Inverse time characteristics - Impedance relay - Directional Relay - Mho Relay.	

Contact periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 45 Periods**

Text Books:

1. *Rao T.S.M "**Power System Protection- Static Relays**" Tata McGraw Hill, Reprint 2010*
2. *Rao "**Digital Numerical Relays**" McGraw Hill, First Ed. 2005*

Reference Books:

1. *Van C. Warrington, "**Protective Relays - Their Theory and Practice**", Chapman and Hall.*
2. *Ravindranath B. and Chander M., "**Power System Protection and Switchgear**", Wiley Eastern, 2007*

COURSE OUTCOME:

CO1: Illustrate the various operational characteristics of relays for steady state and transient performance

CO2: Explain the theory behind the blocks of various protections relaying schemes of power system components and hence assembling into a new one.

CO3: Analyze different applications of the relay, CB, grounding for different elements of power system

CO4: Gain knowledge on different protective equipments and maintenance of equipments

CO5: To test the different industrial applications and different high frequency heating static relay

CO6: Summarize and evaluate conventional and digitized relaying design techniques

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	H	M	H	M	M	M	L	L	M	H	H	M	M	L
CO2	H	H	H	H	H	M	M	M	M	M	H	H	H	M	H
CO3	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CO4	H	H	M	M	M	M	M	M	M	M	H	H	H	M	M
CO5	H	H	H	M	M	L	L	L	L	M	H	H	H	M	L
CO6	H	H	M	H	M	H	M	M	M	M	H	H	H	M	M
16EPEX17	H	H	H	H	M	M	M	M	M	M	H	H	H	M	M

L – Low, M – Moderate (Medium), H- High

16EPEX18 **MEMS AND APPLICATIONS** **Category: PE**

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide the introduction of micro electro mechanical systems and to teach critical thinking in micro engineering process, material and design issues.

UNIT-I : FUNDAMENTALS OF MEASUREMENT SYSTEMS	**(09)**
Basic principles of measurement systems - Primary Transduction Mechanisms Physical variables – Sensor defects – Sensing mechanisms – Enabling Technologies – Silicon – Thick film – Optical.	
UNIT-II : TRANSDUCER MODELLING	**(09)**
Electronic Techniques – Bridge circuits – Amplifiers – Data conversion – Noise and recovery of signal from noise – Sensor Networks and Protocols.	
UNIT-III : SMART TRANSDUCERS	**(09)**
Concepts – Software structures – Hardware structures – Fundamentals and limitations of photolithography – Pattern transfer with etching techniques – Pattern transfer with other physical and chemical techniques.	
UNIT-IV : MICROMACHINING	**(09)**
Bulk micromachining – Surface micromachining – Other micromachining techniques – Packaging techniques – Micro scaling considerations.	
UNIT-V : APPLICATIONS	**(09)**
Applications in automotive industry – Applications in biomedical industry – DNA sensors, Electronic noise – Future developments-Nanotechnology – Carbon Nano Tube (CNT).	

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 45Periods**

Text Books:

1. *Chang Liu "**Foundations of MEMS**" Prentice Hall, 2012*
2. *Marc Madou "**Fundamental of Microfabrication**" CRC Press,3rd Ed, 2011*
3. *Richard C. Jaeger "**Introduction to Microelectronic Fabrication**" Addison- Wesley, 2002*

Reference Books:

1. *Gad-El-Hak, **"MEMS Handbook,"** CRC Press, 2005.*
2. *N.T. Nguyen and S.Wereley, "**Fundamentals and Applications of Microfluidics**", Artech House, 2006.*
3. *Nitaigour Premchand Mahalik, "**MEMS**",TMH, I Reprint, 2008.*
4. *Tai Ran Hsu, "**MEMS and Microsystems Design and Manufacture**", TMH, VII Reprint, 2012.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the basics of electro and mechanical system

CO2: Understand the basics of micro fabrication

CO3: Develop models and simulate electrostatic sensors

CO4: Develop models and simulate different types of actuators

CO5: Recognize the materials properties of mems system performance.

CO6: Recognize the importance of mems system performance.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	L	-	-	-	-	-	-	-	-	-	H	-	-
CO2	H	M	L	-	-	-	-	-	-	-	-	-	M	-	-
CO3	L	L	M	H	L	L	-	-	-	-	-	-	-	M	L
CO4	L	L	M	H	L	L	-	-	-	-	-	-	-	M	L
CO5	-	-	L	L	L	L	-	-	-	-	-	-	M	L	-
CO6	-	-	L	L	L	-	L	-	-	-	-	-	L	-	H
16EPEX18	L	L	L	L	L	L	L	-	-	-	-	-	L	L	L

L – Low, M – Moderate (Medium), H- High

16EPEX19 POWER PLANT INSTRUMENTATION Category: PE

L	T	P	C
3	0	0	3

PRE- REQUISITE:

1 16EPC406 ELECTRICAL AND ELECTRONIC MEASUREMENTS

COURSE OBJECTIVES:

* To familiarize about different power generation process.
* To lecture about the important process variables and their measurements.
* To learn about the important control loops involved in thermal power plants.
* To familiarize the student with the knowledge of turbines and their control.

UNIT - I : METHODS OF POWER GENERATION	**(09)**
Methods of power generation – hydro, thermal, nuclear, solar and wind power –Importance of instrumentation in power generation – basic building block for all types of power generation plants - details of boiler processes – P and I diagram of boiler - cogeneration.	
UNIT - II : MEASUREMENTS IN POWER PLANTS	**(09)**
Measurement of feed water flow, air flow, steam flow and coal flow – Drum level measurement– Steam pressure and temperature measurement – Turbine speed and vibration measurement – Flue gas analyzer – Fuel composition analyzer.	
UNIT - III : ANALYZERS IN POWER PLANTS	**(09)**
Flue gas oxygen analyzer - analysis of impurities in feed water and steam - dissolved oxygen analyzer - chromatography - pH Meter - Fuel analyzer -pollution monitoring instruments.	
UNIT - IV : CONTROL LOOPS IN BOILER	**(09)**
Combustion Control-air/fuel ratio control - furnace draft control - drum level control - main steam and reheat steam temp control - super heater control - attemperator – de-aerator control -distributed control system in power plants - interlocks in boiler operation.	
UNIT – V : TURBINE AND CONTROL	**(09)**
Types of steam turbines – impulse and reaction turbines – compounding – Turbine governing system– Speed and Load control – Transient speed rise – Free governor mode operation – Automatic Load Frequency Control – Turbine oil system – Oil pressure drop relay – Oil cooling system– Turbine run up system.	

Contact Periods:

Lecture : 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text Books:

1. Sam Dukelow "***Control of Boilers***" Instrument Society of America, 1991

2. Gill.A.B "***Power Plant performance***" Butterworth and Co (Publishers) Ltd, 2003

Reference Books:

1. Liptak B.G "***Instrumentation in Process Industries"*** Chilton Book Company, 2005.

2. Jain R.K "***Mechanical and Industrial Measurements***" Khanna Publishers, New Delhi, 1999.

3. Krishnaswamy, K. and Ponnibala.M "***Power Plant Instrumentation***" PHI Learning Pvt. Ltd., New Delhi, 2011.

COURSE OUTCOMES:

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

- **CO1:** Understand the operation of hydro, thermal, nuclear, wind and solar power plants.
- **CO2:** Select instruments for monitoring various parameters related to thermal power plant.
- **CO3:** Analyze and select appropriate control strategy for Boiler.
- **CO4:** Gain knowledge on the important terms related to turbine monitoring system and able to analyze the problems related to turbine governing.
- **CO5:** Design instrumentation systems for electricity generating plants.

COURSE ARTICULATION MARTIX

CO	PO 1	PO 2	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	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
CO2	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
CO3	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
CO4	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
CO5	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
16EPEX19	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M

L- Low, M-Moderate (Medium), H-High

16EPEX20 **PROFESSIONAL ETHICS** **Category : PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

- To possess knowledge on ethics, safety, rights, responsibilities and global issues.

UNIT-I : ENGINEERING ETHICS	**(09)**
Senses of 'Engineering Ethics' - Variety of moral issued - 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.	
UNIT-II : ENGINEERING AS SOCIAL EXPERIMENTATION	**(09)**
Engineering as experimentation - Engineers as responsible experimenters - Codes of ethics - A balanced outlook on law - The challenger case study.	
UNIT-III : SAFETY	**(09)**
Safety and risk - Assessment of safety and risk - Risk benefit analysis and reducing risk - The three mile island and chernobyl case studies.	
UNIT-IV : RESPONSIBILITIES AND RIGHTS	**(09)**
Collegiality and loyalty - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights - Intellectual Property Rights (IPR) - Discrimination.	
UNIT-V : GLOBAL ISSUES	**(09)**
Multinational corporations - Environmental ethics - Computer ethics - Weapons development - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership - Sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of Electronics and Telecommunication Engineers(IETE)(India).	

Contact Periods:

Lecture : 45 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 45Periods**

Text Books:

1. *Mike Martin and Roland Schinzinger "**Ethics in Engineering**" McGraw-Hill, New York 1996*
2. *Govindarajan M, Natarajan S, Senthil Kumar V. S "**Engineering Ethics**" Prentice Hall of India, New Delhi, 2004*

Reference Books:

1. *Charles D. Fleddermann, "**Engineering Ethics**", Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint)*
2. *Charles E Harris, Michael S. Protchard and Michael J Rabins, "**Engineering Ethics – Concepts and Cases**", Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available).*
3. *John R Boatright, "**Ethics and the Conduct of Business**", Pearson Education, New Delhi, 2003*
4. *Edmund G Seebauer and Robert L Barry, "**Fundamentals of Ethics for Scientists and Engineers**", Oxford University Press, Oxford, 2001*

COURSE OUTCOME:

CO1: Recognize the theories and principles of professional ethics
CO2: Understand the basic perception of profession, professional ethics, various moral issues & uses of ethical theories.
CO3: Understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field .
CO4: Analysis of safety and risk benefit analysis.
CO5: Acquire knowledge on professional rights and responsibilities of an engineer.
CO6: Outline the global issues and codes of ethics.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	L	M	M	M	M	L	H	L	L	M	M	H	M	L
CO2	H	M	M	L	M	L	L	M	H	L	L	H	M	M	M
CO3	H	M	M	L	M	H	M	H	L	M	M	L	M	H	M
CO4	H	H	M	M	M	M	M	L	L	M	M	H	L	H	H
CO5	H	M	M	M	M	M	M	M	L	L	H	M	M	L	M
CO6	H	M	M	H	L	M	L	H	L	M	M	H	M	M	L
16EPEX20	H	M	M	M	M	M	M	H	L	M	M	H	M	M	M

L – Low, M – Moderate (Medium), H- High

16EPEX21 **ENERGY STORAGE TECHNOLOGY** **Category: PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 16EBS104 Applied Chemistry
2. 16EHS2Z4 Environmental Science and Engineering

COURSE OBJECTIVE:

- To acquire the essentials of energy storage technologies and use them in the field engineering.

UNIT-I : STORAGE PERSPECTIVES	**(09)**
Need for energy storage- - Transmission Congestion - Demand for Portable Energy – Variation in power generation and demand – Long term and short term energy - Environmental and sustainability issues.	
UNIT-II : METHODS OF ENERGY STORAGE	**(09)**
Introduction: Energy and Energy Transformations - Potential energy (pumped hydro, compressed air, springs) - Kinetic energy (mechanical flywheels) - Thermal energy without phase change passive (adobe) and active (water) - Thermal energy with phase change (ice, molten salts, steam) - Chemical energy (hydrogen, methane, gasoline, coal, oil) - Electrochemical energy (batteries, fuel cells) - Electrostatic energy (capacitors), Electromagnetic energy (superconducting magnets).	
UNIT-III : PERFORMANCE FACTORS OF ENERGY STORAGE SYSTEMS	**(09)**
Energy capture rate and efficiency - Discharge rate and efficiency - Dispatch ability and load flow characteristics - Scale flexibility, durability – Cycle lifetime, mass and safety – Risks of fire, explosion, toxicity - Ease of materials recycling and recovery - Environmental consideration and recycling - Merits and demerits of different types of Storage.	
UNIT-IV : HYDROGEN FUEL CELLS AND HYBRID ENERGY	**(09)**
Economy of Hydrogen storage – Generation and Storage techniques of Hydrogen - Hybrid Energy generation. Applications: Storage for Hybrid Electric Vehicles - Regenerative braking and energy capturing methods.	
UNIT-V : FLOW BATTERIES AND SUPER CAPACITORS	**(09)**
Flow battery - Operation – Types - Super Capacitors: construction - Power calculation – Electricity grid applications.	

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text books:

1. *DetlefStolten "**Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications**" Wiley,2010.*
2. *Jiujun Zhang, LeiZhang,Hansan Liu, Andy Sun, Ru-Shi Liu "**Electrochemical Technologies for Energy Storage and Conversion**" John Wiley and Sons, 2012.*

Reference Book:

1. *Francois Beguin and ElzbietaFrackowiak "**Super capacitors materials,systems and applications"** Wiley, 2013.*

COURSE OUTCOME:

CO1: To be aware of the need for energy storage.

CO2: To learn fundamentals of energy storage technologies.

CO3: To determine the characteristics of storage elements.

CO4: To identify the suitable technology for diverse applications.

CO5: Employing the eco-friendly technology by considering various factors.

CO6: To design the control techniques to enhance the performance of energy system.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	-	M	-	L	-	-	-	-	-	H	-	-
CO2	H	M	M	-	M	-	-	-	-	-	-	-	H	-	-
CO3	H	M	H	H	M	-	-	-	-	-	-	M	H	-	-
CO4	M	H	M	H	-	-	M	-	-	M	-	M	-	H	M
CO5	M	M	M	-	-	M	H	M	-	-	H	-	-	H	M
CO6	H	M	M	M	M	-	-	-	-	-	-	M	-	H	M
16EPEX21	H	M	M	H	M	M	M	M	-	M	H	M	H	H	M

L – Low, M – Moderate (Medium), H- High

16EPEX22 **OPTIMIZATION TECHNIQUES** **Category : PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

- To understand the concept of optimization techniques and algorithms methods for solving various electrical engineering problems.

UNIT-I : CLASSICAL OPTIMIZATION TECHNIQUES	**(09)**
Single variable optimization - Multivariable optimization with no constraints: Semi definite case, Saddle point - Multivariable optimization with Equality constraints: Solution by direct substitution, Solution by the method of constrained variation, Solution by the method of Lagrange Multipliers - Multivariable optimization with Inequality constraints: Kuhn-Tucker conditions, constraint qualification	
UNIT-II : SIMPLEX METHOD	**(09)**
Standard form of a Linear programming problem - Geometry of linear programming problems - Definitions and theorems - Solution of a system of linear simultaneous equations - Pivotal reduction of a general system of equations - Motivation of the simplex method - Simplex algorithm - Revised simplex method.	
UNIT-III : UNCONSTRAINED & CONSTRAINED OPTIMIZATION TECHNIQUES	**(09)**
Unconstrained optimization techniques: Gradient of a function - Steepest descent (Cauchy) method - Newton's method - Marquardt method -Quasi-Newton methods – Broydon – Fletcher – Goldfarb - Sanno method. Constrained optimization techniques: Characteristics of a constrained problem - Generalized reduced gradient method - Sequential quadratic programming - Augmented Lagrange Multiplier method - Checking convergence of constrained optimization problems.	
UNIT-IV : GENETIC ALGORITHMS	**(09)**
Working principles - Differences between Gas and traditional methods - Similarities between GAs and traditional methods - GAs for constrained optimization - Other GAs operators - Real-coded GAs - Advanced GAs - Simulated annealing.	
UNIT-V : MATLAB OPTIMIZATION TOOLBOX	**(09)**
Matlab Basics: Introduction - Matrices and vectors - Matrix and array operations - Built-in functions - Saving and loading data - Script files - Function files.Optimization Toolbox: Linear least squares with linearity constraints - Nonlinear curve fitting via least square with bounds - Linear programming - Quadratic programming - Nonlinear zero finding	

Contact periods:

Lecture : 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text books:

1. *Singiresu S.Rao "**Engineering Optimization – Theory and Practice**" John Wiley & Sons, 4th Ed. 2009*
2. *Kalyanmoy Deb "**Optimization For Engineering Design**" Prentice Hall of India, New Delhi,2nd edition 2012*

Reference Book:

1. *Rudra Pratap "**Getting Started with MATLAB 7**" Oxford University Press, 2005 "Optimization Toolbox Manual", The Mathworks Inc., 2000, www.mathworks.com*

COURSE OUTCOME:

CO1: To introduces the fundamental concept of optimization techniques

CO2: Formulate deterministic mathematical programs in practical system

CO3: Interpret the results of the model and present the insights

CO4: Recognize the limitations of different solution methodology

CO5: To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable

CO6: Analyze real life problems, especially logistics problem through the use of mathematical modelling techniques

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	L	H	M	L	M	L	L	H	M	H	-	-	-
CO2	H	H	L	H	H	L	M	L	H	H	L	H	-	-	-
CO3	L	H	H	H	H	L	M	L	M	M	L	H	-	-	-
CO4	H	H	H	H	H	M	L	M	L	H	H	H	-	-	-
CO5	H	H	H	H	H	M	M	L	M	M	H	H	-	-	-
CO6	H	H	H	H	H	H	L	L	H	L	H	H	-	-	-
16EPEX22	H	H	H	H	H	M	M	L	M	H	H	H	-	-	-

L – Low, M – Moderate (Medium), H- High

16EPEX23 COMPUTER SYSTEM ARCHITECTURE Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISTES:

1. 16EPC405 Digital Circuits
2. 16EPC502 Microprocessor, Microcontroller and Applications

COURSE OBJECTIVES:

- To impart knowledge about the basic principles and current practices of computer architectures and organizations.

UNIT-I : DATA REPRESENTATION, MICRO-OPERATIONS AND ORGANIZATION	**(09)**
Data representation - Data types - Complements – Fixed point representation – Floating point representation - Other binary codes - Error detection codes - Register transfer and micro operations - Register transfer language - Register transfer - Bus and memory transfers - Arithmetic micro-operations - Logic micro-operations - Shift micro-operations - Arithmetic logic shift unit - Basic computer organization and design - Instruction codes - Computer registers - Computer instructions - Timing and control - Instruction cycle - Memory reference instructions - Input-output - Interrupt - Design of accumulator logic**.**	
UNIT-II : CONTROL AND CENTRAL PROCESSING UNIT	**(09)**
Micro programmed control - Control memory - Address sequencing - Micro-program example - Design of control unit. Central processing unit: general register organization - Stacks organization - Instruction formats - Addressing modes - Data transfer and manipulation - Program control - Reduced instruction set computer**.**	
UNIT-III : PIPELINE, VECTOR PROCESSING AND COMPUTER ARITHMETIC	**(09)**
Parallel processing – Pipelining - Arithmetic pipeline - Instruction pipeline - RISC pipeline - Vector processing - array processors - Addition and subtraction algorithms - Multiplication algorithms - Division algorithms - Floating-point arithmetic operations - Decimal arithmetic unit - Decimal arithmetic operations.	
UNIT-IV : INPUT-OUTPUT ORGANIZATION	**(09)**
Input-output organization - Peripheral devices - Input-output interface - Asynchronous data transfer - Modes of transfer - Priority interrupt - Direct memory access - Input-output processor - Serial communication.	
UNIT-V : MEMORY ORGANIZATION	**(09)**
Memory organization: Memory hierarchy - Main memory - Auxiliary memory - Associative memory - Cache memory - Virtual memory - Memory management hardware**.**	

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text books:

1. *Morris Mano M "**Computer System Architecture**" Pearson Education, 3rd Ed., 2008*

Reference Books:

1. *Vincent P.Heuring and Harry F.Jordan, T.G Venkatesh, "**Computer Systems Design and Architecture**", Pearson Education Asia Publications, 2ND Ed., 2008*
2. *John P.Hayes, "**Computer Architecture and Organization**", Tata McGraw Hill, 3RD Ed., 2012*
3. *Andrew S.Tanenbaum, "**Structured Computer Organization**", 6th Ed., Pearson Education, 2010*
4. *William Stallings, "**Computer Organization and Architecture**", 10th Ed., Pearson Education, 2016*

COURSE OUTCOME:

CO1: Demonstrate the organisation of computer hardware and execute a software program expressed in assembly language.

