GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE – 641 013

B. E. ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM & SYLLABI

REGULATIONS

2018

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY

COIMBATORE – 641 013

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 behaviors 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.

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 enhance the ability of 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)

Engineering Graduates will be able to:

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

2. 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.

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

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

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

6. 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.

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

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

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

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

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

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

PROGRAMME SPECIFIC OUTCOMES (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 electrical 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.

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FIRST SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks
		Induction Programme	MC	0	0	0

Details of the Programme:

Number of Days: 21 Days

Day0: College Admission

Day1: Orientation Programme

Day2: Registration.

Day3 to Day 23 : Induction Programme

Activities:
Physical activity,
Playground Events,
Yoga Practices,
Literary, Proficiency modules,
Team Building,
Lectures by Eminent people,
Familiarization to department,
Branch oriented information,
Motivational speakers,
Talent exposure,
Quiz completion,
Visit to local areas….etc.

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FIRST SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18EHS101	Communicative English	HS	50	50	100	2	1	0	3
2	18EBS102	Calculus and Differential Equations	BS	50	50	100	3	1	0	4
3	18EBS103	Waves, Optics and Introduction to Quantum Mechanics	BS	50	50	100	3	1	0	4
4	18EES104	Programming in C	ES	50	50	100	3	0	0	3
		PRACTICAL								
5	18EBS105	Physics Laboratory	BS	50	50	100	0	0	3	1.5
6	18EES106	Workshop Practice	ES	50	50	100	1	0	4	3
7	18EES107	Programming in C Laboratory	ES	50	50	100	0	0	3	1.5
		TOTAL		350	350	700				20

SECOND SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18EBS201	Applied Chemistry	BS	50	50	100	3	1	0	4
2	18EBS202	Linear Algebra, Numerical Methods and Transform Calculus	BS	50	50	100	3	1	0	4
3	18EES203	Basics of Civil and Mechanical Engineering	ES	50	50	100	4	0	1	4.5
		PRACTICAL								
4	18EBS204	Chemistry Laboratory	BS	50	50	100	0	0	3	1.5
5	18EES205	Engineering Graphics	ES	50	50	100	2	0	4	4
		TOTAL		250	250	500				18

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THIRD SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18EES301	Object Oriented Programming with C++	ES	50	50	100	3	0	0	3
2	18EPC302	Electric Circuit Theory	PC	50	50	100	3	1	0	4
3	18EPC303	Field Theory	PC	50	50	100	3	0	0	3
4	18EPC304	Electronic Devices and Circuits	PC	50	50	100	3	0	0	3
5	18EPC305	Electrical Machines - I	PC	50	50	100	3	0	0	3
6	18EPC306	Digital Circuits	PC	50	50	100	3	0	0	3
		PRACTICAL								
7	18EES307	Object Oriented Programming Using C++ Laboratory	ES	50	50	100	0	0	3	1.5
8	18EPC308	Electric Circuits and Electronic Devices Laboratory	PC	50	50	100	0	0	3	1.5
9	18EPC309	Electrical Machines Laboratory – I	PC	50	50	100	0	0	3	1.5
		TOTAL		**450**	**450**	**900**	**18**	**1**	**9**	**23.5**

FOURTH SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18EBS401	Probability and Applied Statistics	BS	50	50	100	3	1	0	4
2	18EES402	Engineering Mechanics	ES	50	50	100	3	1	0	4
3	18EPC403	Principles of Signals and Systems	PC	50	50	100	3	0	0	3
4	18EPC404	Linear Integrated Circuits	PC	50	50	100	3	0	0	3
5	18EPC405	Electrical Machines - II	PC	50	50	100	3	0	0	3
6	18EPC406	Electrical and Electronic Measurements	PC	50	50	100	3	0	0	3
7	18EMC4Z7	Constitution of India	MC	50	50	100	3	0	0	0
		PRACTICAL								
8	18EPC408	Analog Circuits and Digital IC Laboratory	PC	50	50	100	0	0	3	1.5
9	18EPC409	Electrical Machines Laboratory –II	PC	50	50	100	0	0	3	1.5
		TOTAL		**450**	**450**	**900**	**21**	**2**	**6**	**23**