CO2: Illustrate the computer hardware that provides software with the illusion that fast memory and other resources are unlimited, even though they are not.

CO3: Design and analyze the pipe lined control units

CO4: Communicate with I/O devices and standard I/O interfaces.

CO5: Design memory organization

CO6: Evaluate quantitatively and improve computer system performance.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	L	M	M	H	M	L	L	H	M	M	M	H	L	L
CO2	M	L	M	M	H	M	L	L	H	M	M	M	H	L	L
CO3	H	M	H	H	M	H	M	M	M	M	M	M	H	H	L
CO4	M	L	M	M	M	M	L	L	M	H	M	M	H	L	L
CO5	H	M	H	H	M	H	M	M	M	M	M	M	H	H	L
CO6	H	M	H	H	M	H	M	M	M	M	M	M	H	H	L
16EPEX23	H	M	H	H	M	H	M	M	M	M	M	M	H	M	L

L – Low, M – Moderate (Medium), H- High

16EPEX24 **POWER ELECTRONICS APPLICATIONS TO POWER SYSTEM** **Category : PE**

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1.16EPC601 Power Electronic Devices and Circuits

COURSE OBJECTIVES:

- To understand the need and role of power electronics in power generation, transmission and utility applications.

UNIT-I : HIGH POWER DEVICES AND THREE PHASE CONVERTERS	**(09)**
High power devices for power system controllers – Characteristics - Converters configurations for large power control, Properties of three phase converters - Current and voltage harmonics - Effects of source and load impedance - Choice of best circuit of power system.	
UNIT-II : CONVERTER CONTROL	**(09)**
Gate control - Basic means of control - Control characteristics – Stability of control - Reactive power control.	
UNIT-III : HVDC AND FACTS	**(09)**
Application of converters in HVDC system - Static VAR control - Sources of reactive power - Harmonics and filters - FACTS.	
UNIT-IV : WIND ENERGY AND PV ENERGY CONVERSION SYSTEM	**(09)**
Basic components - Generator control – Harmonics - Power factor improvement, Different schemes for PV energy conversion - DC and AC power conditioners - Synchronized operation with grid supply - Harmonic problems.	
UNIT-V : POWER FLOW ANALYSIS	**(09)**
Component models - Converter model - Analysis of converter - Transient and Dynamic stability analysis - Protection.	

Contact periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 45 Periods**

Text books:

1. *Padiyar.K.R "**HVDC Power Transmission System**" New Age International Publishers, 2nd Ed., Reprint 2010*

Reference Books:

1. Rai.G. D, "Solar Energy Utilization", Khanna Publishers, New Delhi, 10th Reprint 2011
2. Daniel, Haunt.V.,"Wind Power-A Handbook of WECS",Van Nostrand Co.,New York, 1981
3. R D Bagamudre, "Extra High Voltage AC Transmission Engineering", New Age International (p) Limited, 3rd Ed. 2007

COURSE OUTCOME:

CO1: Apply the concepts in power electronics for restructuring the power system.
CO2: Study about the basic controls of converters.
CO3: Model and analyze the power system with power electronic converters.
CO4: Develop application to specific power electronic topologies for renewable energy conversion systems.
CO5: Knowledge of power conditioners and their application.
CO6: Analyze the transient and dynamic stability of the converters.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	L	M	L	L	M	L	L	M	H	H	M	M
CO2	H	M	L	M	L	L	L	L	L	L	M	H	L	M	M
CO3	H	H	H	M	L	L	L	L	L	L	L	M	M	H	H
CO4	H	M	H	H	H	M	M	L	M	M	L	M	M	H	H
CO5	H	M	M	L	L	L	M	L	L	L	M	M	L	L	L
CO6	H	H	M	M	M	M	L	L	L	L	M	H	M	H	H
16EPEX24	H	M	M	M	L	L	L	L	L	L	M	M	M	H	H

L – Low, M – Moderate (Medium), H- High

16AOEX01 **NANOSCIENCE AND TECHNOLOGY** **Category: OE**

(Common To All Branches)

	L	T	P	C
PRE-REQUISITES: NIL	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To Understand and analyze the concepts of Quantum confinement, Dimensional structures and Properties of nano systems
- To be familiar with various methods of synthesis of nano materials
- To analyze and understand the mechanical and electrical properties of nonmaterial and its applications
- To realize the importance of Nonporous materials and its applications
- To make the students to understand the fundamental aspects of properties leading to technology

UNIT-I : NANO SYSTEMS	**(09)**
Size effect and properties of nanoparticles - Particle size - Particle shape - Particle density - Melting point, surface tension, wettability - Specific surface area and pore size – Properties of Individual nanoparticles. Quantum confinement in 3D, 2D, 1D and zero dimensional structures - Size effect and properties of nanostructures - Top down and Bottom up approach.	
UNIT-II : SYNTHESIS OF NANOMATERIALS	**(09)**
Sol-Gel Process - Self assembly - Electrodeposition - Spray Pyrolysis - Flame Pyrolysis – Metal Nanocrystals by Reduction - Solvothermal Synthesis - Chemical Vapor Deposition (CVD) – Metal Orgonic Chemical Vapor Deposition (MOCVD).Ball Milling - Inert Gas Condensation Technique (IGCT) – Thermal evaporation – Pulsed Laser Deposition (PLD) – DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE) – Melt Spinning process.	
UNIT-III : MECHANICAL AND ELECTRICAL PROPERTIES	**(09)**
Nanoscale Mechanics - Introduction – Mechanical properties – Density Considered as an Example Property – The Elasticity of Nanomaterials – Elasticity of Bulk Nanomaterials – Plastic Deformation of Nanomaterials - The Physical Basis of Yield Strength – Crystals and Crystal Plasticity – From Crystal Plasticity to Polycrystal Plasticity. Introduction - Energy Storage Basics - General Information: Electrical Energy Storage Devices and Impact of Nanomaterials – Batteries – Capacitors - Electrochemical Properties of Nanoscale Materials - Aerogels and Structure-Directed Mesoporous and Macroporous Solids - Nanoparticles - Nanotubes, Nanowires, and Nanorolls	
UNIT-IV : NANOPOROUS MATERIALS	**(09)**
Nanoporous Materials – Silicon - Zeolites, mesoporous materials – Nano membranes and carbon nanotubes - AgX photography, smart sunglasses and transparent conducting oxides - Hydrophobic & Hydrophilic materials – Molecular sieves – Nanosponges.	
UNIT-V : NANOTECHNOLOGY APPLICATIONS	**(09)**
Applications of nanoparticles, quantum dots, Nanotubes and nanowires for nanodevice fabrication – Single electron transistors, coulomb blockade effects in ultra-small metallic tunnel junctions - Nanoparticles based solar cells and quantum dots based white LEDs – CNT based transistors – Principle of Dip Pen Lithography.	

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Reference Books :

1. *G. Timp. Editor, "**Nanotechnology**" AIP press, Springer-Verlag, New York, 1999*
2. *Hari Singh Nalwa, Editor, **"Nanostructured materials and Nanotechnology''**, Concise Edition, Academic Press, USA (2002).*
3. *Guozhong Gao, "**Nanostructures & Nanomaterials: Synthesis, Properties & Applications"**, Imperial College Press (2004).*
4. *K. T. Ramesh, "**Nanomaterials : Mechanics and Mechanisms"**, Springer 2009.*
5. *Kenneth J. Klabunde, "**Nanoscale materials in chemistry"**, John Wiley & Sons, 2001.*
6. *Hari Singh Nalwa, Editor, "**Hand book of Nanostructured Materials and Technology''**, Vol.1-5, Academic Press, USA (2000).*
7. *"**Hand book of Nanoscience, Engineering and Technology"** (The Electrical Engineering handbook series), Kluwer Publishers, 2002*
8. *N John Dinardo, Weinheim,"**Nanoscale characterization of surfaces & interfaces"**, Cambridge: Wiley-VCH, 2nd ed., 2000*
9. *G. Cao, "**Nanostructures & Nanomaterials: Synthesis, Properties &Applications"**, Imperial College Press, 2004.*
10. *J.George, "**Preparation of Thin Films"**, Marcel Dekker, Inc., New York. 2005.*

COURSE OUTCOME:

CO1 : Analyze the particle size, particle shape, particle density, Size effect and properties of nanostructures. [Familiarity]

CO2 : Acquire knowledge in various methods of synthesis of Nano materials. [Application]

CO3 : Analyze the Elasticity of Nanomaterials , Electrical Energy Storage Devices and Aerogels. [Assessment]

CO4: Acquire knowledge in Zeolites, mesoporous materials, nano membranes and carbon nanotubes. [Familiarity]

CO5: Apply various nano materials to the LED, Transistor Applications. [Usage and Assessment]

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	H	-	M	-	L	-	-	-	-	-	-	-	-	-
CO2	M	-	-	L	H	-	-	-	-	-	-	-	-	-	-
CO3	-	H	-	-	L	-	M	-	-	-	-	-	H	-	-
CO4	H	-	-	M	-	L	-	-	-	-	-	-	-	H	-
CO5	L	-	H	-	-	-	M	-	-	-	-	M	-	-	H
16AOEX01	M	M	L	M	M	L	M	-	-	-	-	L	L	L	L

L – Low, M – Moderate (Medium), H- High

16AOEX02 **MATERIAL CHARACTERIZATIONS** **Category: OE**

(Common To All Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To Understand and analyze the concepts of Thermo gravimetric analysis and Differential thermal analysis.
- To be familiar with various methods of microscope
- To analyze and understand the working principle of SEM, FESEM, EDAX, and HRTEM
- To realize the importance of Electrical methods and its limitations
- To understand the fundamental aspects and properties of spectroscopy techniques.

UNIT-I : THERMAL ANALYSIS	**(09)**
Introduction – Thermo gravimetric analysis (TGA) – Instrumentation – Determination of weight loss and decomposition products – Differential thermal analysis (DTA) - Cooling curves - Differential scanning calorimetry (DSC) – Instrumentation – Specific heat capacity measurements – Determination of thermo mechanical parameters .	
UNIT-II : MICROSCOPIC METHODS	**(09)**
Optical Microscopy: optical microscopy techniques – Bright field optical microscopy – Dark field optical microscopy - Phase contrast microscopy - Fluorescence microscopy - Confocal microscopy - Digital holographic microscopy - Oil immersion objectives - Quantitative metallography - Image analyzer.	
UNIT-III : ELECTRON MICROSCOPY AND OPTICAL CHARACTERISATION	**(09)**
SEM – FESEM - EDAX,- HRTEM: working principle and Instrumentation – Sample preparation – Photoluminescence – Light – Matter interaction – Instrumentation – Electroluminescence – Instrumentation – Applications.	
UNIT-IV : ELECTRICAL METHODS	**(09)**
Two probe and four probe methods - Van der Pauw method – Hall probe and measurement – Scattering mechanism – C-V, I-V characteristics – Schottky barrier capacitance – Impurity concentration – Electrochemical C-V profiling – Limitations.	
UNIT-V : SPECTROSCOPY	**(09)**
Principles and instrumentation for UV-Vis-IR, FTIR spectroscopy, Raman spectroscopy, ESR, NMR, NQR, ESCA and SIMS- proton induced X-ray Emission spectroscopy (PIXE) – Application – Mass spectroscopy.	

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Reference books

1. *Stradling, R.A; Klipstain, P.C;* ***"Growth and Characterization of semiconductors"****, Adam Hilger, Bristol,1990.*
2. *Belk, J.A;* ***"Electron microscopy and microanalysis of crystalline materials"****, Applied Science Publishers, London, 1979.*
3. *Lawrence E.Murr,* ***"Electron and Ion microscopy and Microanalysis principles and Applications"****, Marcel Dekker Inc., New York, 1991*
4. *D.Kealey & P.J.Haines,* ***"Analytical Chemistry"****, Viva Books Private Limited, New Delhi, 2002.*
5. *G. Gao,* ***"Nanostructures and Nanomaterials"****, Imperial College Press, London, 2006*
6. *Y. Gogotsi,* ***"Nanomaterials Handbook"****, CRC Taylor and Francis, New York, 2006*
7. *Banwell,* ***"Fundamentals of Molecular Spectroscopy"****, Tata McGraw-Hill, 1994.*

COURSE OUTCOME:

- **CO1:** Analyze the properties of TGA, DTA and DSC. [Assessment]
- **CO2:** Acquire knowledge in various types of microscopes. [Familiarity]
- **CO3:** Analyze the working principle and Instrumentation of SEM, FESEM, EDAX, and HRTEM [Familiarity]
- **CO4:** Acquire knowledge in I-V and C-V characteristics. [Application]
- **CO5:** Analyze the Principles and instrumentation of Spectroscopy methods. [Familiarity]

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	H	-	-	M	M	L	-	-	-	-	-	H	-	-
CO2	H	M	M	-	-	-	L	-	-	-	-	L	-	-	-
CO3	-	H	M	M	L	-	-	-	-	-	-	-	-	H	-
CO4	M	H	-	L	M	-	-	-	-	-	-	-	-	-	H
CO5	-	M	H	-	L	M	-	-	-	-	-	L	-	-	-
16AOEX02	H	H	M	M	M	M	L	-	-	-	-	L	H	H	H

L – Low, M – Moderate (Medium), H- High

16AOEX03 **ELECTROCHEMICAL TECHNOLOGY** **Category:OE**

(Common to All Branches)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- This course aims at making Mechanical Engineers know about Electrochemical principles applied in manufacturing of Chemical products, fabrication of metals, metallurgy and corrosion studies

UNIT-I	**(09)**
Fundamental concepts, electron transfer, mass transfer, adsorption, electro-catalysis, phase formation in electrode reaction, assessment of cell voltage, costing of electrolytic process, performance and figure of merit. Typical cell designs. Laboratory data and scale-up.	
UNIT-II	**(09)**
Chlor-alkali industry - Concept of brine electrolysis, chlorine cell technology, the production of NaOH. Water electrolysis, sodium chlorate, hydrogen peroxide, ozone, cuprous oxide, and synthesis of metal salt via anodic dissolution, Organic electro synthesis - dimerization of acrylonitrile, indirect electrosynthesis.	
UNIT-III	**(09)**
The extraction, refining and production of metal–electro-winning, cementation, electro-refining, Electro-deposition of metal powders. Corrosion and its control - Thermodynamics and kinetics of corrosion reactions, corrosion problems in practice, corrosion prevention and control, corrosion problems in electrolytic processing, corrosion measurement and monitoring.	
UNIT-IV	**(09)**
Metal finishing - Electroplating, electroless plating, conversion coatings, electroforming, electrochemical etching. Batteries and fuel cells-battery characteristics, battery specifications, evaluation of battery performance, battery components. Fuel cells.	
UNIT-V	**(09)**
Water purification, effluent treatment and recycling of industrial process stream - Metal ion removal and recovery, treatment of liquors containing dissolved chromium, electrolytic method of phase separation, flue gas desulphurization, electrodialysis. Electrochemical sensor and monitoring techniques, polarographic to anodic stripping voltammetry, ion selective electrode, electrochemical biosensors.	

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text Books:

1. *Derek Pletcher and Frank C Walsh "**Industrial Electrochemistry**" 2nd edition, Chapman & Hall, UK, 1990*
2. *A.T.Kuhn "**Industrial Electrochemistry**" Elsevier Publishers, 1972*

Reference Books :

1. *C.L. Mantell, "**Chemical Engineering Series – Industrial Electrochemistry**", McGraw Hill Co., Inc. London, 1958*
2. *Ullmann's "**Encyclopedia of Industrial Chemistry**", John Wiley & Sons, Vol.6, pp: 399 - 481, 2003.*
3. *Krik–"**Othmer Encyclopedia of Chemical Technology**", 4th edition, Vol: I., Pp938 –1025 (1991)*
4. *N.M.Proutand J.S.Moorhouse, **"Modern Chlo-Alkali Technology"**, Vol. IV, Elsevier Applied Science, London, 1990*

COURSE OUTCOME:

Students after the completion of this course:

CO1: Students will be able to understand the electrodic processes and design cell requirements

CO2: Students can apply the electrolysis principle in manufacture of materials required for regular use.

CO3: Students will be able to apply their technical skill in metallurgy.

CO4: Students will be able to acquire knowledge in all metal finishing techniques.

CO5: Students will gain knowledge in solving the problems of corrosion of equipment and battery systems.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	L	H	M	M	H	L	-	-	-	-	-	-	-	-	-
CO2	L	M	H	L	H	L	-	-	-	-	-	-	-	-	-
CO3	H	L	H	M	M	H	-	-	-	-	-	-	-	-	-
CO4	M	L	L	L	M	H	-	-	-	-	-	-	-	-	-
CO5	L	M	H	L	H	M	-	-	-	-	-	-	-	-	-
16AOEX03	L	M	H	L	H	M	-	-	-	-	-	-	-	-	-

L – Low, M – Moderate (Medium), H- High

16AOEX04 **POLYMER TECHNOLOGY** **Category: OE**

(Common to All Branches)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- *This course is aimed to make Mechanical Engineers apply their skills in identifying the types of polymers and their properties applicable to plastics and rubber processing.*

UNIT-I : ***CHEMISTRY OF HIGH POLYMERS***	**(09)**
Monomers, functionality, degree of polymerizations, classification of polymers, glass transition, melting transition, criteria for rubberiness, polymerization methods: addition and condensation; metallocene polymers and other newer techniques of polymerization, copolymerization, block and graft copolymers, techniques for copolymerization-bulk, solution, suspension and emulsion.	
UNIT-II : ***SYNTHESIS AND PROPERTIES***	**(09)**
Commodity and general purpose thermoplastics: PE, PP, PS, PVC, Polyesters, Acrylic, PU polymers. Engineering Plastics: Nylon, PC, ABS, Fluoropolymers - Thermosetting polymers: PF, MF, UF, Epoxy, Unsaturated polyester. Natural and synthetic rubbers: Recovery of NR hydrocarbon from latex, SBR, Nitrile, CR, CSM, EPDM, IIR, BR, Silicone, TPE.	
UNIT-III : ***POLYMER TECHNOLOGY***	**(09)**
Polymer compounding - Need and significance, different compounding ingredients for rubber and plastics, cross-linking and vulcanization,. Compression molding, transfer molding, injection molding, blow molding, reaction, extrusion, pultrusion, calendaring, rotational molding, thermoforming, rubber processing in two-roll mill, internal mixer.	
UNIT-IV : ***POLYMER BLENDS AND COMPOSITES***	**(09)**
Difference between blends and composites, their significance, choice of polymers for blending, blend miscibility-miscible and immiscible blends, FRP, particulate, long and short fibre reinforced composites.	
UNIT-V : ***POLYMER TESTING***	**(09)**
Mechanical-static and dynamic tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness. Conductivity - Thermal and electrical, dielectric constant, dissipation factor, power factor, electric resistance, surface resistivity, volume resistivity, swelling, ageing resistance, environmental stress cracking resistance.	

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Reference Books:

1. *F.W. Billmeyer, Jr., **"Textbook of polymer science"**, Wiley - Interscience, N.Y.(1971)*
2. *G.Odian , **"Principles of polymerization"**, , Wiley – Interscience (1981)*
3. *Gowarikar V.R. and others , **"Polymer science"**, Wiley Eastern (1986).*
4. *Fenner R.T., **"Principles of polymer processing"**, Chemical publishing N.Y. (1979)*

COURSE OUTCOME:

Students after the completion of this course:

CO1: Will be able to identify different types of polymers by structure and behaviour, properties and their method of polymerisation.

CO2: Will be able to apply various processes of fabrication of plastics and rubber.

CO3: Will be able to distinguish polymer blends and composites and understand their specific applications.

CO4: Will be able to test the polymer specimens for mechanical properties applicable for various end uses.

CO5: Will be able to test the polymer specimens for electrical properties applicable for various end uses.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	H	L	L	M	H	-	-	-	-	-	-	-	-	-
CO2	L	L	H	M	H	L	-	-	-	-	-	-	-	-	-
CO3	M	M	L	L	M	L	-	-	-	-	-	-	-	-	-
CO4	L	L	M	M	M	H	-	-	-	-	-	-	-	-	-
CO5	-	H	L	L	H	M	-	-	-	-	-	-	-	-	-
16AOEX04	M	M	L	L	M	M	-	-	-	-	-	-	-	-	-

L – Low, M – Moderate (Medium), H- High

16COEX05 DISASTER MANAGEMENT AND MITIGATION Category: OE

(Common to All Branches)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To give knowledge about basics of Disaster Management.
- To impart knowledge about Hazards and Vulnerability.
- To give knowledge about mitigation and preparedness.
- To teach about Response and Recovery.
- To impart knowledge about the participants involved in the disaster management activity.

UNIT-I : INTRODUCTION	**(08)**
Disaster throughout history, History of disaster management, Capacity by demand, UN International strategy for disaster reduction, the Hyogo framework for action, Post 2015 framework, Disaster trends.	
UNIT-II : HAZARDS AND RISK VULNERABILITY	**(10)**
Hazard Identification and Hazard Profiling, hazard analysis, Types of hazards - Natural and technological Components of Risk - Likelihood and Consequence, Trends and Computation of likelihood and Consequence. Risk Evaluation – Purpose, Risk Acceptibility, Alternatives, Personnel. Political/ social, Economic. Vulnerability - Physical Profile, Social Profile, Environmental Profile, Economic Profile. Factors Influencing Vulnerability, risk Perception.	
UNIT-III : MITIGATION AND PREPAREDNESS	**(08)**
Mitigation - Types of mitigation, Obstacles in mitigation, Assement and selection of Mitigation options, Emergency response capacity as , Incorporating Mitigation into development and relief projects Prepareness - Government Preparedness, Public Preparedness, Media as a public educator. Obstacles to public education and preparedness.	
UNIT-IV : RESPONSE AND RECOVERY	**(09)**
Response the Emergency - Pre disaster, post disaster, Provision of water, food and shelter, volunteer management, command, control and coordination Recovery - Short term and long term recovery .components of recovery - Planning, coordination, information, money and supplies, allocation of relief funds, personnel. Types of recovery - Government, Infrastructure, Debris removal disposal and processing, environment, housing, economic and livelihood, individual, family and social recovery - Special considerations in recovery.	
UNIT-V : PARTICIPANTS	**(10)**
Governmental Disaster management agencies - Fire, law, emergency management, Emergency medical service, Military and other resources. Structures - Local, regional, national. Bilateral assistance and its types. Types of national agencies involved in international disaster management. Political implications of bilateral assistance. Non Governmental Organizations – Operations, NGO/ Military coordination, standard of conduct. The role of Private sector and academia. Multilateral organizations - UN agencies and programmes, Regional & International organizations. International Financial Institutions - the world bank, IMF, ADB, IADB. Special considerations.	

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text Books:

1. *Damon P. Coppola "**Introduction to International Disaster management**" Elsevier publication, 2015*

Reference Books

1. *Brassard, Caroline, Giles, David W., Howitt, Arnold M., "**Natural Disaster Management in the Asia-Pacific**", Policy and Governance.*
2. *"**Disaster Management**", Global Challenges and Local Solutions, Universities Press, 2009.*
3. *Jack Pinkowski, "**Disaster Management Handbook**", CRC Press , January 22, 2008.*
4. ***Disaster Management Guidelines**, GOI-UNDP Disaster Risk Reduction Programme (2009-2012).*

COURSE OUTCOME:

CO1: Able to get knowledge about basics of Disaster management.
CO2: Able to impact knowledge about Hazards and vulnerability
CO3: Able to know about Mitigation and preparedness.
CO4: Able to attain knowledge about response and recovery.
CO5: Able to learn about the participants involved in the disaster management activity.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	PSO 4
CO1	-	L	-	-	L	L	-	L	-	-	-	-	-	-	-	L
CO2	L	H	-	M	L	M	-	-	-	-	-	L	L	-	-	L
CO3	L	L	-	-	H	M	-	-	-	-	-	L	L	-	-	L
CO4	L	M	-	L	L	M	M	-	-	-	-	-	-	-	-	L
CO5	-	M	-	L	L	M	-	-	-	-	-	-	-	-	-	L
16COEX05	L	M	-	L	L	M	M	L	-	-	-	L	L	-	-	L

L – Low, M – Moderate (Medium), H- High

16COEX06 **ENVIRONMENTAL MANAGEMENT** **Category: OE**

(Common to All Branches)

PRE-REQUISITES:

1.16EHS2Z4 Environmental Science and Engineering

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the importance of nature and study about the water, air and soil pollution control as well as solid waste management.

UNIT-I : NATURE AND SCOPE OF ENVIRONMENTAL PROBLEMS	**(09)**
Environment and sustainable development – Natural and human environmental disturbances – Global warming – Acid rain – Ozone depletion – Effects and control - Climate change conventions – Kyoto protocol – India's efforts for Environmental protection – Public policy and role of NGO's	
UNIT-II : WATER POLLUTION AND CONTROL	**(09)**
Fresh water and its pollution – Natural processes – Sources and pollutants – Pollution due to industrial, agricultural and municipal wastes – Effects on streams - Limitations of disposal by dilution – BOD consideration in streams – Oxygen Sag Curve – Strategies for sustainable water management – Marine environment and its management – Water acts.	
UNIT-III : AIR AND NOISE POLLUTION	**(09)**
Pollutant emissions - Sources and sink – Effects of air pollution on human health, vegetation and climate – Global effects – Prevention and control of air pollution – Control of particulates – Air pollution surveys and sampling – Air quality monitoring - Air Act – Management of air pollution – Sound level – Effect of noise on people – Environmental noise control - Noise pollution rules, 2000.	
UNIT-IV : SOLID WASTE MANAGEMENT AND SOIL POLLUTION	**(09)**
Sources – Characteristics – Quantities – Collection methods – Processing and disposal techniques – Onsite Handling, storage and processing – Sanitary landfill – Incineration and pyrolysis – Composting – Aerobic and anaerobic of compositing – Recycling and reuse of solid wastes – Hazardous wastes – Definition – Sources & types only – Integrated system for waste management – The Basel convention. Land use and degradation – Management problems – Strategies for sustainable land management – Soil pollution – Wetland conservation.	
UNIT-V : ENVIRONMENTAL MANAGEMENT SYSTEM	**(09)**
Terminology – Installation and common motives of EMS – Environmental standards – ISO 14000 (Series) – Basic principles – Environmental Audit – Environmental Impact assessment - Trade rules and environmental protection – Practices for Waste Minimization and Cleaner Production.	

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text Books:

1. *N.K.Uberoi "**Environmental Management**" Excel Books, New Delhi (2006).*
2. *Rao "**Air Pollution**" Tata McGraw-Hill Education, 01-Jun-1988*

Reference Books :

1. *S.Vigneahwaran,M.Sundaravadivel and D.S.Chaudhary , "Environmental Management", SCITECH Publications(India) Pvt.Ltd, Chennai & Hyderabad (2004).*
2. *Technobanoglous, "Environmental Management", McGraw Hill Book Company (2006).*

COURSE OUTCOME:

CO1: Students exposed to know common issues related with environment.

CO2: Students able to know the sources, causes and effects of water pollution.

CO3: Able to attain knowledge related with air and noise pollution.

CO4: Able to understand the various management techniques of solid waste and soil Pollution.

CO5: Able to aquire knowledge on Environmental Management Systems.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	PSO 4
CO1	M	L	-	-	-	-	M	-	-	-	-	-	L	H	-	L
CO2	L	M	-	-	L	-	H	-	-	-	-	L	H	H	L	L
CO3	L	M	-	-	L	-	H	-	-	-	-	L	H	H	L	L
CO4	L	M	-	-	L	-	H	-	-	-	-	L	H	H	L	L
CO5	M	L	-	-	-	-	M	-	-	-	-	-	L	H	L	L
16COEX06	L	M	-	-	L	-	H	-	-	-	-	L	H	H	L	L

L – Low, M – Moderate (Medium), H- High

16COEX07 **TOWN PLANNING AND ARCHITECTURE** **Category: OE**

(Common to All Branches)

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Students are introduced the basics of Town Planning and Architecture

UNIT-I : TOWN PLANNING	**(09)**
History of evolution of towns - Town and environment – Planning acts – land use classification – Transportation network - Climate, humidity, wind and radiation - Surveys and Data collection - Residential neighborhoods - Industrial areas - Public Buildings - Housing and Slum clearance.	
UNIT-II : BUILDING RULES AND GUIDELINES	**(09)**
General – Zoning regulations – Regulations regarding layouts or subdivisions – Building regulations – Rules for special types of buildings – Floor space index – minimum plot size and building front age – Open spaces – Minimum standard dimensions of building elements – Provision for lighting and ventilation – Provision for means of access – Provision for urban growth.	
UNIT-III : BASIC ELEMENTS OF ARCHITECTURE	**(09)**
Introduction of Architecture – Definition – Mass and space visual emotional effects of geometric forms and their derivatives– The sphere, the cube, the pyramid, the cylinder and cone – The aesthetic qualities of Architecture – Proportion, scale, balance, symmetry, rhythm and axis – contrast in form – Harmony – Consideration of comfort factors acoustics, lighting, ventilation and thermal aspects.	
UNIT-IV : PRINCIPLES OF ORIENTATION AND PLANNING OF BUILDINGS	**(09)**
General – factors affecting orientation – sun – Wind – Rain – Orientation criteria for Indian conditions – Principles governing the theory of Planning – General requirements of site and building – Functional planning of buildings.	
UNIT-V : ELEMENTS OF INTERIOR DESIGN	**(09)**
General – Decorative Materials – Cement Bonded Board (BISON PANEL), Water proof cement paint, Industrial glazing and Roofing, unit masonry, plaster and dry wall, Wall surface materials, Effect of colour on architecture – Home furnishing– plans in rooms.	

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical : 0 periods Total: 45 Periods

Text Books:

1. *S.C.Rangwala "**Elements of Town Planning**" McGraw Hill, London, 2006*
2. *Biswas Hiranmay*, "***Principles of Town Planning and Architecture***" VAYU Education of India 2012.

Reference Books :

1. *V.S.Pramar, 'Design fundamentals and architecture' Lakshmi Publishers, 2003.*
2. *Hiraskar, "Fundamentals in town planning" Khanna Publishers, 2005.*

COURSE OUTCOME :

CO1: Students will be able to know about the basics of town planning and building rules.
CO2: Students will be able to gain knowledge on building rules & regulations.
CO3: Students able to apply the architectural principles in the area of Civil Engineering.
CO4: Students will be able to do planning of various buildings.
CO5: Students will be able to understand about interior design of buildings.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	-	-	M	-	-	-	-	-	-	-	L	-	L	-
CO2	-	-	-	-	-	-	M	-	-	-	L	L	-	-	-
CO3	-	L	-	L	-	-	-	-	-	M	-	-	L	-	-
CO4	-	L	-	L	-	-	-	-	-	M	-	-	-	-	-
CO5	-	M	-	-	-	-	-	L	-	-	-	H	-	-	-
16COEX07	-	L	-	L	-	-	M	L	-	M	L	L	L	L	-

L – Low, M – Moderate (Medium), H- High

16MOEX08 TOTAL QUALITY MANAGEMENT FOR ENGINEERS CATEGORY:OE

(Common to All Branches except Production)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES

- *To impart knowledge to develop a product with the required quality at a reasonable price and to satisfy the requirements under various quality standards*

UNIT - I QUALITY CONCEPTS (9)

Definition of quality, dimensions of quality, quality planning, quality costs concepts - basic concepts of total quality management, principles of TQM, leadership concepts - quality council, quality statements, strategic planning- steps in strategic planning- Deming philosophy, barriers in TQM implementation, benefits of TQM.

UNIT - II TQM PRINCIPLES (9)

Contribution of TQM Gurus - customer perception of quality - retention, employee involvement - motivation, empowerment, performance appraisal, continuous process improvement – Juran trilogy, PDSA cycle, 5S concept, kaizen, supplier partnership - supplier rating – performance measures- Malcom Balridge National Quality Award.

UNIT - III STATISTICAL PROCESS CONTROL (9)

Seven old and new tools of quality - statistical fundamentals - population and sample – normal curve - control charts for variables ,attributes and its applications- process capability - concept of six sigma.

UNIT - IV TOOLS AND TECHNIQUES (9)

Benchmarking needs and benefits - benchmarking process - quality function deployment (QFD) - house of quality - Taguchi quality loss function - total productive maintenance (TPM) - pillars of TPM - Failure Mode Effective Analysis (FMEA) - Failure rate- types of FMEA - stages of FMEA- case studies.

UNIT - V QUALITY SYSTEMS (9)

Introduction to ISO 9000 and other quality system - ISO 9001:2015 quality system – elements - implementation of quality system - documentation - quality auditing - QS 9000, ISO 14000 - concept, requirements and benefits- integrating ISO 14000 with ISO 9000 – OSHSAS 18001,Implementation of TQM in manufacturing industry.

Contact periods:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books

*1. Dale H.Besterfield, et al., **"Total Quality Management",** Pearson Education, 2008.*

*2. Subburaj Ramasamy, **"Total Quality Management",** Tata McGraw Hill, 2008.*

3.Vilas S.Bagad, "Total Quality Management", TECHNICAL PUBLICATIONS, 2017.

Reference Books

*1. James R.Evans & William M.Lidsay, **"The Management and Control of Quality",** Thomson Learning, 2002.*

*2. Feigenbaum.A.V. **"Total Quality Management",** McGraw-Hill, 1991.*

*3. Zeiri,**"Total Quality Management for Engineers"** Wood Head Publishers, 1991*

*4. P.N.Mukherjee**"Total Quality Management"**,PHI Publishers,2006*

*5. John.L Hradesky **"Total Quality Management Hand book"** McGraw-Hill, 1995.*

COURSE OUTCOMES

On completion of this course, students will be able to

CO1*: apply the principle of strategic planning, Deming philosophy and leadership concepts in industries.*

CO2: *apply the principle of TQM in industries.*

CO3: *apply the principle of statistical process control in industries.*

CO4: *select appropriate quality tools to meet industrial requirements.*

CO5: *implement appropriate quality standards for industries.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	H	-	-	M	-	-	L	L	-	L	L	M	L	M
CO2	L	H	-	-	M	-	-	L	L	-	L	L	M	L	M
CO3	L	H	-	-	M	-	-	L	L	-	L	L	M	L	M
CO4	L	H	-	-	M	-	-	L	L	-	L	L	M	L	M
CO5	L	H	-	-	M	-	L	L	L	-	L	L	M	L	M
16MOEX08	L	H	-	-	M	-	L	L	L	-	L	L	M	L	M

L-Low, M-Moderate(Medium), H-High

16MOEX09 **COMPOSITE MATERIALS** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES:

1. 16EBS2Z3 Material Science

COURSE OBJECTIVES:

- To impart the fundamentals of composite materials with different reinforcement, matrix materials and comprehend the types of manufacturing methods for advance composite materials to meet various engineering requirements.

UNIT-I : INTRODUCTION TO COMPOSITE MATERIALS	**(09)**
Types and characteristics of composite materials - Mechanical behavior - Basic terminology and Manufacture of laminated fiber - Reinforced composite materials - Current and potential advantages - Applications of composite materials.	
UNIT-II : REINFORCEMENT AND MATRICES	**(09)**
Different types of fibers - Properties and applications of fibers - Roll of matrix - Matrix materials, Selection of matrix -Thermoset matrix -Thermoplastic matrix, Fiber architecture – Natural Fibers.	
UNIT-III : DESIGN OF COMPOSITE STRUCTURES	**(09)**
Elements of Design - Steps in design process - Elements of analysis in design - Analysis iterations - Design analysis stages - Material selection - Configuration selection - Laminate joints - Design requirements and design failure criteria.	
UNIT-IV : MANUFACTURING OF ADVANCED COMPOSITES	**(09)**
Bag-Molding process-Compression molding-Pultrusion-Filament winding-Liquid composite molding processes-Resin film infusion-Elastic reservoir molding-Tube rolling-Forming methods for thermoplastic matrix composites.	
UNIT-V : METAL, CERAMIC AND CARBON MATRIX COMPOSITES	**(09)**
Metal matrix composites - Manufacturing processes - Ceramic matrix composites- Mechanical properties - Manufacturing processes - Carbon matrix composites - Fabrication methods - Applications.	

Contact periods:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *Krishnan K., Chawla "**Composite Materials Science and Engineering**" Springer (India) Private Limited, 2011.*
2. *P.K. Mallick "**Fiber Reinforced Composite materials, Manufacturing and Design**" CRC Press, Taylor and Francis Group, Boca Raton, London, Newyork 2010*

Reference Books :

1. *A.K.Bhargava, **"Engineering Materials: Polymers, ceramics and composites"**, Pentice Hall of India Limited, 2010.*
2. *Hyer M., Stress Analysis of Fiber – **"Reinforced Composite Materials"**, Tata McGraw Hill, 1998.*
3. *Madhujit Mukhopadhyay , **"Mechanics of Composite Materials and Structures "**, Universities Press (India) Private Limited, 2009.*
4. *Robert M.Jones, "**Mechanics of Composite Materials"**, Taylor & Francis Group, 2010.*
5. *Web Portal: Composite Materials {Nptel .Mechanical Engineering}*

COURSE OUTCOME:

On completion of this course, students will be able to

CO1*:* Understand the mechanics and behaviour of reinforced composite materials for specific applications and developing composite materials for sustainability

CO2: Formulate different types of reinforcement and matrices to develop new composite material for the various application

CO3: Design and manufacture post processing methods of composite structures and capable to perform various analysis

CO4: Execute different methods of manufacturing advanced composites to meet the innovate demand in engineering.

CO5: Fabricate metal matrix, ceramic matrix and carbon matrix composite for various engineering application to meet the societal demand.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	H	-	-	M	M	-	-	-	L	-	H	-	L
CO2	H	M	M	M	M	-	L	-	-	-	M	-	M	M	-
CO3	M	M	M	M	-	L	M	-	-	-	L	-	L	M	-
CO4	M	M	M	L	-	H	L	-	L	-	M	-	M	L	-
CO5	L	L	-	L	-	M	L	-	-	-	-	L	M	M	-
16MOEX09	M	M	M	M	M	M	L	-	L	-	M	L	M	M	L

L – Low, M – Moderate (Medium), H- High

16MOEX10 **AUTOMOBILE ENGINEERING** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- The learners are able to visualize the scope of Automobile Engineering.

UNIT-I : INTRODUCTON TO AUTOMOTIVES	**(09)**
An overview of different types of automobiles and their power sources. Specifications, Performance Parameters, Quality standards, Trends in automobile design	
UNIT-II : POWER SOURCE FEATURES	**(09)**
Reciprocating Engine systems, Rotary Engine systems, Gas Turbine systems, Hybrid systems - Pollutant emissions and their control; Catalytic converter systems, Electronic Engine management systems	
UNIT-III : TRANSMISSION, SUSPENSION AND BRAKING SYSTEMS	**(09)**
Clutch system, Gear box system, propeller shafting, differential, axles, wheels and tyres and Preliminaries of suspension systems	
UNIT-IV : AUXILIARY SYSTEMS	**(09)**
Electrical and electronic systems, safety systems, Heating, Ventilation, and Air Conditioning (HVAC) systems, Vehicle Thermal Management System and vehicle body design features.	
UNIT-V : TESTS, SERVICE AND MAINTENANCE	**(09)**
Engine Tuning, vehicle maintenance, engine and Chassis Dynamometry Pollutants and emissions Check, Wind Tunnel Tests, preliminaries of engine and vehicle testing.	