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FIFTH SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18EHS501	Business Communication Skills	HS	50	50	100	3	0	0	3
2	18EPC502	Power Generation, Transmission and Distribution	PC	50	50	100	3	0	0	3
3	18EPC503	Microprocessors, Microcontrollers and Applications	PC	50	50	100	3	0	0	3
4	18EPC504	Control Systems Engineering	PC	50	50	100	3	1	0	4
5	18#OE5XX	Open Elective – I	OE	50	50	100	3	0	0	3
6	18EMC5Z6	Environmental Sciences and Engineering	MC	50	50	100	3	0	0	0
		PRACTICAL								
7	18EPC507	Microprocessors and Microcontrollers Laboratory	PC	50	50	100	0	0	3	1.5
8	18EEE508	Communication skills laboratory	EEC	50	50	100	0	0	3	1.5
		TOTAL		**400**	**400**	**800**	**18**	**1**	**6**	**19**

SIXTH SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18EHS601	Technology Management	HS	50	50	100	3	0	0	3
2	18EPC602	Power System Analysis	PC	50	50	100	3	0	0	3
3	18EPC603	Power Electronic Devices and Circuits	PC	50	50	100	3	0	0	3
4	18EPE6XX	Professional Elective – I	PE	50	50	100	3	0	0	3
5	18#OE6XX	Open Elective – II	OE	50	50	100	3	0	0	3
6	18#OE6XX	Open Elective – III	OE	50	50	100	3	0	0	3
		PRACTICAL								
7	18EPC607	Power Electronics and Drives Laboratory	PC	50	50	100	0	0	3	1.5
8	18EPC608	Measurements and Control Systems Laboratory	PC	50	50	100	0	0	3	1.5
9	18EVL609	Virtual Laboratory in Electrical Engineering	PC	50	50	100	0	0	2	1
		TOTAL		**400**	**400**	**800**	**18**	**0**	**8**	**22**

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SEVENTH SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18EHS701	Professional Ethics	HS	50	50	100	3	0	0	3
2	18EPC702	Power System Operation, Control and Protection	PC	50	50	100	3	0	0	3
3	18EPE7XX	Professional Elective – II	PE	50	50	100	3	0	0	3
4	18EPE7XX	Professional Elective – III	PE	50	50	100	3	0	0	3
5	18EPE7XX	Professional Elective – IV	PE	50	50	100	3	0	0	3
6	18#OE7XX	Open Elective – IV	OE	50	50	100	3	0	0	3
		PRACTICAL								
7	18EPC707	Power System Laboratory	PC	50	50	100	0	0	3	1.5
8	18EEE708	Mini Project	EEC	50	50	100	0	0	8	4
		TOTAL		**400**	**400**	**800**	**18**	**0**	**11**	**23.5**

EIGHTH SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18EPE8XX	Professional Elective – V	PE	50	50	100	3	0	0	3
2	18EPE8XX	Professional Elective – VI	PE	50	50	100	3	0	0	3
		PRACTICAL								
3	18EEE803	Project Work	EEC	50	50	100	0	0	16	8
		TOTAL		**150**	**150**	**300**	**6**	**0**	**16**	**14**

Total Credits: 20+18+23.5+23+19+22+23.5+14=163

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT (HS)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18EHS101	Communicative English	HS	50	50	100	2	1	0	3
2	18EHS501	Business Communication Skills	HS	50	50	100	3	0	0	3
3	18EHS601	Technology Management	HS	50	50	100	3	0	0	3
4	18EHS701	Professional Ethics	HS	50	50	100	3	0	0	3

BASIC SCIENCES (BS)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18EBS102	Calculus and Differential Equations	BS	50	50	100	3	1	0	4
2	18EBS103	Waves and Optics and Introduction to Quantum Mechanics	BS	50	50	100	3	1	0	4
3	18EBS105	Physics Laboratory	BS	50	50	100	0	0	3	1.5
4	18EBS201	Applied Chemistry	BS	50	50	100	3	1	0	4
5	18EBS202	Linear algebra, Numerical methods and Transform calculus	BS	50	50	100	3	1	0	4
6	18EBS204	Chemistry Laboratory	BS	50	50	100	0	0	3	1.5
7	18EBS401	Probability and Applied Statistics	BS	50	50	100	3	1	0	4

ENGINEERING SCIENCES (ES)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18EES104	Programming in C	ES	50	50	100	3	0	0	3
2	18EES106	Workshop Practice	ES	50	50	100	1	0	4	3
3	18EES107	Programming in C Laboratory	ES	50	50	100	0	0	3	1.5
4	18EES203	Basics of Civil and Mechanical Engineering	ES	50	50	100	4	0	1	4.5
5	18EES205	Engineering Graphics	ES	50	50	100	2	0	4	4
6	18EES301	Object Oriented Programming with C++	ES	50	50	100	3	0	0	3
7	18EES307	Object Oriented Programming Using C++ Laboratory	ES	50	50	100	0	0	3	1.5
8	18EES402	Engineering Mechanics	ES	50	50	100	3	1	0	4