Contact periods:
Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Text Books:

1. *Dr. Kirpal Singh "**Automobile Engineering Vol. I & II**" Standard Distributors Publishers, 2012*
2. *R.B.Gupta "**Automobile Engineering**" Sathya Prakashan, New Delhi, 2006.*

Reference Books :

1. *William H.Crouse, "Automotive Mechanics", McGraw Hill Book Co. 2004.*
2. *K.K. Ramalingam, "Automobile Engineering – theory and Practice" SciTech Publications, 2001.*
3. *Joseph Heinter "Automobile Mechanics Principles and Practice" Affiliated East West Press, 1997.*
4. *Jain K.K. and Asthana. R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.*
5. *Heinz Heisler, "Advanced Engine Technology" SAE International Publications USA, 1998.*

COURSE OUTCOME:

On completion of this course, learners will be able to:

CO1: Identify the different components in an automobile.
CO2: Clearly understand different auxiliary and transmission systems.
CO3: Explain the working of various parts like engine, transmission, clutch, brakes
CO4: Understand the environmental implications of automobile emissions
CO5: Develop a strong base for understanding future developments in the automobile industry

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	M	M	L	H	M	M	M	L	L	L	H	M	M	H
CO2	H	M	H	H	M	H	L	L	L	M	M	L	H	M	H
CO3	M	M	M	L	M	H	M	L	L	M	H	L	H	H	M
CO4	H	M	H	M	H	M	H	H	M	M	H	L	L	L	H
CO5	M	L	L	L	M	H	M	-	L	H	H	H	H	M	H
16MOEX10	M	M	H	L	M	H	M	L	L	M	H	L	H	M	H

L – Low, M – Moderate (Medium), H- High

16EOEX11 RENEWABLE ENERGY SOURCES AND TECHNOLOGY Category : OE

(Common to all Branches)

	L	T	P	C
PRE-REQUISITES:NIL	**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

- To elucidate the technologies used for generation and utilization of power from renewable energy resources.

UNIT-I : SOLAR ENERGY	**(09)**
Solar radiation, solar spectra-latitude and longitude, Declination angle, solar window, cosine law, seasonal variations, hour angle, calculation of angle of incidence, angstroms equation and constants, Photo voltaic: p-n junctions. Solar cells, PV systems, Standalone, Grid connected solar power - Types of solar thermal collectors – Flat and concentrating collectors, solar thermal applications -water heaters, dryers, stills, refrigeration, air-conditioning, solar pond, central receiver power generation.	
UNIT-II : WIND ENERGY	**(09)**
Wind energy - Basic principle of wind energy conversion system, wind data and energy estimation, site selection, components of wind energy conversion systems, design consideration of horizontal axis wind mill- merits and limitations- application	
UNIT-III : BIOMASS ENERGY	**(09)**
Biomass, sources of biomass, thermo-chemical and bio-chemical conversion of biomass - Pyrolysis, gasification, combustion and fermentation. Gasifiers – Up draft, downdraft and fluidized bed gasifier. Digesters - Fixed and floating digester biogas plants, economics of biomass power generation.	
UNIT-IV : OCEAN AND GEOTHERMAL ENERGY	**(09)**
Ocean energy resources - Principles of ocean thermal energy conversion systems - ocean thermal power plants - Principles of ocean wave energy conversion and tidal energy conversion - Difference between tidal and wave power generation, Economics of OTEC. Definition and classification of Geothermal resources, Utilization for electricity generation and direct heating, Wellhead power generating units. Overview of micro and mini hydel power generation	
UNIT-V : RENEWABLE ENERGY POLICIES	**(09)**
Renewable energy policies - Feed-in tariffs, portfolio standards, policy targets, tax incentives, and biofuels mandates. International policies for climate change and energy security. Economic analysis and comparisons, Life cycle analysis, financial analysis, cost of conserved energy, and externalities. Cost assessment of supply technologies versus energy - Efficiency.	

Contact periods:
Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *Rao. S. and Dr. Pamlekar B.B "**Energy Technology**" Khanna Publishers, Second Ed. 1997*
2. *Pai and Ramaprasad "**Power Generation through Renewal sources**" Tata McGraw Hill – 1991*

Reference Books :

1. *Rai , G.D., "**NonConventional sources of Energy**", Khanna Publishers , IV Ed.,2009*
2. *Bansal NK, Kleeman and Meliss, M "**Renewable Energy Sources and Conversion Techniques**", Tata McGraw Hill, 1996*
3. *Roland Wengenmayr, Thomas Buhrke," Renewable energy: Sustainable energy concepts for the future", Wiley-VCH, 1st edition, 2008.*

COURSE OUTCOME:

CO1: Realize the need for utilizing the energy from clean and Sustainable energy resources.
CO2: Describe the principles of operation of the broad spectrum of renewable energy Technologies
CO3: Analyze energy technologies from a systems perspective.
CO4: Articulate the technical challenges for each of the renewable sources
CO5: Create solutions for alternate energy issues
CO6: Discuss economic, technical and sustainability issues involved in the integration of renewable energy systems

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	M	M	M	-	-	L	L	L	H	M	M
CO2	H	H	M	M	M	M	M	L	-	L	L	L	H	H	H
CO3	H	M	M	M	M	M	M	M	-	-	L	L	M	H	H
CO4	M	H	M	L	M	H	M	M	-	L	L	L	H	H	H
CO5	M	H	H	H	M	M	M	M	-	L	L	L	M	H	M
CO6	H	M	M	M	M	M	M	-	H	H	L	L	M	H	M
16EOEX11	H	H	M	M	-	M	M	M	L	L	L	L	H	H	H

L – Low, M – Moderate (Medium), H- High

16EOEX12 **SMART GRID TECHNOLOGY** **Category: OE**

(Common to all Branches)

	L	T	P	C
PRE-REQUISITES: NIL	**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

* To gain knowledge on the fundamentals of smart grid technologies, its architecture and its managements. Also the students should learn many of the challenges facing the smart grid as part of its evolution.

UNIT-I : SMARTGRIDS: MOTIVATION, STAKES AND PERSPECTIVES	**(09)**
Introduction – Information and Communication technologies serving the electrical system – Integration of advanced technologies – Definitions of SmartGrids – Objectives addressed by the SmartGrid concept – Socio-economic and environmental objectives – Stakeholders involved the implementation of the Smart Grid concept – Research and scientific aspects of the Smart Grid – SmartGrids from the customer's point of view.	
UNIT-II : INFORMATION AND COMMUNICATION TECHNOLOGY	**(09)**
Data Communication, Dedicated and shared communication channels, Layered architecture and protocols, Communication technology for smart grids, standards for information Exchange, Information security for the smart grid - Cyber Security Standards - IEEE1686 - IEC62351.	
UNIT-III : SENSING AND MEASUREMENT	**(09)**
Synchro Phasor Technology – Phasor Measurement Unit, Smart metering and demand side integration - Communication infrastructure and protocol for smart metering – Data Concentrator, Meter Data Management System. Demand side Integration – Services, Implementation and Hardware Support of DSI.	
UNIT-IV : CONTROL AND AUTOMATION	**(09)**
Distribution automation equipment – Substation automation equipments: current transformer, potential transformer, Intelligent Electronic Devices, Bay controller, Remote Terminal Unit. Distribution management systems – SCADA: modeling and analysis tools, applications	
UNIT-V : REGULATION OF SMARTGRIDS AND ENERGY STORAGE SYSTEMS	**(09)**
Regulation and Economic models – Evolution of the value chain – The emergence of a business model for smart grids – Regulation can assist in the emergence of SmartGrids – The standardization of SmartGrids - Energy Storage Technologies-Methods - Batteries, Flow Battery, Fuel Cell and Hydrogen Electrolyser, Flywheel, Super-Conducting magnetic energy storage system, Super Capacitor.	

Contact periods:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Text Books:

1. *Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage "**Smart Grid Technologies and applications"** John Wiley Publishers Ltd., 2012*
2. *Nouredine Hadjsaid, Jean-Claude Sabonnadiere "**Smart Grids**" Wiley Publishers Ltd., 2012*
3. *Lars T. Berger, Krzysztof Iniewski "**Smart Grid applications, Communications and Security**" John Wiley Publishers Ltd., 2012*

Reference Books

1. *Yang Xiao,* ***"Communication and Networking in Smart Grids",*** *CRC Press Taylor and Francis Group, 2012.*
2. *Caitlin G. Elsworth,* ***"The Smart Grid and Electric Power Transmission"****, Nova Science Publishers Inc, 2010*

COURSE OUTCOME:

CO1: Develop and demonstrate the various aspects of the smart grid, including Technologies, Components, Architectures, Applications.

CO2: Design a smart grid and to meet the needs of a utility, including Meeting a utility's objectives, helping to adopt new technologies into the grid.

CO3: Creating a framework for knowledgeable power engineers to operate the grid more effectively.

CO4: Transfer the available information from any part of the power system to centralized control centre.

CO5: Handle the smart meter, sensors and intelligent devices to measure the electrical quantity.

CO6: Control the Electrical quantity from remote place.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	-	-	L	L	M	H	L	M	M	M	H	M	H	M
CO2	L	L	M	M	M	M	M	L	M	M	M	M	M	M	H
CO3	-	-	-	M	M	M	M	M	M	M	M	H	M	M	M
CO4	L	-	-	M	M	M	H	-	M	M	M	H	M	H	H
CO5	M	-	L	M	M	M	M	-	M	M	M	M	M	M	M
CO6	L	L	M	L	M	M	L	-	M	M	M	M	M	M	M
16EOEX12	L	L	M	M	M	M	M	L	M	M	M	M	M	M	M

L – Low, M – Moderate (Medium), H- High

16LOEX13 **PRINCIPLES OF COMMUNICATION** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To understand the concepts of analog communication
- To gain the fundamental knowledge of digital communication
- To be familiar with the fundamentals of satellite and optical communication

UNIT-I : AMPLITUDE MODULATION	**(09)**
Introduction to communication systems- Electromagnetic spectrum- Principle of amplitude modulation − AM envelope − frequency spectrum and bandwidth − modulation index and percentage of modulation − AM power distribution –AM generation and-detection – square law modulator- envelope detector.	
UNIT-II : ANGLE MODULATION	**(09)**
Frequency modulation and phase modulation- FM and PM waveforms − phase deviation and modulation index − frequency deviation and percentage of modulation − Frequency analysis of angle modulated waves- Bandwidth requirements for Angle modulated waves – generation and detection of FM – Armstrong modulator- Foster Seely Discriminator.	
UNIT-III : PULSE MODULATION	**(09)**
Sampling and Quantization – Pulse Amplitude modulation- Pulse width modulation –Pulse position modulation- Pulse code modulation- PCM transmitter and receiver - Signal to Quantization noise ratio – Differential Pulse Code Modulation − Delta modulation − Adaptive Delta modulation	
UNIT-IV : DIGITAL COMMUNICATION	**(09)**
Introduction – ASK, FSK,PSK- transmitter and receiver – QPSK transmitter and receiver – M ary PSK – Error probability in PSK, FSK.	
UNIT-V : SATELLITE AND OPTICAL COMMUNICATION	**(09)**
Satellite Communication Systems-Transmitter and receiver- Kepler's Law – LEO and GEO Orbits – GEO Stationary orbit-–Optical Communication Systems – Transmitter and receiver- Sources and Detectors- Types of Optical Fiber – Losses	

Contact periods:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Text Books:

1. *Wayne Tomas*i " ***Advanced Electronic Communication Systems"*** 6/e, Pearson Education, 2007.
2. *Simon Haykin "**Communication Systems**" 4th Edition, John Wiley & Sons., 2008*

Reference Books :

1. *H.Taub,D L Schilling ,G Saha , "**Principles of Communication**" 3/e,2007.*
2. *B.P.Lathi, **"Modern Analog And Digital Communication systems**", 3/e, Oxford University Press, 2007*
3. *Blake, "**Electronic Communication Systems**", Thomson Delmar Publications, 2002.*
4. *B.Sklar, **"Digital Communication Fundamentals and Applications**" 2/e Pearson Education 2007.*

COURSE OUTCOMES:

Upon completion of this course, the students will have the:

CO1: Basic knowledge of amplitude modulation systems
CO2: Basic knowledge of angle modulation systems
CO3: Fundamental knowledge of digital communication systems
CO4: Understanding of digital transmission techniques
CO5: Fundamental knowledge of satellite communication system
CO6: Fundamental knowledge of optical communication system

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	M	M	-	-	-	-	-	-	-	-	L	M	L	-
CO2	M	M	M	-	-	-	-	-	-	-	-	L	M	L	-
CO3	M	M	M	-	-	-	-	-	-	-	-	L	L	L	-
CO4	M	M	M	-	-	-	-	-	-	-	-	L	M	L	-
CO5	M	M	M	-	-	-	-	-	-	-	-	L	L	L	-
CO6	M	M	M	-	-	-	-	-	-	-	-	L	M	M	-
16LOEX13	M	M	M	-	-	-	-	-	-	-	-	L	M	L	-

L – Low, M – Moderate (Medium), H- High

16LOEX14 MICROCONTROLLERS AND ITS APPLICATIONS Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To gain knowledge on basics of microcontrollers
- To get exposure to programming of microcontroller 8051
- To acquire knowledge on interfacing of peripherals with 8051 and PIC microcontrollers
- To get exposure on applications of microcontrollers

UNIT-I : INTRODUCTION TO MICROCONTROLLER	**(09)**
Microprocessors and Microcontrollers – CISC and RISC - Fundamentals of Assembly language Programming – Instruction to Assembler – C Programming for Microcontrollers – Compiler and IDE – Introduction to Embedded systems - Architecture 8051 family - PIC 18FXXX – family – Memory organization	
UNIT-II : PROGRAMMING OF 8051 MICROCONTROLLER	**(09)**
Instruction set – Addressing modes – I/O Programming-Timer/Counter - Interrupts – Serial communication of 8051.	
UNIT-III : PROGRAMMING OF PIC18FXXX MICROCONTROLLER	**(09)**
Instruction set – Addressing modes – I/O Programming-Timer/Counter - Interrupts – Serial communication, CCP, ECCP PWM programming of PIC18FXXX.	
UNIT-IV : PERIPHERAL INTERFACING	**(09)**
Interfacing of Relays, Memory, key board, Displays – Alphanumeric and Graphic, RTC, ADC and DAC, Stepper motors and DC Motors, I^2C, SPI with 8051 and PIC family.	
UNIT-V : MICROCONTROLLER APPLICATIONS	**(09)**
Pulse measurement-measuring frequency, pulse width measurement -Speed control of DC Motor-Speed control of Stepper Motor-Traffic Light Controller and Washing Machine Controller.	

Contact periods:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *Kenneth J.Ayala.* ***"The 8051 Microcontroller"*** *3rd Edition, Thompson Delmar Learning, 2007, New Delhi.*
2. *John B. Peatman "****PIC programming****" McGraw Hill International, USA, 2005*

Reference Books :

1. *Muhammad Ali Mazidi and Janice GillispicMazdi, "****The 8051 Microcontroller and Embedded Systems****" Pearson Education, Inc 2006.*
2. *John B. Peatman, "****Design with Micro controllers****", McGraw Hill International, USA, 2005*
3. *James W. Stewart, "****The 8051 Micro controller hardware, software and interfacing****", regents Prentice Hall, 2003.*
4. *David Calcutt, Fred Cowan, Hassan Parchizadeh, "****8051 Microcontroller An Application Based Introduction****", Elsevier Publication, 1st edition,2004.*
5. *Krishna Kant, "****Microprocessor and Microcontrollers****" Eastern company edition, Prentice Hall of India, New Delhi, 2007.*

COURSE OUTCOME:

Upon completion of this course the student will:

CO1: Acquire knowledge on the basics of microcontroller

CO2: Exposure to 8051 microcontroller Programming

CO3: Exposure to PIC microcontroller Programming

CO4: Able to interface peripherals with microcontrollers

CO5: Get exposure to the applications of microcontrollers

CO6: Able to design microcontroller based systems

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	H	M	-	-	-	-	-	-	-	-	L	L	L	-
CO2	M	H	M	-	-	-	-	-	-	-	-	M	M	M	-
CO3	M	H	M	-	-	-	-	-	-	-	-	M	M	M	-
CO4	M	H	M	-	-	-	-	-	-	-	-	M	M	M	-
CO5	M	H	M	-	-	-	-	-	-	-	-	M	M	M	-
CO6	H	H	H	-	-	-	-	-	-	-	-	M	H	H	-
16LOEX14	M	H	M	-	-	-	-	-	-	-	-	M	M	M	-

L – Low, M – Moderate (Medium), H- High

16NOEX15 **INDUSTRIAL AUTOMATION SYSTEMS** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To elaborate the basic concept of automation and the components required for automation.
- To introduce the concept and programming of programmable logic controllers and distributed control system which is used for process automation.
- To outline the basic concepts of SCADA technology.

UNIT-I : INTRODUCTION TO AUTOMATION	**(09)**
Automation overview – requirement of automation systems – architecture of industrial automation system – power supplies and isolators –relays – switches –transducers – sensors –seal-in circuits – industrial bus systems : modbus and profibus.	
UNIT-II : AUTOMATION COMPONENTS	**(09)**
Sensors for temperature – pressure – force – displacement - speed – flow- level – humidity and pH measurement. Actuators – process control valves – power electronic drives DIAC- TRIAC – power MOSFET – IGBT. Introduction to DC and AC servo drives for motion control	
UNIT-III : PROGRAMMABLE LOGIC CONTROLLERS	**(09)**
PLC Hardware – PLC programming – ladder diagram – sequential flow chart – PLC communication and networking – PLC selection – PLC installation – Advantages – Application of PLC to process control industries and Robotics.	
UNIT-IV : DISTRIBUTED CONTROL SYSTEM (DCS)	**(09)**
Overview of DCS – DCS hardware – DCS software configuration – DCS communication – DCS supervisory computer tasks – DCS integration with PLC and Computers	
UNIT-V : SCADA	**(09)**
Introduction - Supervisory Control and Data Acquisition Systems (SCADA) – SCADA HMI Essentials – SCADA Components – SCADA Configuration and Software – HMI hardware and software.	

Contact periods:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *John.W. Webb Ronald A Reis "**Programmable Logic Controllers - Principles and Applications**" Prentice Hall Inc., 5th Edition, 2003.*
2. *M. P. Lukcas "**Distributed Control Systems"** Van Nostrand Reinhold Co., 1986*

Reference Books:

1. *Bela G Liptak, "**Process software and digital networks – Volume 3**", 4th Edition, CRC press, 2012.*
2. *Frank D. Petruzella, "**Programmable Logic Controllers**", 5th Edition, McGraw Hill, 2016.*
3. *Huges T, "**Programmable Logic Controllers**", ISA press, 1994*
4. *Romily Bowden, "**HART application guide and the OSI communication foundation**", 1999*
5. *Krishna Kant, "**Computer Based Industrial Control**" Second edition, Prentice Hall of India, New Delhi, 2010*

COURSE OUTCOME:

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

CO1: Elaborate the basic architecture of automation systems

CO2: Describe the various sensors and actuators involved in industrial automation

CO3: Construct ladder logic diagram using PLC basic functions, timer and counter functions for simple applications

CO4: Illustrate the functionary components and supervisory control of DCS with relevant diagrams.

CO5: Describe the basics of SCADA technology

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO2	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO3	H	H	M	M	L	L	M	H	L	M	L	L	H	L	L
CO4	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO5	H	H	M	M	M	L	L	H	L	M	L	L	H	L	L
16NOEX15	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L

L – Low, M – Moderate (Medium), H- High

16NOEX16 MEASUREMENTS AND INSTRUMENTATION Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To study about the electrical parameter measuring instruments.
- To familiarize about the measurement techniques for power and energy.
- To gain knowledge about potentiometer and instrument transformers.
- To learn about the working of different analog and digital instruments.
- To study about display and recording devices.

UNIT-I : MEASUREMENT OF ELECTRICAL PARAMETERS	**(09)**
Types of ammeters and voltmeters: PMMC Instruments, Moving Iron Instruments, Dynamometer type Instruments – Resistance measurement: Wheatstone bridge, Kelvin double bridge and Direct deflection methods. Measurement of Inductance: Maxwell-Wien Bridge, Hay's bridge and Anderson Bridge - Measurement of Capacitance: Schering Bridge.	
UNIT-II : POWER AND ENERGY MEASUREMENTS	**(09)**
Electro-dynamic type wattmeter: Theory and its errors – LPF wattmeter – Phantom loading – Single phase Induction type energy meter – 3 phase induction energy meter and phase measurement– Calibration of wattmeter and Energy meters – Synchroscope.	
UNIT-III : POTENTIOMETERS AND INSTRUMENT TRANSFORMERS	**(09)**
D.C. Potentiometers: Student type potentiometer, Precision potentiometer – A.C. Potentiometers: Polar and Coordinate types – Applications – Instrument Transformer: Construction and theory of Current Transformers and Potential Transformers.	
UNIT-IV : ANALOG AND DIGITAL INSTRUMENTS	**(09)**
Wave analyzers – Signal and function generators – Distortion factor meter – Q meter – Digital voltmeter and multi-meter – Microprocessor based DMM with auto ranging and self diagnostic features – Frequency measurement	
UNIT-V : DISPLAY AND RECORDING DEVICES	**(09)**
Cathode ray oscilloscope: Classification, Sampling and storage scopes – LED, LCD and dot matrix displays – X-Y recorders – Magnetic tape recorders –Digital Data Recording –Digital memory waveform recorder – Data loggers.	

Contact periods:
Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *Kalsi. H.S "**Electronic Instrumentation**" Tata McGraw-Hill, New Delhi, 2010*
2. *Sawhney.A.K "**A Course in Electrical & Electronic Measurements & Instrumentation**" Dhanpat Rai and Co., New Delhi, 2010*

Reference Books:

1. *Northrop. R.B, "**Introduction to Instrumentation and Measurements**", Taylor & Francis NewDelhi,2008.*
2. *Carr.J.J, "**Elements of Electronic Instrumentation and Measurement**", Pearson Education India, New Delhi, 2011.*
3. *David A.Bell, "**Electronic Instrumentation and Measurements**", PHI, New Delhi.*
4. *Copper. W.D and Hlefrick.. A.D, "**Modern Electronic Instrumentation and Technique**" 5th Edition, Prentice Hall of India, 2002.*

COURSE OUTCOME:

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

CO1: Compare the working principles, merits and demerits of different types of electrical instruments and can understand about different instruments that are used for Measurement purpose.

CO2: Understand how different bridge networks are constructed and balanced for finding the values of resistance, capacitance and inductance.

CO3: Apply knowledge of electronic instrumentation for measurement of electrical quantities.

CO4: Apply the principles and practices for instrument design and development to real world problems.

CO5: Select a suitable measuring instrument for a given application.

CO6: Pursue higher studies and do research activities in the field of measurement and instrumentation.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	M	H	M	H	M	L	H	M	H	H	H	M	H
CO2	H	M	M	M	H	H	H	M	H	L	H	H	H	H	M
CO3	H	H	M	H	M	H	M	L	H	M	H	H	H	H	H
CO4	H	H	M	H	M	H	M	L	H	M	H	H	H	M	H
CO5	H	H	M	H	M	H	M	L	H	M	H	H	H	M	M
CO6	H	H	M	H	M	H	M	L	H	M	H	H	M	H	M
16NOEX16	H	H	M	H	M	H	M	L	H	M	H	H	H	H	H

L – Low, M – Moderate (Medium), H- High

16SOEX17 **ENTERPRISE JAVA** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Basic programming constructs in java to develop simple object oriented programs
- Enterprise Architecture types and features of Java EE platform
- JEE foundation concepts like Enterprise java bean, JSP and JSF
- Distributed Programs and methods to connect with database.
- Java Web services

UNIT-I : INTRODUCTION TO JAVA	**(09)**
Introduction to object oriented programming-Features of Java – Data types, variables and arrays – Operators – Control statements – Classes and Methods – Inheritance. Packages and Interfaces – Exception Handling – Multithreaded Programming – Input/Output – Files – Utility Classes – String Handling – Networking –Applet class – Event Handling	
UNIT-II : INTRODUCTION TO ENTERPRISE JAVA	**(09)**
Challenges of Enterprise application Development - Platform for enterprise Solutions – J2EE Application Scenario - J2EE Platform Technologies –J2EE Multi-Tier Architecture - J2EE Architecture Approaches - Model-View-Controller Architecture - J2EE Design Patterns - Designing the Sample Application - Choosing Application Tiers - Choosing Local or Distributed Architecture - Architecture of the Sample Application	
UNIT-III : ENTERPRISE JAVA FOUNDATION	**(09)**
Enterprise Java Beans -Business Logic and Business Objects. - Enterprise Beans as J2EE Business Objects - Entity Beans - Session Beans - Message-Driven Beans -Transaction support in EJB- Security support in EJB –Java Server Pages - Directive Elements - Scripting Elements - Action Elements- Expression Language-JSP Standard Tag Library - Java Server Page Online Store –JavaServer Faces - Life Cycle - Resource Management.	
UNIT-IV : INTERCONNECTIVITY	**(09)**
Concept of JDBC – JDBC Driver types- Database Connection – Associating JDBC Bridge with the database – Statement Objects –Resultset – Transaction Processing – RMI- Network File-Locking Server -Java Mail API and Java Activation Framework – send ,receive, retrieve and delete email message - Java Message Service – JMS Fundamentals –Components of a JMS program -JMS architecture –JMS-Based Alarm System - JNDI – Naming and Directories – Naming Operations	
UNIT-V : WEB SERVICES	**(09)**
SOAP Basics – Java API for XML Messaging – Creating a SOAP Attachment – Accessing a SOAP Attachment – Universal Description, Discovery and Integration (UDDI)- UDDI Architecture – UDDI Application Programming Interface – Inquiry Application Programming Interface – Publishing Application Programming Interface –JAXR – JAXR client – Publishing a service to an XML Registry – Removing a published service from an XML Registry- WSDL – Inside WSDL- WSDL and SOAP - RESTFul Web services – REST Approach - Java API for RESTful Web service	

Contact periods:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *Herbert Schildt "**Java The Complete Reference**" 9th Edition. Tata McGraw- Hill Edition. 2014*
2. *Stephen Asbury and Scott R. Weiner **"Developing Java Enterprise Applications"** second edition Wiley Publishing.1999.*
3. *Antonio Goncalves "**Beginning Java™ EE 6 Platform with GlassFish™ 3From Novice to Professional**" Apress 2009.*
4. *Jim Keogh "**The Complete Reference J2EE**" Tata McGraw –Hill 2002*

Reference Books:

1. *John Brock, Arun Gupta, Geertjan Wielenga "**Java Server Programming Java EE 7 (J2EE 1.7) – Black Book**" McGraw Hill, 2015.*
2. *Inderjeet Singh, Beth Stearns, Mark Johnson, and the Enterprise Team "**Designing Enterprise Applications with the J2EE™ Platform**", Second Edition Addison Wesley, 2002.*

COURSE OUTCOMES:

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

- **CO1:** Write simple java programs using fundamental concepts of java like control structures inheritance, packages, interfaces, multithreaded programming and exception handling. *[Usage]*
- **CO2:** Write java program for Networking using applets. *[Usage]*
- **CO3:** Describe and use the client/server and distributed architectures in a programming environment.*[Usage]*
- **CO4:** Use EJB, JSP and JFC technology in developing enterprise applications *[Usage]*
- **CO5:** Apply Java interconnectivity techniques like JDBC, RMI, Java Mail, JMS, JNDI in developing enterprise applications.*[Usage]*
- **CO6**: Explain the roles XML, JAXR, SOAP, WSDL and UDDI in the architecture of Web services*[Familiarity]*
- **CO7:** Develop java program to use RESTful web services *[Assessment]*.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	L	L	M	-	-	-	-	L	-	L	-	L	-	-	-
CO2	L	L	M	L	H	-	-	L	-	-	-	L	L	H	-
CO3	L	L	M	L	H	-	-	L	-	-	-	M	L	H	H
CO4	L	L	M	L	H	L	L	L	L	L	L	M	L	H	H
CO5	L	L	M	L	H	-	-	L	-	-	-	M	L	H	-
CO6	-	L	L	-	-	-	-	-	-	-	-	L	-	H	H
CO7	L	L	L	L	H	-	-	L	L	L	L	M	L	H	H
16SOEX17	L	L	M	L	H	L	L	L	L	L	L	M	L	H	H

L – Low, M – Moderate (Medium), H- High

16SOEX18 **CYBER SECURITY** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Cybercrime and cyber offenses.
- Cybercrime using mobile devices.
- Tools and methods used in cybercrime.
- Legal perspectives of cybercrime.
- Fundamentals of computer forensics.

UNIT-I : INTRODUCTION TO CYBERCRIME AND CYBEROFFENSES	**(09)**
Cybercrime and Information Security - Classifications of Cybercrimes - The Legal Perspectives - Cybercrime and the Indian ITA 2000 - A Global Perspective on Cybercrimes - Plan of Attacks - Social Engineering – Cyberstalking - Cybercafe and Cybercrimes – Botnets - Attack Vector.	
UNIT-II : CYBERCRIME: MOBILE AND WIRELESS DEVICES	**(09)**
Proliferation of Mobile and Wireless Devices - Trends in Mobility - Credit Card Frauds in Mobile and Wireless Computing Era – Security challenges posed by mobile devices – registry setting for mobile devices – authentication service security – attacks on mobile/cell phones – Organizational measures for handling mobiles.	
UNIT-III : TOOLS AND METHODS USED IN CYBERCRIME	**(09)**
Proxy Servers and Anonymizers – Phishing - Password Cracking – Keyloggers – Spywares -Virus and Worms - Trojan Horses and Backdoors – Steganography - DoS and DDoS Attacks - SQL Injection - Attacks on Wireless Networks.	
UNIT-IV : CYBERCRIMES AND CYBERSECURITY: THE LEGAL PERSPECTIVES	**(09)**
Cyberlaws- The Indian Context - The Indian IT Act - Challenges to Indian Law and Cybercrime Scenario in India - Consequences of Not Addressing the Weakness in Information Technology Act - Digital Signatures and the Indian IT Act - Amendments to the Indian IT Act - Cybercrime and Punishment.	
UNIT-V : UNDERSTANDING COMPUTER FORENSICS	**(09)**
Digital Forensics - Forensics Analysis of E-Mail - Network Forensics - Forensics and Steganography - Forensics and Social Networking Sites - Challenges in Computer Forensics - Data Privacy Issues – Forensics Auditing – Antiforensics	

Contact periods:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *Nina Godbole and Sunit Belapur "**Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives**" Wiley India Publications, April, 2011*

Reference Books:

1. Robert Jones, "**Internet Forensics: Using Digital Evidence to Solve Computer Crime**", O'Reilly Media, October, 2005.
2. Chad Steel, "**Windows Forensics: The field guide for conducting corporate computer investigations**", Wiley India Publications, December, 2006.

COURSE OUTCOME:

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

CO1: Explain the fundamental concepts of cybercrime and cyberoffenses. [Familiarity]

CO2: Describe the cybercrimes occurred in mobile and wireless devices. [Familiarity]

CO3: Elaborate the methods used in cybercrime. [Familiarity]

CO4: Explain the laws for cybercrime and its respective punishments. [Familiarity]

CO5: Explain the forensics Analysis of E-Mail, Network and Social Networking Sites [Familiarity]

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	PSO 4
CO1	L	L	L	M	L	H	-	-	-	-	-	L	L	L	H	L
CO2	L	L	L	M	L	H	-	-	-	-	-	L	L	L	H	L
CO3	L	L	L	M	L	H	-	-	-	-	-	L	L	L	H	L
CO4	L	L	L	M	L	H	-	-	-	-	-	L	L	L	H	L
CO5	L	L	L	M	L	H	-	-	-	-	-	L	L	L	H	L
16SOEX18	L	L	L	M	L	H	-	-	-	-	-	L	L	L	H	L

L – Low, M – Moderate (Medium), H- High

16SOEX19 **NETWORK ESSENTIALS** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with*:*

- Basic taxonomy and terminology of the computer networking
- Wireless networking
- Addressing and Routing
- Routing protocols
- Troubleshooting and security issues.

UNIT-I : INTRODUCTION	**(09)**
Introduction to Computer Networks - Goals and advantages of Computer Networks - Network Topologies – Basic networking devices – Protocols – the need for a layered architecture - The OSI Model and the TCP/IP reference model – the Ethernet LAN – Home Networking – Assembling an office LAN – Testing and Troubleshooting a LAN – Physical layer cabling: Twisted pair and Fiber optics	
UNIT-II : WIRELESS NETWORKING	(09)
Importance of Wireless Networking – IEEE 802.11 Wireless LANs – Bluetooth- WIMAX – RFIDs – Securing the Wireless LANs – Configuring a Point to Multipoint Wireless LAN – Interconnecting network LANs – Switch, Bridges and Routers. Interconnecting LANs with the router, Configuring the network interface-Auto negotiation.	
UNIT-III : ADDRESSING AND ROUTING FUNDAMENTALS	**(09)**
IPv4 and IPv6 addressing – Subnet masks – CIDR blocks – configuration of a router – Console port connection - user EXEC mode – Privileged EXEC mode - Configuration of a switch – Static VLAN configuration - Spanning Tree protocol – Network Management – Power over Ethernet	
UNIT-IV : ROUTING PROTOCOLS	**(09)**
Static Vs Dynamic Routing Protocols – Distance vector Routing – Link State Routing – Hybrid Routing – Configuring RIP - Network Services – DHCP , DNS - Analyzing Internet Traffic.	
UNIT-V : TROUBLESHOOTING AND NETWORK SECURITY	**(09)**
Analyzing Computer Networks – FTP data packets – Analyzing Campus Network data traffic – Troubleshooting the router and switch interface, Troubleshooting fiber optics – Intrusion – DOS – Security software and hardware.	

Contact periods:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *Jeffrey S.Beasley Piyasat Nilkaew "**Network Essentials**" 3rd Edition, Pearson, 2012*
2. *Larry L. Peterson and Bruce S. Davie "**Computer Networks, A Systems Approach**" Morgan Kaufmann Publishers Inc, 5th edition 2011.*

Reference Books:

1. *Behrouz A.Ferouzan,"**Data Communications and Networking**", 5th edition, Tata McGraw-Hill, 2012.*
2. *Andrew S. Tanenbaum, "**Computer networks**", PHI, 5th edition 2011.*
3. *William Stallings, "Data and computer communication", 10th edition, Pearson Education, 2013.*

COURSE OUTCOME:

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

- **CO1:** Identify topologies and types of Computer Networks [Familiarity]
- **CO2:** Enumerate the layers of the OSI model and TCP/IP and Explain the functions of each layer [Familiarity]
- **CO3:** Identify and Compare types of cabling for data communication [Usage]
- **CO4:** Explain the significance of wireless networks [Familiarity]
- **CO5:** Configure a Wireless LAN [Assessment]
- **CO6:** Configure router and a switch [Assessment]
- **CO7:** Describe basic routing algorithms and network services. [Usage]
- **CO8:** Troubleshoot the router and switch interface [Usage]
- **CO9:** Analyze Campus Network data traffic [Usage]

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	H	H	H	H	-	-	-	H	H	H	H	M	H	H	M
CO2	H	H	H	H	H	-	-	-	H	H	H	H	M	H	H	M
CO3	L	L	L	L	H	-	-	-	L	L	L	H	M	H	H	M
CO4	L	H	M	-	H	-	-	-	H	M	L	H	L	H	H	L
CO5	H	H	H	M	H	-	-	-	H	H	M	H	M	H	H	M
CO6	H	H	H	M	H	-	-	-	H	M	L	H	M	H	H	M
CO7	H	H	H	H	H	-	-	-	H	H	M	H	M	H	H	M
CO8	H	H	H	M	H	-	-	-	H	M	L	H	M	H	H	M
CO9	H	H	H	M	H	-	-	-	H	H	M	H	M	H	H	M
16SOEX19	H	H	H	M	H	-	-	-	H	H	M	H	M	H	H	M

L – Low, M – Moderate (Medium), H- High

16IOEX20 **PROGRAMMING IN PYTHON** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course the students will be Familiar with:

- Data types and variables declaration
- Control statements, Functions and the use of basic programming.
- List, dictionary and functions used in python.
- File and Exception handling.
- Object oriented programming and GUI development.

UNIT-I : INTRODUCTION	**(09)**
Introduction to Python - Setting up Python in OS – Python IDLE(write- edit- run- and save programs) – Strings - Numbers – Variables – simple I/O - Getting user input– Using String method–Converting values.	
UNIT-II : CONTROL STATEMENTS AND FUNCTIONS	**(09)**
Control statements – Random number generator- Branching and loops – Range functions- Functions –User defined functions- passing parameters- return function- working with global variables and constants.	
UNIT-III : LISTS AND DICTIONARIES	**(09)**
Lists – create- index- slice a list- Add and delete elements from a list- Append- Sort and reverse a list- nested sequences- Dictionaries – Create- add- delete from a Dictionary- Operations associated with pairs of data.	
UNIT-IV : FILES AND EXCEPTIONS	**(09)**
Files – Read from text files- Write to text files- Read and write more complex data- Exceptions – Intercept and handle errors during program's execution.	
UNIT-V : OBJECT ORIENTED PROGRAMMING AND GUI	**(09)**
Object oriented programming – Create objects of different classes in the same program- objects communication- complex object creation- derive new classes- existing class extension- override method- GUI – GUI toolkit- create and fill frames- create buttons- text entries and text boxes- create check buttons and radio buttons - case study – create a web page using GUI functionality	

Contact periods:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total: 45 Periods**

Text Books:

1. *Y. Daniel Liang "**Introduction to Programming Using Python**" Pearson, 2013*
2. *Charles Dierbach "**Introduction to Computer Science Using Python: A Computational Problem-Solving Focus**" Wiley Publications, 2012*

Reference Books:

1. *Michael Dawson **"Python Programming for the Absolute Beginner"**, Premier Press, 2003.*

COURSE OUTCOME:

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

CO1: Use various data types.[Understand]
CO2: Handle the arrangement of data elements in Lists and Dictionary structures.[Analyze]
CO3: Use control statements and functions. [Understand]
CO4: Handle exceptions and perform file operations. [Understand]
CO5: Develop application using object oriented programming and GUI. [Analyze]

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	L	-	L	L	-	L	L	-	-	L	-	L	L
CO2	M	L	-	L	L	-	L	L	-	-	L	-	L	L
CO3	M	M	L	M	L	-	L	L	-	-	L	-	M	L
CO4	M	M	L	M	L	-	M	M	-	-	L	-	M	L
CO5	M	M	L	M	L	-	M	M	-	-	M	L	M	L
16IOEX20	M	M	L	M	L	-	L	L	-	-	L	L	M	L

L – Low, M – Moderate (Medium), H- High

16IOEX21 **BIG DATA SCIENCE** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Big Data and its characteristics
- Technologies used for Big Data Storage and Analysis
- Mining larger data streams
- Concepts related to Link analysis and handle frequent data sets

UNIT-I : THE FUNDAMENTALS OF BIG DATA	**(09)**
Understanding Big Data-Concepts and Technology-Big Data Characteristics-Types of data-Case Study-Business Motivation and Drivers for Big Data Adoption- Planning Considerations-Enterprise Technologies and Big Data Business Intelligence- OLTP-OLAP-Extract Transform Load-Data Warehouses-Data Mart-Traditional and Big Data BI-Case Study	
UNIT-II : BIG DATA STORAGE AND PROCESSING	**(09)**
Big Data Storage Concepts- Clusters-File systems and Distributed File Systems-NoSQL- Sharding -Replication -Sharding and Replication-CAP Theorem-ACID-BASE-Case Study- Big Data Processing Concepts- Parallel Data Processing-Distributed Data Processing-Hadoop-Processing Workloads-Cluster-Processing in Batch mode-Processing in RealTime mode-Case study	
UNIT-III : BIG DATA STORAGE AND ANALYSIS TECHNOLOGY	**(09)**
Big Data Storage Technology: On-Disk Storage devices-NoSQL Databases-In-Memory Storage Devices-Case study, Big Data Analysis Techniques: Quantitative Analysis-Qualitative Analysis-Data Mining-Statistical Analysis-Machine Learning-Semantic Analysis-Visual Analysis-Case Study	
UNIT-IV : MINING DATA STREAMS	**(09)**
The stream data model – Sampling data streams – counting distinct elements in a stream – Estimating moments. Finding similar items – Applications of nearest neighbor search – shingling of documents - similarity preservation – locality sensitive hashing- distance measures – methods for high degree similarity.	
UNIT-V : LINK ANALYSIS AND FREQUENT ITEMSETS	**(09)**
Link analysis – Page rank – Efficient computation of a page rank – topic sensitive page rank – link spam –Frequent datasets – the market basket model – A-Priori algorithm – handling larger datasets in main memory –limited pass algorithm – counting frequent items in a stream	