PROFESSIONAL CORE (PC)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18EPC302	Electric Circuit Theory	PC	50	50	100	3	1	0	4
2	18EPC303	Field Theory	PC	50	50	100	3	0	0	3
3	18EPC304	Electronic Devices and Circuits	PC	50	50	100	3	0	0	3
4	18EPC305	Electrical Machines - I	PC	50	50	100	3	0	0	3
5	18EPC306	Digital Circuits	PC	50	50	100	3	0	0	3
6	18EPC308	Electric Circuits and Electronic Devices Laboratory	PC	50	50	100	0	0	3	1.5
7	18EPC309	Electrical Machines Laboratory – I	PC	50	50	100	0	0	3	1.5
8	18EPC403	Principles of Signals and Systems	PC	50	50	100	3	0	0	3
9	18EPC404	Linear Integrated Circuits	PC	50	50	100	3	0	0	3
10	18EPC405	Electrical Machines - II	PC	50	50	100	3	0	0	3
11	18EPC406	Electrical and Electronic Measurements	PC	50	50	100	3	0	0	3
12	18EPC408	Analog Circuits and Digital IC Laboratory	PC	50	50	100	0	0	3	1.5
13	18EPC409	Electrical Machines Laboratory – II	PC	50	50	100	0	0	3	1.5
14	18EPC502	Power Generation, Transmission and Distribution	PC	50	50	100	3	0	0	3
15	18EPC503	Microprocessors, Microcontrollers and Applications	PC	50	50	100	3	0	0	3
16	18EPC504	Control Systems Engineering	PC	50	50	100	3	1	0	4
17	18EPC507	Microprocessors and Microcontrollers Laboratory	PC	50	50	100	0	0	3	1.5
18	18EPC602	Power System Analysis	PC	50	50	100	3	0	0	3
19	18EPC603	Power Electronic Devices and Circuits	PC	50	50	100	3	0	0	3
20	18EPC607	Power Electronics and Drives Laboratory	PC	50	50	100	0	0	3	1.5
21	18EPC608	Measurements and Control Systems Laboratory	PC	50	50	100	0	0	3	1.5
22	18EVL609	Virtual Laboratory in Electrical Engineering	PC	50	50	100	0	0	2	1
23	18EPC702	Power System Operation, Control and Protection	PC	50	50	100	3	0	0	3
24	18EPC707	Power System Laboratory	PC	50	50	100	0	0	3	1.5

PROFESSIONAL ELECTIVES (PE)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18EPE$01	Principles of Virtual Instrumentation	PE	50	50	100	3	0	0	3
2	18EPE$02	Neural and Fuzzy Systems	PE	50	50	100	3	0	0	3
3	18EPE$03	Power System Economics	PE	50	50	100	3	0	0	3
4	18EPE$04	Power Quality Engineering	PE	50	50	100	3	0	0	3
5	18EPE$05	HVDC Transmission Systems	PE	50	50	100	3	0	0	3
6	18EPE$06	Facts Controllers	PE	50	50	100	3	0	0	3
7	18EPE$07	Energy Auditing and Management	PE	50	50	100	3	0	0	3
8	18EPE$08	Automotive Electronics for Electrical Engineering	PE	50	50	100	3	0	0	3
9	18EPE$09	Power System Stability	PE	50	50	100	3	0	0	3
10	18EPE$10	Power Plant Instrumentation	PE	50	50	100	3	0	0	3
11	18EPE$11	Digital Signal Processing and Processors	PE	50	50	100	3	0	0	3
12	18EPE$12	Computer System Architecture	PE	50	50	100	3	0	0	3
13	18EPE$13	Principles of Embedded Systems	PE	50	50	100	3	0	0	3
14	18EPE$14	Special Machines and Controllers	PE	50	50	100	3	0	0	3
15	18EPE$15	Logic and Distributed Control Systems	PE	50	50	100	3	0	0	3
16	18EPE$16	Restructured Power Systems	PE	50	50	100	3	0	0	3
17	18EPE$17	Solid State Relays	PE	50	50	100	3	0	0	3
18	18EPE$18	Mems and Applications	PE	50	50	100	3	0	0	3
19	18EPE$19	Biomedical Instrumentation	PE	50	50	100	3	0	0	3
20	18EPE$20	Industrial Drives and Control	PE	50	50	100	3	0	0	3
21	18EPE$21	Energy Storage Technology	PE	50	50	100	3	0	0	3
22	18EPE$22	Optimization Techniques	PE	50	50	100	3	0	0	3
23	18EPE$23	Electrical Machine Design	PE	50	50	100	3	0	0	3
24	18EPE$24	Smart Grid Technology	PE	50	50	100	3	0	0	3
25	18EPE$25	Modern Control Theory	PE	50	50	100	3	0	0	3
26	18EPE$26	Distributed Generation and Microgrid	PE	50	50	100	3	0	0	3
27	18EPE$27	Electronic Circuit Design	PE	50	50	100	3	0	0	3
28	18EPE$28	Electronic System Design And Productization	PE	50	50	100	3	0	0	3