Contact periods:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *Thomas Erl, WajidKhattak, and Paul Buhler "**Big Data Fundamentals Concepts, Drivers & Techniques**" Prentice Hall,2015*
2. *AnandRajaraman and Jeffrey David Ullman "**Mining of Massive Datasets**" Cambridge University Press, 2012.*

Reference Books:

1. *Paul Zikopoulos, Chris Eaton, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw Hill, 2011.*
2. *Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS Business Series, 2012.*

COURSE OUTCOME:

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

CO1: Understand the Big Data and usage in Enterprise Technologies. [Understand]

CO2: Store and Process Big Data using suitable Processing Methods[Understand]

CO3: Handle Big Data using appropriate analysis Techniques. [Analyse]

CO4: Mine larger data streams using suitable algorithms. [Understand]

CO5: Rank pages and handle large data sets efficiently [Analyse]

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	L	M	L	H	L	-	-	-	-	-	-	H	L
CO2	M	-	-	-	H	-	-	L	-	-	-	-	M	L
CO3	-	H	-	-	H	-	-	-	-	-	-	-	H	-
CO4	M	H	M	-	M	-	-	-	-	-	-	-	H	-
CO5	L	M	H	-	-	-	-	-	-	-	-	-	H	-
16IOEX21	M	H	M	L	H	L	-	L	-	-	-	-	H	L

L – Low, M – Moderate (Medium), H- High

16IOEX22 OBJECT ORIENTED PROGRAMMING USING C++ Category: OE

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Fundamentals of object oriented programming
- Classes and objects
- Concepts of overloading and type conversions
- Inheritance and Polymorphisms
- Files, templates and exception handling

UNIT-I : PRINCIPLES OF OBJECT ORIENTED PROGRAMMING	**(09)**
Basic concepts- benefits – applications of object oriented programming – beginning with C++ - tokens – expressions and control structures – C++ stream classes – Formatted and Unformatted I/O operations. Managing output with manipulators.	
UNIT-II : CLASSES AND OBJECTS	**(09)**
Introduction – specifying class – defining member functions – memory allocation constructors and destructors:- parameterized- copy – default -dynamic and multiple constructors – destructors	
UNIT-III : FUNCTIONS AND TYPE CONVERSIONS	**(09)**
Introduction – function prototyping call by reference – return by reference – inline function – recursion – friend function – function overloading – operator overloading – manipulation of strings using operators – type conversions	
UNIT-IV : INHERITANCE AND POLYMORPHISM	**(09)**
Defining derived classes – single, multiple, multilevel, hierarchical and hybrid inheritance – virtual base classes – abstract base classes – nesting of classes - pointers – pointers to objects – this pointer – pointers to derived classes – virtual functions – pure virtual functions virtual constructors and destructors	
UNIT-V : FILES AND TEMPLATES	**(09)**
Classes for file stream operations – opening and closing a file – detecting EOF – open file modes – file pointers and their manipulations – sequential I/O operations – updating and error handling of file. Class and function template – template with multiple parameters – overloading, member function and non-type template arguments-Exception handling.	

Contact periods:

Lecture: 45 periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *E.Balagurusamy "**Object oriented Programming with C++**" McGraw Hill Education Ltd,6th Edition 2013*

Reference Books:

1. *R.Rajaram **"Object Oriented Programming and C++"** New Age International 2nd edition , 2013*
2. *K.R. Venugopal,Rajkumar,T. Ravishankar **"Mastering C++"** , Tata McGraw Hill Education,2nd edition, 2013*
3. *Yashavant P. Kanetkar**" Let us C++"** BPB Publications , 2nd edition 2003.*

COURSE OUTCOME:

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

CO1: Understand the principles of object oriented programming [Understand]

CO2: Develop programs using classes and objects.[Analyze]

CO3: Use functions and type conversions in programs. [Understand]

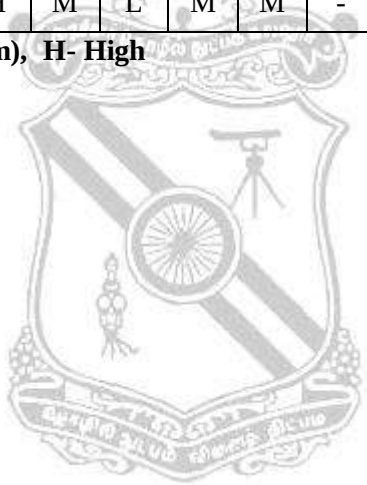
CO4: Apply inheritance and polymorphism to develop applications. [Analyze]

CO5: Use files, templates and handle exceptions. [Understand]

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	H	H	M	M	-	M	M	-	-	M	-	M	M
CO2	M	H	H	H	M	-	M	M	-	-	M	-	H	M
CO3	M	H	H	H	M	-	M	M	-	-	M	-	H	M
CO4	M	H	H	H	M	L	M	M	-	-	M	-	H	M
CO5	M	H	H	H	M	-	M	M	-	-	M	-	H	M
16IOEX22	M	H	H	H	M	L	M	M	-	-	M	-	H	M

L – Low, M – Moderate (Medium), H- High



16BOEX23 **COMPUTATIONAL BIOLOGY** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Understand the basic concepts and role of computation in biological analysis
- Familiarize with sequence alignment methods
- Understand the machine learning tools used for biological analysis

UNIT-I : BASICS OF BIOLOGY	**(09)**
Biomolecules of life:Structure and Composition of DNA, RNA & Protein.Protein Structure basics-Primary, Secondary and tertiary Structure of protein	
UNIT-II : BIOLOGICAL DATABASES	**(09)**
Concept of Relational database, Data archiving, Data mining, Primary databases-NCBI,EMBL,DDBJ; Structure databases-PDB	
UNIT-III : SEQUENCE ANALYSIS	**(09)**
Pairwise alignment tools-Dot matrix analysis, Dynamic programming-Smith waterman and Needleman wunsch algorithm ,Heuristic methods- BLAST,FASTA;Multiple sequence alignment methods-Progressive alignment(Clustal)	
UNIT-IV : STRUCTURE ANALYSIS AND DRUG DESIGN	**(09)**
Protein secondary prediction-Chou fasman method, GOR method; Tertiary structure prediction-Homology modelling, Introduction to Computer aided drug design.	
UNIT-V : MACHINE LEARNING	**(09)**
Genetic Algorithm, Neural networks,Artificial Intelligence, Hidden markov model -application in bioinformatics	

Contact periods:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *David W. Mount "**Bioinformatics: Sequence and Genome Analysis**" Cold Spring Harbor Laboratory Press, Second Edition, 2004.*
2. *Arthur M. Lesk "**Introduction to Bioinformatics**" Oxford University Press, 2008*
3. *Pierre Baldi, Soren Brunak "**Bioinformatics: The machine learning approach**" MIT Press, 2001*

Reference Books:

1. *Andrew R. Leach, "**Molecular Modeling Principles And Applications**", Second Edition, Prentice Hall, 2001.*
2. *Baxevanis A.D. and Oullette, B.F.F, "**A Practical Guide to the Analysis of Genes and Proteins**", 2nd ed., John Wiley, 2002*
3. *David L. Nelson ,Michael M. Cox , "**Lehninger Principles of Biochemistry**", Sixth edition, Freeman, W. H. & Co. Publisher,2012.*

COURSE OUTCOME:

Upon completion of the Computational Biology course, the students will be able to

CO1: Understand basic structure of Biological macromolecules

CO2: Acquire the knowledge of biological databases

CO3: Ability to perform pair wise and multiple sequence alignment

CO4: Ability to predict the secondary and tertiary structure of proteins.

CO5: Understand the machine learning approaches in computational biology

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	M	L	L	-	L	-	-	M	-	-	-	M	-	-
CO2	M	L	L	L	-	-	-	-	L	-	-	L	L	-	-
CO3	L	-	L	-	-	M	-	-	L	-	-	L	-	M	-
CO4	M	M	L	M	M	-	-	-	-	-	-	-	L	L	-
CO5	-	M	-	H	H	M	L	-	M	-	-	-	L	M	-
16BOEX23	M	M	L	M	M	M	L	-	M	-	-	L	M	M	-

L – Low, M – Moderate (Medium), H- High

16BOEX24 **BIOLOGY FOR ENGINEERS** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To enable the students
- To understand the basic functions of the cell and their mechanisms in transport process
- To get familiarize human anatomy and physiology
- To learn about microbes, immune system and biomolecules
- To know the concepts of applied biology

UNIT-I : BASICS OF CELL BIOLOGY	**(09)**
An Overview of cells – Origin and evolution of cells. Cell theory, Classification of cells – prokaryotic cells and eukaryotic cells. Structure of prokaryotic and eukaryotic cells and their organelles. Comparison of prokaryotic and eukaryotic cells, Transport across membranes – diffusion - active and passive diffusion.	
UNIT-II : BASICS OF MICROBIOLOGY	**(09)**
Classification of microorganism, Microscopic examination of microorganisms, Structural organization and multiplication of bacteria, viruses, algae and fungi, Microorganism used for the production of penicillin, alcohol and vitamin B-12.	
UNIT-III : HUMAN ANATOMY AND PHYSIOLOGY	**(09)**
Basics of human anatomy, tissues of the human body: epithelial, connective, nervous and muscular, Nervous system, Respiratory System, Circulatory system and Digestive system.	
UNIT-IV : BIO MOLECULES AND IMMUNE SYSTEM	**(09)**
Introduction to Biochemistry, Classification, structure and properties of carbohydrates, proteins, lipids and nucleic acids. Innate and acquired immunity, Types of immune responses.	
UNIT-V : APPLIED BIOLOGY FOR ENGINEERS	**(09)**
Overview of biosensors- glucometer applications-medicine, Microarray analysis to diagnose the cancer, Microbial production of biofuels, Applications of stem cells.	

Contact periods:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *Darnell J, Lodish H, Baltimore D "**Molecular Cell Biology"** W.H.Freeman; 8th edition,2016*
2. *Pelczar MJ, Chan ECS and KreinNR "**Microbiology**" Tata McGraw Hill, 5th edition, New Delhi.2001*
3. *WulfCruger and AnnelieseCruger "**A Textbook of Industrial Microbiology"** Panima Publishing Corporation, 2nd Edition, 2000.*

Reference Books:

1. *David L. Nelson and Michael M Cox, "**Lehninger's Principles of Biochemistry**", Macmillan Worth Publisher, 4th edition, 2004.*
2. *Brain R.Eggins ,"**Chemical Sensors and Biosensors**", John Wiley & Sons, 2002*
3. *Anton Moser, "**Bioprocess Technology, Kinetics and Reactors**" Springer, Berlin (Verlag),1998*
4. *Kuby J, **"Immunology"**, WH Freeman & Co., 2000.*

COURSE OUTCOME:

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

CO1: Understand the functions of cell and their structural organization

CO2: Describe the mechanisms and role of cell in immune system

CO3: Get familiarized biomolecules and human anatomy system

CO4: Illustrate the applications of microbes in industrial process

CO5: Apply the engineering concepts in biology

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	L	L	L	-	L	M	-	L	-	L	M	L	L	L	-
CO2	L	-	L	L	L	M	M	-	L	L	L	L	L	L	-
CO3	L	L	-	-	L	L	L	L	L	-	L	L	L	L	-
CO4	L	-	L	-	L	-	-	L	-	L	L	L	L	M	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16BOEX24	L	L	L	L	L	M	M	L	L	L	L	L	L	L	-

L – Low, M – Moderate (Medium), H- High

16BOEX25 **FUNDAMENTALS OF BIO ENGINEERING** **Category: OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To make the students aware of the overall industrial bioprocess.
- To understand the basic configuration and parts of a fermentor.
- To study the production of primary and secondary metabolites.
- To understand the production of modern biotechnology products.

UNIT-I : INTRODUCTION TO INDUSTRIAL BIOPROCESS	**(9)**
Fermentation - Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology - A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess.	
UNIT-II : FERMENTATION INDUSTRY	**(9)**
Overview of fermentation industry, Basic configuration of Fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes. Types of fermentation – Solid state, submerged, batch, continuous, fed batch fermentation methods.	
UNIT-III : PRODUCTION OF PRIMARY METABOLITES	**(9)**
A brief outline of processes for the production of some commercially important organic acids - Citric acid, lactic acid ,acetic acid; amino acids - glutamic acid, phenylalanine; ethanol	
UNIT-IV : PRODUCTION OF SECONDARY METABOLITES	**(9)**
Study of production processes for various classes of secondary metabolites: Antibiotics: beta lactams – penicillin and cephalosporin; aminoglycosides – streptomycin; macrolides - erythromycin, vitamin - B9, B12	
UNIT-V : PRODUCTS THROUGH MODERN BIOTECHNIQUES	**(9)**
Production of industrial enzymes - proteases, amylases, lipases; Production of single cell protein from wastes; biopreservatives – Bacterosin; biopolymers - xanthan gum and PHA. Industrial uses of enzymes in detergents, beverage and food.	

Contact periods:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

Text Books:

1. *Peter F. Stanbury, Stephen J. Hall & A. Whitaker "**Principles of Fermentation Technology**" Science & Technology Books. 1995.*
2. *Presscott, S.C. and Cecil G. Dunn "**Industrial Microbiology"** Agrobios (India), 2005.*
3. *Casida, L.E "**Industrial Microbiology**" New Age International (P) Ltd, 1968*

Reference Books:

1. *Crueger, W and AnnelieseCrueger, Biotechnology: "**A Textbook of Industrial Microbiology**", Panima Publishing Corporation, Edition 2, 2003*
2. *Sathyanarayana, U., "**Biotechnology**", Books and Allied (P) Ltd. Kolkata, 2005*
3. *Ratledge C and Kristiansen B. "**Basic Biotechnology**", Cambridge University Press, second Edition 2001.*
4. *Michael J. Waites. **"Industrial Microbiology: An Introduction",** Blackwell Publishing,2001.*

COURSE OUTCOME:

CO1: Upon completion of the course in Bioprocess Principles graduates will be able to understand the basics of industrial bioprocess.

CO2: Explain the principle of a fermentation process and the chronological development of fermentation industry.

CO3: Understand the basic configuration of a fermentor and its ancillaries.

CO4: Learn the production of various primary and secondary metabolites.

CO5: Understand the production of biotechnological products.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	H	H	-	-	-	-	-	-	-	-	-	M	-	-
CO2	H	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	H	H	H	M	M	M	-	L	H	-	-	-	-	H	-
CO4	H	L	L	-	-	L	-	L	-	-	-	-	-	H	-
CO5	H	M	H	L	M	-	-	L	-	-	-	-	-	H	-
16BOEX25	H	M	H	M	M	M	-	L	H	-	-	-	M	H	-

L – Low, M – Moderate (Medium), H- High

16EOC1Z1 **HUMAN VALUES – I** **Category : OC**

(Common To All Branches)

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

- Essential complementarily between 'values' and 'skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- The development of a Holistic perspective among students towards life, profession and happiness based on correct understanding of the Human reality and the rest of existence, which forms the basis of Value based living in a natural way.
- The plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually satisfying human behaviour and mutually enriching interaction with nature.

UNIT-I : INTRODUCTION TO VALUE EDUCATION	**(05)**
Introduction – Need, Basic Guidance, Content and Process for Value Education - Basic human Aspirations - Prosperity and happiness - Methods to fulfill human aspirations - Understanding and living in harmony at various levels.	
UNIT-II : HARMONY IN THE HUMAN BEING	**(05)**
Coexistence - Happiness and convenience - Appraisal of Physical needs - Mental and Physical health - Human relationship - Mutual Trust and Respect.	
UNIT-III : ETHICS	**(05)**
Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Caring – Sharing – honesty – Courage – Empathy – Self Confidence – Ethical Human Conduct – Basic for humanistic Eduction, Constitution and universal order – Competence in professional ethics – Strategy for transition from the present state to Universal human order.	

Contact periods:
Lecture: 15 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 15 Periods**

Text Books:

1. *Gaur.R.R., Singal.R., Bangaria.G.P "**Foundation Course in Human Values and Professional Ethics**" Excel Book Private Ltd., New Delhi., 2009*

Reference Books :

1. *S.K. Chakraborty and Dabangshu Chakraborty, "**Human Values and Ethics:Achieving Holistic Excellence**", ICFAI University Press, 2006*
2. *A.N Tripathy, "**Human Values**",**New Age International publishers,**2003*
3. *M.Govindarajan,S.Natarajan and V.S. Senthil kumar, "**Engineering Ethics (including human values)**", Eastern Economy Edition,Printice Hall of India Ltd., 2004*
4. *E.G.Seebauer and Rober.L.Berry, "**Fundamentals of Ethics for Scientists and Engineers**",Oxford University Press,2000*

COURSE OUTCOME:

Upon completion of this course the students will be able to

- **CO1:** Start exploring themselves, get comfortable to each other and to the teacher and start finding the need and relevance for the course.
- **CO2:** See that their practice in living is not in harmony with their natural acceptance most of the time and able to refer to their natural acceptance to remove this disharmony.
- **CO3:** Aware of their activities like understanding, desire, thought and selection and start finding their focus of attention at different moments.
- **CO4:** Able to see that respect is right evaluation and only right evaluation leads to fulfilment in relationship.
- **CO5:** Develop an understanding of the whole existence and interconnectedness in nature.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	-	-	-	-	-	M	-	M	M	M	-	-	-	-
CO2	-	-	-	-	-	-	-	-	L	-	-	-	-	-	-
CO3	-	-	-	-	-	H	H	-	M	H	M	-	-	-	-
CO4	-	-	-	-	-	L	-	-	-	-	-	M	-	-	-
CO5	-	-	-	-	-	L	M	-	-	-	-	-	-	-	-
16EOC1Z1	-	-	-	-	-	L	M	-	M	H	M	M	-	-	-

L – Low, M – Moderate (Medium), H- High

16EOCX02 HUMAN VALUES AND PROFESSIONAL ETHICS Category : OC

(Common to all branches)

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

- Engineering ethics and human value
- Social responsibility of an Engineer
- Ethical dilemma while discharging duties in professional life.

UNIT-I : ENGINEERING ETHICS	**(05)**
Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy – Kohlberg's theory – Gilligen's theory – Consensus and controversy – Models of Professional roles – Theories about right actions – Self interest – Customs and religion – Uses of ethical theories - Valuing time – Cooperation – Commitment.	
UNIT-II : ENGINEERING AS SOCIAL EXPERIMENTATION	**(05)**
Engineering as experimentation – Engineers as responsible experimenters – Codes of ethics – A balanced outlook on law – The challenger case study – Engineers as managers – Consulting engineers – Moral leadership.	
UNIT-III : SAFETY, RESPONSIBILITIES, RIGHTS AND GLOBAL ISSUES	**(05)**
Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing risk – The three mile island and Chernobyl case studies - Environmental ethics – Computer ethics – Weapons development – Multinational corporations – Engineers as expert witnesses and advisors.	

Contact periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical : 0 periods Total: 15 Periods

Text Books:

1. *Mike Martin and Roland Schinzinger "**Ethics in Engineering**" McGraw Hill, New York, 1996*
2. *M. Govindarajan, S. Natarajan and V.S. Senthil kumar "**Engineering Ethics (including human values)**" Eastern Economy Edition, Printice Hall of India Ltd., 2004*

Reference Books :

1. *Charles D.Flenddermann, "**Engineering Ethics**", Pearson Education, 2004.*
2. *Edmund G seebauer and Robert L. Berry, **"Fundamentals of Ethics for Scientists and Engineers**", 2001, Oxford University Press*
3. *Charles E. Harries, Michael S. Protchard and Michael J. Rabins, "**Engineering Ethics-concepts and Cases**", Thomson Learning, 2000.*
4. *John R. Boatright,"**Ethics and Conduct of Business**", Pearson Education, 2003.*

COURSE OUTCOME:

Upon completion of this course the students will be able to

- **CO1:** understand and appreciate human values, exhibit self confidence and develop good character.
- **CO2:** Sense engineering ethics, professional roles valuing time, co-operation and commitment.
- **CO3:** understand and practise code of ethics.
- **CO4:** Assess safety and risk and capable of doing risk benefit analysis.
- **CO5:** Develop and exhibit moral leadership qualities in exercising engineering consultations without compromising environmental, legal and ethical issues.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	-	-	-	-	M	-	-	M	-	-	-	-	-	-
CO2	-	-	-	-	-	H	-	M	H	-	-	-	-	-	-
CO3	-	-	-	-	-	M	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	H	-	-	-	-	-	L	-	-	-
CO5	-	-	-	-	-	-	M	-	H	-	-	H	-	-	-
16EOCX02	-	-	-	-	-	H	M	M	H	-	-	H	-	-	-

L – Low, M – Moderate (Medium), H- High

16EOCX03 **YOGA FOR YOUTH EMPOWERMENT** **Category: OC**

L	T	P	C
1	0	0	1

PRE-REQUISTE: NIL

COURSE OBJECTIVES:

- To create awareness and the benefits of yoga and meditation
- To study and analyze the influential factors, which affect the engineering students' healthy life

UNIT-I : PHYSICAL STRUCTURE AND ITS FUNCTIONS	**(05)**
Yoga - Purpose of life, philosophy of life, Physical structure, Importance of physical exercise, Rules and regulation of simplified physical exercises, hand exercise, leg exercise, breathing exercise, eye exercise, kapalapathy, maharasana, body massage, acupressure, body relaxation	
UNIT-II : ENGINEERING AS SOCIAL EXPERIMENTATION	**(05)**
Rules & Regulations – asana, pranayama, mudra, bandha	
UNIT-III : SAFETY, RESPONSIBILITIES, RIGHTS AND GLOBAL ISSUES	**(05)**
Bio magnetism& mind - imprinting & magnifying – eight essential factors of living beings, Mental frequency and ten stages of mind, benefits of meditation, such as perspicacity, magnanimity, receptivity, adaptability, creativity, Simplified Kundalini yoga: Agna, Santhi, thuriam, thuriyatheetham.	

Contact periods:

Lecture: 15 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 15 Periods**

Text Books:

1. *Yoga for Modern Age – Vethathiri Maharashi*

Reference Book:

1. *Mind – Vethathiri Maharashi*

COURSE OUTCOMES:

Upon completion of the course, student will be able to

- **CO 1:** YOGA which gives healthy & better living, Physical, Mental mood, Intellectual & spiritual.
- **CO 2:** Work skillfully and perfectly towards the excellence.
- **CO 3:** achieve meditation practices, which strengthen the mind and increases the will power,
- **CO 4:** Concentration, creativity and ultimately to transform the mind to achieve self-realization

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	-	-	-	-	-	H	-	-	-	-	-	-	L	-	-
CO2	-	-	-	-	-	-	-	-	M	-	-	-	-	L	-
CO3	-	-	-	-	-	-	L	-	-	-	L	-	L	-	L
16EOCX03	-	-	-	-	-	L	L	-	L	-	L	-	L	L	L

L – Low, M – Moderate (Medium), H- High

16EOCX04 **EMBEDDED CONTROLLERS** **Category: OC**

L	T	P	C
1	0	0	1

PRE-REQUISITES:

1. 16EES2Z5 Programming in C
2. 16EPC502 Microprocessor, Microcontroller and Applications

COURSE OBJECTIVE:

- To disseminate the expertise of embedded systems to develop control techniques for realistic applications

COURSE CONTENT:

Basic concepts-architecture - Programming techniques –PWM Generation, Motor Control, ADC/DAC and LCD and Sensor –Interfacing.

1. Design with Microcontrollers (PIC Microcontrollers)
2. Design with FPGA based controllers using system generator tool
3. Design with Digital signal processors(TMS320C2XXX)

Contact Periods:

Practical: 15periods **Total: 15 Periods**

Text Book:

1. PIC 16F87X microcontroller, user manual microchip technology Inc,2013.
2. TMS 320C28X DSP user manual, Texas instruments, 2015.
3. Xilinx System Generator for DSP, user guide, Xilinx Inc, 2009

COURSE OUTCOME

CO1: Review of basic programming skills
CO2: To explain the different tool for embedded software development
CO3: To design hardware components for diverse applications.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	-	-	H	-	-	-	-	-	-	H	H	-	-
CO2	M	H	-	M	H	-	-	-	-	-	-	H	H	H	M
CO3	H	-	-	H	-	-	M	-	-	-	M	M	-	M	H
16EOCX04	H	H	-	M	H	-	L	-	-	-	L	H	H	M	M

L – Low, M – Moderate (Medium), H- High

16EOCX05 WIND ENERGY CONVERSION SYSTEM Category: OC

L	T	P	C
1	0	0	1

PRE-REQUISITES:

1. 16EPC503 Rotating AC Machinery and Special Machines
2. 16EPC601 Power Electronic(s) Devices and Circuits

COURSE OBJECTIVE:

- To demonstrate the principle of wind energy conversion and explore the applications of power electronics.

COURSE CONTENT:

1. Introduction to wind energy conversion system(WECS)
2. Emulation of aero dynamic characteristics of wind turbine
3. Working principle of induction generator
4. Role of power electronic converters in WECS

Contact Periods:

Practical: 15periods Tutorial: 0 Periods Practical : 0 periods Total: 15 Periods

Text Book:

1. *B.H.Khan "**Non-conventional energy resources**" MC-Graw Hill pvt.Ltd,New Delhi second edition,2014.*

Reference Book:

1. Thomas Ackermann "***Wind power in power systems***", Wiley, second edition2012.

COURSE OUTCOME:

CO1: Review the concepts of electromechanical energy conversion
CO2: To understand the working principle of aero generators.
CO3: To design the power electronic topologies and control techniques for wind energy Conversion system

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	-	-	M	-	-	-	-	H	H	-	-
CO2	H	M	H	-	-	-	H	-	H	-	-	-	H	H	M
CO3	H	H	M	-	H	-	H	-	-	-	-	H	-	H	M
16EOCX05	H	M	M	M	H	-	H	-	H	-	-	H	H	H	M

L-Low, M- Moderate (Medium), H-High

16EOCX06 PRACTICAL ASPECTS OF VAR CONTROL AND ENERGY STORAGE DEVICES **Category: OC**

L	T	P	C
1	0	0	1

PRE-REQUITE: NIL

COURSE OBJECTIVE:

- To study the basic issues, challenges in the Var control, understand the concepts of energy storage devices.

UNIT- I : PRACTICAL ASPECTS OF VAR CONTROL AND ENERGY STORAGE DEVICE	**(15)**
Basic principles and operation of Var Control - Influence of Var Control in wind form - Field study of STATCOM - Study of different types of energy storage devices - Selection criteria for batteries in electronic gadgets - Case study of Energy storage devices .	

Contact Periods:

Lecture: 15periods Tutorial: 0 Periods Practical : 0 periods Total: 15 Periods

Text Books:

1. *Timothy, J.E.Miller, "Reactivepower control in electrical systems",Wiley, 1st Edition, 2010.*
2. *Leizhang, Hansanliu,Andy sun, "Electrochemical technologies for energy storage and conversion", Wiley, 2nd Volume,2010*

References Books:

1. *AbhijtChakrabarthi, D.P.Kothari,A.K,Mukhopadhyay"An introduction to reactive power control and voltage stability in power systems", Jhon Wiley & Sons Ltd., Vol.21,2010*
2. *Detlef Stolten "Hydrogen and fuel cells: Fundamentals,Technologies and Applications", Wiley, 2nd Edition, 2012*

COURSE OUTCOME:

On completion of this course, students will be able to

CO1: Understanding and design of STATCOM

CO2: Understanding and design of Energy storage devices

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	L	M	L	H	L	-	-	L	-	L	M	L	M	-	H
CO2	L	M	L	H	L	-	-	L	-	L	M	L	M	-	H
16EOCX06	L	M	L	H	L	-	-	L	-	L	M	L	M	-	H

L- Low, M – Moderate (Medium), H – High

16EOCX07 ELECTRICAL WIRING, WINDING AND EARTHING, REPAIRING OF HOUSEHOLD APPLIANCES **Category: OC**

L	T	P	C
1	0	0	1

PRE-REQUISTE: NIL

COURSE OBJECTIVE:

* To develop an ability and skill to design the feasible protection systems needed for each main part of a power system in students.

LIST OF EXPERIMENTS:

1. Conductors, Insulators & its types
2. Crimping & Crimping Tools, Soldering
3. Joints in Electrical Conductor
4. Concept of gauge of wire, conductor
5. Determination of Fuse size according to the load of circuit and its location
6. Study of different components used in house wiring.
7. Concept of earthing, purpose & types
8. Pipe earthing & Plate earthing
9. Earthing of domestic installation
10. Use of Megger & Test lamps in fault location
11. Energy meter installation
12. Repair and service technique of home appliances

Contact Periods:

Lecture: 15periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 15 Periods**

Text Books :

1. *Phil Simons, "**Electrical Wiring Residential**".*
2. *J. Coker and W. Turner, **"Electric Wiring**".*

Reference Book:

1. *Dr.Subharansu Sekhar Dash, Dr.K.Vijayakumar, "**Electrical Engineering Practice Lab Manual**".*

COURSE OUTCOMES:

CO1: Know about various protective systems- how it works and where it works?

CO2: Different applications of the relays, circuit breakers, grounding for different elements of power system

CO3: Ability to discuss recovery and Restriking.

CO4: Ability to express Oil circuit Breaker, Air Blast circuit Breakers, SF6 Circuit Breaker.

CO5: Abiity to identify DMT,IDMT type relays

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	M	H	L	L	-	-	M	-	-	H	M	M
CO2	H	M	H	H	M	M	-	-	L	M	-	L	M	H	H
CO3	M	M	M	M	H	M	L	L	-	L	-	L	L	M	M
CO4	H	M	L	M	H	L	-	-	-	-	-	L	H	M	L
CO5	M	L	L	M	H	M	L	L	-	-	-	L	M	H	L
16EOCX07	H	M	M	M	H	M	L	L	L	M	-	L	M	M	M

L- Low, M – Moderate (Medium), H – High

16EOCX08 SIMULATION OF ELECTRICAL SYSTEMS AND CONTROL USING DIGSILENT **Category: OC**

L	T	P	C
1	0	0	1

PRE-REQUISITE:

1. 16EPC602- Power System Analysis
2. 16EPC406Power Generation and Utilization

COURSE OBJECTIVES:

- To study about the electrical power systems through simulation using DIGSILENT software.

LIST OF EXPERIMENTS:

1. Load Flow Calculation and Its Application Using DIGSILENT
2. Dynamic wind turbine models in power system simulation tool DIGSILENT
3. Modeling of Automatic Generation Control in Power Systems
4. Parameterized Modal Analysis Using DIGSILENT
5. Implementation of Simplified Models of Local Controller for Multi-terminal HVDC Systems in DIGSILENT.

Contact Periods:

Lecture: 15periods Tutorial: 0 Periods Practical : 0 periods Total: 15 Periods

Text Books:

1. *Francisco Gonzalez-Longatt, José Luis Rueda, "Power Factory Applications for Power System Analysis", Springer, 2014*

References Books:

1. *D.P.Kothari and I.J.Nagrath, "Power System Engineering", Tata McGraw Hill, Third Reprint 2008*
2. *HadiSaadat, "Power System Analysis", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.*

COURSE OUTCOMES:

CO1: Enrich the knowledge on power system analysis, operation and control.
CO2: Analyze the performance of power system under steady and transient state.
CO3: Evaluate the power system with the help of digital simulation

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	M	L	L	L	H	H	L	L	H	H	L	H	L	M
CO2	H	M	L	H	H	L	H	M	M	H	H	M	L	H	H
CO3	L	L	H	H	M	L	H	M	H	H	H	H	M	H	H
16EOCX08	M	M	M	M	M	M	H	M	M	H	H	M	M	M	H

L- Low, M – Moderate (Medium), H – High

16EOCX09 DISTRIBUTED GENERATION AND ITS IMPACTS Category: OC

PRE-REQUISTE: NIL

L	T	P	C
1	0	0	1

COURSE OBJECTIVE:

* To impart knowledge about the concepts of distribution generation and its impact on power system.

UNIT-I : INTRODUCTION	**(05)**
Solar – Small Hydro – Wind Generation – Fuel cells – Microturbine - Generation Technology – Environmental impact – Cost benefits – Optimal location of Distributed Generation	
UNIT-II : IMPACT OF DISTRIBUTED GENERATION	**(05)**
Impact of Distributed Generation on Voltage profile – Equipment Loading – Losses – Short Circuit Level – Stability – Protection and Relay Coordination – Harmonic and Power Quality- Regulation of the electric sector impact on distributed generation	
UNIT-III : DISTRIBUTED GENERATION PROTECTION	**(05)**
Distributed grids protection - Relaying and protection, distributed generation interconnection relaying, sensing using CTs and PTs. - Intentional and unintentional islanding of distribution systems. Problems in distributed grids - Solutions	

Contact periods:
Lecture: 15 Periods Tutorial: 0 Periods Practical : 0 periods Total: 15 Periods

Text Books:

1. *Anne-Marie Borbely, Jan F. Kreider "**Distributed Generation: The Power Paradigm for the New Millennium**" CRC Press,2001*
2. *Math H. Bollen, Fainan Hassan* "***Integration of Distributed Generation in the Power System***" *July 2011, Wiley-IEEE Press*

Reference Books:

1. *Gregory W. Massey, "**Essentials of Distributed Generation Systems**" Jones & Bartlett Learning, 2010.*
2. *Jim Thornycroft, "**Distribution System Constraints and Their Impact on Distributed Generation**", DTI, 2004.*
3. *H. Lee Willis**, "Distributed Power Generation: Planning and Evaluation**" , CRC Press, 2000*

COURSE OUTCOME:

CO1: Revise the concept of renewable energy system
CO2: Compare the renewable energy systems
CO3: Explain the concept, impact and protection of distribution generation
CO4: Examine the effects of distributed generation on control, protection, standards and economic aspects.
CO5: Identify the Impact of Distributed Generation
CO6: Demonstrate the economic and financial aspects of distributed generation

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	-	L	L	-	-	L	-	L	H	M	M
CO2	M	H	M	M	-	L	-	L	-	L	-	L	H	H	M
CO3	H	M	H	H	-	L	-	-	-	L	L	L	H	H	H
CO4	M	H	H	H	-	L	L	L	-	L	L	L	M	H	H
CO5	M	H	M	M	-	L	-	-	-	L	-	L	M	H	M
CO6	H	H	M	M	-	L	L	L	-	L	L	L	H	H	H
16EOCX09	H	H	M	M	-	L	L	L	-	L	L	L	H	H	H

L-Low, M- Moderate (Medium), H-High

16EOCX10 **SOLAR POWER PLANT - DESIGN** **Category: OC**

L	T	P	C
1	0	0	1

PRE-REQUITE: NIL

COURSE OBJECTIVE:

* To gain knowledge on basics of designing and installing solar power plant. Also the various factors and features that influence the location and efficiency of the solar power plant by considering solar PV system building environment and the climatic conditions.

UNIT-I : PV Cells and Inverter selection	**(05)**
Introduction - Characteristics of a Solar Cell - Power Characteristics - Fill factor and Equivalent Solar cell Circuit - STC and NOCT - Factors Which Affect the Performance of Solar Cells -Types of Solar Cells Inverters Selection and Sizing (Grid Connection and Off Grid): Purpose of inverters - Grid-Connected Inverters vs. Stand - Alone Inverters - Types of Grid - Connected inverters - Isolated Inverters - PV to Inverter Interface - Inverter Protection Systems - Power Quality Module Mounting Systems: Introduction - Calculating the Wind Loading of the Solar Array - Roof Mounted Systems - PV Array Row Spacing - Ground Mounted Systems Solar Power Plant Balance of System: Introduction – Cabling - Array String Protection and Disconnect Switches - Lightning Protection - Array Junction Box – PV Main Disconnection Devices - Metering; System Monitoring: Local and/or Web Based Display	
UNIT-II : Energy Efficiency and Calculation, site survey, inverter sizing	**(05)**
Energy Efficiency Measures - Overview of Passive Solar Design Principles Solar power Plant Site Survey & Assessment: Introduction - Undertaking a Site Assessment - Choosing a PV Module - Choosing an Inverter - Choosing a Mounting System Type - Determining the Maximum Number of Modules That Can Fit on a Roof Matching Array and Inverter Sizing: Matching The PV Array to the voltage specifications of an inverter - Matching the PV Array to the inverter's current rating - Matching the PVArray to the Inverter's Power Rating - Summary of Calculations for Matching Array and Inverter	
UNIT-III : Solar Power Plant System Protection, Plant installation	**(05)**
Determining the Protection Equipment and Switching - PV Array Maximum Voltage - Circuit Protection: Over-Current - Disconnection Devices - System Earthing - Connecting the System to the Grid; System Losses of Solar Power Plant - Determining the Size of the DC and AC Cables - Losses in a Grid - Connected PV System Solar Power System Yield Performance(Energy Guarantee): What Determines the Energy of a System - Calculating the Energy Yield for a PV Grid - Connected System - Specific Yield - Performance Ratio - CUF Calculation Plant Installation And Commissioning: IEC Standards - Equipment Selection – Warranties - Installation Preparation - Equipment Installation - Monitoring Equipment – Commissioning - System Documentation - System Installation & Pre-Commissioning Checklist - Commissioning Test Sheets Smart metering and Net Metering	

Contact periods:
Lecture: 15 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 15 Periods**

Text Books:

1. *Micahel Boxwell "**Solar electricity handbook**" 2012 edition*
2. *Deutsche gesellschaft fur, Sonnenene DGS "**Planning & Installing photovoltaic sytem**" Earth scan Publication II edition 2006.*

Reference Book:

1. *Peter gevovkia* **"Large Scale Solar Power System design"** *Mc graw hill-2011.*
2. *Augustin mcEvoy, Tom Markuart, Luis Castaner* **"Solar cells"** *ELSEVIEN Publication II edition 2013.*

COURSE OUTCOME:

CO1: To provide a general overview on solar energy resources and on technologies to utilise solar energy in power production.

CO2: To obtain a good general understanding on solar photovoltaic (PV) power production technologies

CO3: To explore solar PV power systems operating in various environmental conditions.

CO4: Basics understanding on solar PV power plants as electrical systems and their electrical safety and lightning protection will be obtained.

CO5: To explain and argue plausibly on the forthcoming development of solar PV market and its role in power production in the future.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	L	M	H	-	M	M	L	-	M	L	H	H	M	M	M
CO2	L	L	M	L	-	-	-	L	M	L	L	-	M	M	M
CO3	L	-	-	-	-	L	M	-	M	-	-	L	-	M	M
CO4	-	-	L	L	-	-	L	L	H	-	H	-	M	M	M
CO5	L	-	L	L	L	M	H	L	H	H	H	H	H	M	M
16EOCX10	L	M	L	L	M	M	L	L	M	L	H	H	M	M	M

L-Low, M- Moderate (Medium), H-High

16EOCX11 **ENERGY CONSERVATION** **Category: OC**

L	T	P	C
1	0	0	1

PRE-REQUISITES:

1. 16EPC406 Power Generation And Utilization

COURSE OBJECTIVES:

* To acquire knowledge on conventional and energy efficient lighting schemes with energy conservation prospective.

COURSE CONTENT:

1. Conventional lighting sources(Domestic/commercial/industrial lighting)
2. Energy efficient light sources
3. Lighting controls
4. Electricity audit instruments
5. Energy consumption models
6. assessment and Evaluation methods
7. Energy conservation in lighting schemes
8. Case studies.

Contact periods:

Lecture: 15 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 15 Periods**

Text books

1. *Soni M.L., Gupta P.V., Bhatnagar U.S., "**A Course in Electric Power**", Dhanpat Rai and Sons, New Delhi, 2005*
2. *Rajput R.K., "**Utilization of Electrical Power**", Laxmi Publications Pvt. Ltd, New Delhi, 2008*

COURSE OUTCOMES:

CO1: Study of lighting schemes for Domestic/commercial/industrial
CO2: Learning the energy efficient lighting scheme
CO3: Analyse the performance of conventional and energy efficient lighting schemes
CO4: Identify the demand supply gap of energy in Indian scenario
CO5: Select appropriate energy conservation method to reduce the wastage of energy
CO6: Evaluate the techno economic feasibility of the energy conservation technique adopted

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	M	M	M	L	L	L	M	L	M	H	H	-	-
CO2	H	M	H	H	H	L	L	L	M	L	H	H	H	-	-
CO3	H	H	M	H	M	M	M	L	L	L	M	M	-	H	-
CO4	H	H	H	H	H	L	L	L	M	L	M	H	-	H	-
CO5	H	M	M	M	M	L	L	L	M	L	M	M	-	-	H
CO6	H	H	H	H	H	M	M	M	L	M	H	H	-	-	H
16EOCX11	H	H	H	H	H	L	L	L	M	L	M	H	H	H	H

L-Low, M- Moderate (Medium), H-High

16EOCX12 **POWER SYSTEM PLANNING** **Category: OC**

PRE-REQUISITE:

L T P C

1 0 0 1

1. 16EPC406 Power Generation and Utilization

COURSE OBJECTIVES:

- To study the way of power system planning in the design of power system with respect to the power requirement

UNIT - I	**(3)**
Power System planning: Introduction, National and regional planning, structure of power system, planning tools, electricity regulation, Load forecasting, forecasting techniques, modeling.	
UNIT - II	**(4)**
Generation planning, Integrated power generation, co-generation / captive power, power pooling and power trading, transmission & distribution planning	
UNIT - III	**(4)**
Power system economics: power sector finance, financial planning, private participation, rural electrification investment, concept of rational tariffs.	
UNIT - IV	**(4)**
Computer aided planning: Wheeling, environmental effects, green house effect, technological impacts, insulation co-ordination and reactive compensation.	

Contact periods:

Lecture: 15 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 15 Periods**

Text Books:

1. *Hossein Seifi, Mohammad Sadegh Sepasian, "**Electric Power System Planning: Issues, Algorithms and Solutions**", Springer, 2011*

Reference Books:

1. *Elkarmi, Fawwaz, "**Power System Planning Technologies and Applications: Concepts, Solutions and Management**", Technology & Engineering,2012*
2. *Juergen Schlabbach, Karl-Heinz Rofalski, "**Power System Engineering: Planning, Design, and Operation of Power Systems and Equipment**", John Wiley & Sons, 2014*

COURSE OUTCOMES:

CO1: Enrich the knowledge on planning of power generation, transmission and distribution.
CO2: Analyze the performance of planned power system.
CO3: Evaluate the designed power system

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	M	M	L	L	L	H	H	L	L	H	H	L	H	L	M
CO2	H	M	L	H	H	L	H	M	M	H	H	L	M	H	H
CO3	L	L	H	H	M	L	H	M	H	H	H	H	L	H	H
16EOCX12	M	M	M	M	M	M	H	M	M	H	H	M	M	M	H

L-Low, M- Moderate (Medium), H-High

16EOCX13 **POWER SYSTEM DEREGULATION** **Category : OC**

PRE-REQUISTE: NIL

L	T	P	C
1	0	0	1

COURSE OBJECTIVE:

- To understand how the Power Market operates in a deregulated Electrical Power Industry.

COURSE CONTENT:

1. Introduction
2. Unbundling of electric utilities
3. Fundamentals of Deregulated Markets
4. Role of the independent system operator (ISO)
5. Operational planning activities of ISO:
   I. ISO in Pool markets
   II. ISO in Bilateral markets
6. Power wheeling
7. Security management in deregulated environment
8. Congestion management in deregulation
9. Ancillary services management in various countries
10. Reactive power management in some deregulated electricity markets.

Contact periods:

Lecture: 15 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 15 Periods**

Text Books:

1. *Geoffrey Rothwell, Tomás Gómez "**Electricity Economics: Regulation and Deregulation**".*
2. *Loi Lei Lai **"Power System Restructuring and Deregulation: Trading, Performance and Information Technology"***

Reference Books:

1. ***Power System Economics: Designing markets for electricity** - S. Stoft*
2. ***Power generation, operation and control**, -J. Wood and B. F. Wollenberg*
3. ***Operation of restructured power systems** - K. Bhattacharya, M.H.J. Bollen and J.E. Daalder*
4. ***Market operations in electric power systems** - M. Shahidehpour, H. Yamin and Z. Li*
5. ***Fundamentals of power system economics** - S. Kirschen and G. Strbac*
6. ***Competition and Choice in Electricity** - Sally Hunt and Graham Shuttleworth*

COURSE OUTCOMES:

- **CO1:** **Know** the significance of generation planning and transmission planning for power system reliability and security assessment.
- **CO2:** **Analyze** and **distinguish** load forecasting and price forecasting methods
- **CO3:** Analyze the power system reliability and security assessment under deregulated environmental.
- **CO4:** To analyze the concepts of locational marginal pricing and financial transmission rights.
- **CO5:** To Illustrate about various power sectors in India

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	L	M	H	-	M	M	L	-	M	L	H	H	M	M	M
CO2	L	L	M	L	-	-	-	L	M	L	L	-	M	M	M
CO3	L	-	-	-	-	L	M	-	M	-	-	L	-	M	M
CO4	-	-	L	L	-	-	L	L	H	-	H	-	M	M	M
CO5	L	-	L	L	L	M	H	L	H	H	H	H	H	M	M
16EOCX13	L	M	L	L	M	M	L	L	M	L	H	H	M	M	M

L-Low, M- Moderate (Medium), H-High

16EOCX14 **ENERGY POLICIES** **Category: OC**

PRE-REQUITE: NIL

L	T	P	C
1	0	0	1

COURSE OBJECTIVE:

- To provide students with a thorough grounding in the key concepts of energy policies**.**

COURSE CONTENT:

1. Introduction
2. Need of energy policy
3. Overview Of Low-Impact Renewable Energy Technologies
4. Energy Planning Tools
5. Energy System Planning For India
6. Policy Framework For Promotion Of Renewables In India
7. Foreign Investment Policy
8. Foreign Investment Implementation Authority (FIIA)
9. Industrial Policy
10. Joint Ventures Policies
11. Policies for Small-Scale Industries
12. Challenges And Constraints

Contact periods:

Lecture: 15 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 15 Periods**

Text Books:

1. *Carol A. Dahl,* ***"International Energy Markets: Understanding Pricing, Policies, and Profits", Tulsa: Pennwell.***
2. *Peter M. VanDoren,* ***"Politics, Markets, and Congressional Policy Choices"***

Reference Books:

1. *Roland Wengenmayr,* ***"Renewable Energy: Sustainable Energy Concepts for the Energy Change"***
2. *Ferdinand E. Banks,* ***"Energy Economics: A Modern Introduction , Kluwer Academic".***
3. *J.M. Conrad and C.W. Clark,* ***"Natural Resource Economics, Cambridge University Press".***
4. *R. Perman, Y. Ma, J. McGilvray and M. Common,* ***" Natural Resource and Environmental Economics",*** *3rd edition, Pearson Education, Harlow.*
5. *J.M. Hartwick and N.D. Olewiler,* ***"The Economics of Natural Resource Use",*** *2nd edition, Addison Wesley .*

COURSE OUTCOMES:

- **CO1:** To illustrate how these concepts and standard economic tools can be used to analyse energy-related policy issues.
- **CO2:** To be able to apply this knowledge to the analysis of specific energy issues in India.
- **CO3:** To understand Synopsis of earlier National Energy Policies in India
- **CO4:** To illustrate how these concepts and standard economic tools can be used to analyse energy-related policy issues.
- **CO5:** To be able to apply this knowledge to the analysis of specific energy issues in India.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	L	M	H	-	M	M	L	-	M	L	H	H	M	M	M
CO2	L	L	M	L	-	-	-	L	M	L	L	-	M	M	M
CO3	L	-	-	-	-	L	M	-	M	-	-	L	-	M	M
CO4	-	-	L	L	-	-	L	L	H	-	H	-	M	M	M
CO5	L	-	L	L	L	M	H	L	H	H	H	H	H	M	M
16EOCX14	L	M	L	L	M	M	L	L	M	L	H	H	M	M	M

L-Low, M- Moderate (Medium), H-High

16EOCX15 **PCB DESIGN AND FABRICATION** **Category:OC**

L	T	P	C
1	0	0	1

PRE-REQUISITES:

1. 16EPC304 Electronic Circuits - I

COURSE OBJECTIVES:

- To acquire knowledge on Circuit board designing in assembling and testing of PCD based electronics circuits and become familiar with the simulation software

COURSE CONTENT:

1. Introduction to PCB Designing
2. Scope of PCB Designing
3. Hardware on Breadboard
4. Software Description
5. Design circuit on PCB software (Proteus, Express PCB, ARES)
6. Schematic Layout
7. Board creation
8. Fabrication Process
9. Design of single sided PCB

Contact periods:

Lecture: 15 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 15 Periods**

Text Books:

1. *R.S.Khandpur, **" Printed Circuit Boards: Design, Fabrication, Assembly and Testing",** Tata McGraw –Hill Education, 2005.*
2. *Jan Axelson, **" Making Printed Circuit Boards",** TAB Books, 1993.*

COURSE OUTCOMES:

- **CO1:** An ability to apply knowledge of mathematics, science and engineering
- **CO2:** An ability to design and conduct experiments as well as to analyze and interpret data
- **CO3:** Make schematic electronic circuits in the software
- **CO4:** Design and develop layout of PCB using PCB layout design tool with fabrication
- **CO5:** Design and fabricate simple electronic equipment prototype for demonstration, development and experimentation purposes
- **CO6:** An understanding of professional and ethical responsibility

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	H	H	M	M	L	L	L	M	H	H	-	-
CO2	H	H	H	H	M	M	M	M	L	M	H	H	H	-	-
CO3	H	M	L	M	M	M	L	M	L	M	H	H	-	H	-
CO4	H	H	H	M	M	M	M	M	L	L	M	M	-	H	-
CO5	H	H	H	H	H	M	M	L	M	L	M	H	-	-	H
CO6	H	H	M	M	M	M	M	L	L	L	M	M	-	-	H
16EOCX15	H	H	H	M	M	M	M	M	L	L	M	H	H	H	H

L-Low, M- Moderate (Medium), H-High

16EOCX16 **HOME AUTOMATION** **Category: OE**

L	T	P	C
1	0	0	1

PRE-REQUISITES*:*

1. 16EPC304- Electronic Circuits – I
2. 16EPC404- Electronic Circuits – II
3. 16EPC405- Digital Circuits

COURSE OBJECTIVES:

* Ability to design and develop project by applying the knowledge acquired in the field of electrical and electronics engineering

COURSE CONTENT:

1. Automatic fan control under varying weather condition
2. Automatic home security system
3. Automatic water pump control system
4. Automatic plant watering system
5. Automatic detection of gas leakage and warning system
6. Automatic car parking system

Contact periods:
Lecture: 15 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 15 Periods**

Text Books:

1. *Robert L.Boylestad, "**Electronic Devices and Circuit theory**", 2002*
2. *Floyd, "**Electron Devices**" Pearson Asia 5th Edition, 2001.*
3. *D.Roy Choudhary, Sheil B.Jani, '**Linear Integrated Circuits'**, II edition, New Age, 2003.*
4. *ARDUINO, user manual, Revision 02, 2014*
5. *James Gerhart **"Home Automation and Wiring"**, McGraw Hill Professional, 1999*

Reference Books:

1. *Donald A Neamen, "**Electronic Circuit Analysis and Design**" Tata McGraw Hill, 3rd Edition, 2003.*

COURSE OUTCOMES:

CO1: Design, implement and evaluate the solutions of engineering problems
CO2: Understand the impact of the professional engineering solutions in societal and environmental contexts
CO3: Comply with current trends through lifelong learning and to develop entrepreneurial skills

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	H	H	M	M	M	H	M	H	H	M	H	M	H	M
CO2	M	M	M	M	H	M	H	M	M	M	M	L	H	M	H
CO3	M	M	M	M	M	L	M	L	M	M	H	H	M	M	M
16EOCX16	M	M	M	M	M	M	H	M	M	M	M	M	M	M	M

L-Low, M- Moderate (Medium), H-High

16EOCX17 **ELECTRICAL SAFETY** **Category : OC**

PRE-REQUISITES: NIL

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

* To gain skills in identifying the presence of electrical hazards, implementing measures to minimise risks and develop skills in investigative techniques for determining the cause of electrical accidents, fires and explosions.

UNIT-I : ELECTRICAL HAZARDS	**(08)**
Primary and secondary hazards - Human safety in the use of electricity. Energy leakage - Clearances and insulation - Current surges- Heating effects of current - Electromagnetic forces - Corona effect - Static electricity – Definition, sources, hazardous conditions, electrical causes of fire and explosion - Ionization, spark and arcignition energy - National electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – Earthing, specifications, earth resistance, earth pit maintenance - Indian electricity act and rules - Statutory requirements from electrical inspectorate	
UNIT-II : PROTECTION SYSTEMS	**(07)**
Fuse, circuit breakers and overload relays – Protection against over voltage and under voltage – Safe limits of amperage – Voltage – Safe distance from lines - Protection against Electric Shock - Protection against Direct Contact - Protection against Thermal Effects – Grounding - Emergency Switching - Protective devices - Safety in handling hand held electrical appliances tools	

Contact Periods :
Lecture: 15 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 15 Periods**

Text Books:

1. *W. Fordham Cooper "**Electrical Safety Engineering**" second edition, Butterworth & Co., 1986*
2. *D.C. Winburn "**Practical Electrical Safety**" Marcel Dekker Inc., 1988*

Reference Books:

1. *John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, "**Electrical Safety Handbook**", 3rd edition, McGraw-Hill, 2006.*
2. *J. Maxwell Adams, "**ELECTRICAL SAFETY - a guide to the causes and prevention of electrical hazards**", The Institution of Electrical Engineers, 1994.*
3. ***Indian Electricity Act and Rules**, Government of India.*

COURSE OUTCOME:

CO1: Explain the hazards of electricity and effects.
CO2: Select appropriate personal protective equipment for a variety of applications.
CO3: Control electrical hazards by following safety procedures and using appropriate protective **r**equipment.
CO4: Employ Safe Work Practices when working with and around electricity.
CO5: Assess and provide solutions to a practical case study.
CO6: Write a formal engineering report with independent conclusions.

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	-	M	M	-	-	L	-	L	H	M	M
CO2	M	M	-	-	-	M	M	L	-	L	-	L	H	H	H
CO3	H	-	M	-	-	M	M	M	-	-	-	L	M	H	H
CO4	M	-	L	L		H	M	M	-	-	-	L	H	H	H
CO5	M	H	M	M	-	M	M	M	-	L	L	L	M	H	M
CO6	H	-	-	M	-	-	-	-	H	H	L	L	M	H	M
16EOCX17	H	M	M	M	-	M	M	M	L	L	L	L	H	H	H

L-Low, M- Moderate (Medium), H-High

16EOCX18 **PLUG-IN ELECTRIC VEHICLE** **Category: OC**

L	T	P	C
1	0	0	1

PRE-REQUISTE: NIL

COURSE OBJECTIVES:

- To learn the basics and understand the concepts of plug-in Electric Vehicle.

UNIT- I	PLUG-IN ELECTRIC VEHICLE	(15)
Concept and testing of different types of motors for EV- Study of different types of batteries for EV- Study of different charging methods - Selection of motor ratings - Case study of PEV		

Contact Periods :

Lecture: 15 Periods Tutorial: 0 Periods Practical : 0 periods Total: 15 Periods

Text books:

1. David B. Sandalow "**Plug-in electrical vehicles**", Booking institution press, 2nd Edition,2010

Reference Books:

1. Sherry Boschert "**Plug-in Hybrids**", New Society Publisher, 1st Edition, 2006

COURSE OUTCOME:

On completion of this course, students will be able to

CO1: Examine the operation of various Plug-in electric vehicle

CO2: Design a suitable power supplies for different electric vehicle

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	L	L	-	L	-	L	-	L	L	-	-	-	L	-
CO2	-	L	M	H	-	-	-	L	L	-	-	M	M	M	-
16EOCX18	M	L	M	M	L	-	L	L	L	L	-	L	L	M	-

L-Low, M- Moderate (Medium), H-High

16EOCX19 **LVDC SYSTEMS** **Category : OC**

L	T	P	C
1	0	0	1

PRE-REQISTE: NIL

COURSE OBJECTIVES:

- To elucidate the concept and the resilience potential of LVDC systems

UNIT-I : LVDC SYSTEMS	**(15)**
LVDC Distribution System Topologies - LVDC System Connections - Grounding Arrangement and DC Voltage Level – Cables - LVDC Network Grounding Arrangement – Faults in LVDC microgirds - Protection scheme – LVDC Appliances - Standards	

Contact Periods :
Lecture: 15 Periods **Tutorial: 0 Periods** **Practical : 0 periods** **Total: 15 Periods**

Text books:

1. *European Commission, " **Low Voltage Directive**", LVD 2006/95/EC. European Union Directive, Brussels 2006.*
2. *SFS 6000 –" **Low Voltage Electrical Installations and Safety at Electrical Work"**. National Low Voltage Standard –series. SESKO Standardization in Finland*
3. *Kaipia T, Salonen P, Lassila J and Partanen J, "**Possibilities of the Low Voltage DC distribution Systems**". Stockholm, 2006.*

Reference books:

1. *Salonen P, "**Exploitation Possibilities of DC in Electricity Distribution"**. Master's thesis. Lappeenranta University of Technology. Lappeenranta, 2006.*
2. *Partanen J, Pyrhönen, J, Silventoinen P, Niemelä M, Lindh T, Kaipia T, Salonen P, Nuutinen P, Peltoniemi P, Lassila J. "**Power Electronics in Electricity Distribution**" – project part 1/2. Research report. Lappeenranta University of Technology, Lappeenranta 2008.*

COURSE OUTCOME:

CO1: Explain the concept of LVDC system
CO2: Elaborate the importance of distribution through LVDC system
CO3: Identify the significance of DC over AC
CO4: Classify the distribution system topologies
CO5: Develop the Protection scheme for LVDC
CO6: Carry out the standards while working with LVDC

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	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	H	M	M	M	-	M	M	-	-	L	-	L	H	M	M
CO2	M	M	H	-	-	M	M	L	-	L	-	L	H	H	H
CO3	H	M	M	-	-	M	M	M	-	-	-	L	M	H	H
CO4	M	H	M	L		H	M	M	-	-	-	L	H	H	H
CO5	M	H	M	M	-	M	M	M	-	L	L	L	M	H	M
CO6	H	-	H	M	-	-	-	-	H	H	L	L	M	H	M
16EOCX19	H	M	M	M	-	M	M	M	L	L	L	L	H	H	H

L- Low, M – Moderate (Medium), H – High

16EOCX20 STUDY OF WEATHER MONITORING SYSTEM Category : OC

L	T	P	C
1	0	0	1

PREREQUISITE: NIL

COURSE OBJECTIVE:

* To Interpret The Application Of Weather Monitoring Station In Research Activities.

COURSE CONTENT:

1. Description of Weather Monitoring station.
2. Data Logger and Software
3. Communications
4. Troubleshooting and Maintenance.
5. Case Studies

Contact Periods :

Lecture: 15 Periods Tutorial: 0 Periods Practical : 0 periods Total: 15 Periods

Text Book:

1. *Stephen Burt, "**The weather observers handbook**", Cambridge University Press, 2012.*

Reference Book:

1. *User Manual on "**Weather monitoring station**" , Met One Instruments, Inc, Oregon, 2*014.

COURSE OUTCOMES:

CO1: To understand the role of weather monitoring station in analysis and design

CO2: To know the usage of software and data logger

CO3: To evaluate the applications of weather monitoring station

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	H	H	H	H	L	L	L	L	M
CO2	H	H	H	H	M	M	L	L	L	L	L
CO3	H	H	H	M	M	M	L	L	L	L	L
16EOCX20	H	H	H	H	M	M	L	L	L	L	L

L- Low, M – Moderate (Medium), H – High