OPEN ELECTIVES (O.E)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	18COE$01	Climate Change and Adaptation	OE	50	50	100	3	0	0	3
2.	18COE$02	Disaster Management and Mitigation	OE	50	50	100	3	0	0	3
3.	18COE$03	Energy Efficient Buildings	OE	50	50	100	3	0	0	3
4.	18MOE$04	Nanotechnology and Surface Engineering	OE	50	50	100	3	0	0	3
5.	18MOE$05	Mechatronics	OE	50	50	100	3	0	0	3
6.	18EOE$07	Renewable Power Generation Systems	OE	50	50	100	3	0	0	3
7.	18EOE$08	Electric Vehicles	OE	50	50	100	3	0	0	3
8.	18EOE$09	Smart Grid Systems	OE	50	50	100	3	0	0	3
9.	18LOE$10	Mobile Communication	OE	50	50	100	3	0	0	3
10.	18LOE$11	Introduction to VLSI System Design	OE	50	50	100	3	0	0	3
11.	18LOE$12	Microcontroller and Applications	OE	50	50	100	3	0	0	3
12.	18POE$13	Rapid Prototyping	OE	50	50	100	3	0	0	3
13.	18POE$14	Managerial Economics	OE	50	50	100	3	0	0	3
14.	18POE$15	Hydraulics and Pneumatics	OE	50	50	100	3	0	0	3
15.	18NOE$16	Measurement and Control	OE	50	50	100	3	0	0	3
16.	18NOE$17	Industrial Automation	OE	50	50	100	3	0	0	3
17.	18NOE$18	Virtual Instrumentation	OE	50	50	100	3	0	0	3
18.	18SOE$19	Programming in Java	OE	50	50	100	3	0	0	3
19.	18SOE$20	Cyber Security	OE	50	50	100	3	0	0	3
20.	18SOE$21	Network Essentials	OE	50	50	100	3	0	0	3
21.	18IOE$22	Programming in Python	OE	50	50	100	3	0	0	3
22.	18IOE$23	Big Data Science	OE	50	50	100	3	0	0	3
23.	18IOE$24	Object Oriented Programming Using C++	OE	50	50	100	3	0	0	3
24.	18BOE$25	Computational Biology	OE	50	50	100	3	0	0	3
25.	18BOE$26	Fundamental Concepts of Biology for Engineers	OE	50	50	100	3	0	0	3
26.	18BOE$27	Fundamentals of Bioengineering	OE	50	50	100	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC) – PRACTICAL COURSES AND PROJECT WORK

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18EEE508	Communication Skills Laboratory	EEC	50	50	100	0	0	3	1.5
2	18EEE708	Mini Project	EEC	50	50	100	0	0	8	4
3	18EEE803	Project Work	EEC	50	50	100	0	0	16	8

MANDATORY COURSE (MC) (NO - CREDIT)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18EMC4Z7	Constitution of India	MC	50	50	100	3	0	0	0
2	18EMC5Z6	Environmental Science and Engineering	MC	50	50	100	3	0	0	0

VALUE ADDED COURSES (VA) ONE CREDIT

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18EVA$01	Yoga for Youth Empowerment	VA	100	-	100	1	0	0	1
2	18EVA$02	Electrical Wiring, Winding and Earthing, Repairing of Household Appliances	VA	100	-	100	1	0	0	1
3	18EVA$03	Simulation of Electrical Systems And Control using DIgSILENT	VA	100	-	100	1	0	0	1
4	18EVA$04	Solar Power Plant-Design	VA	100	-	100	1	0	0	1
5	18EVA$05	PCB Design and Fabrication	VA	100	-	100	1	0	0	1
6	18EVA$06	Home Automation	VA	100	-	100	1	0	0	1
7	18EVA$07	Electrical Safety	VA	100	-	100	1	0	0	1
8	18EVA$08	Plug-In Electric Vehicle	VA	100	-	100	1	0	0	1
9	18EVA$09	Study of Weather Monitoring System	VA	100	-	100	1	0	0	1
10	18EVA$10	Online Course (NPTEL/SWAYAM)	VA	100	-	100	1	0	0	1

SUMMARY OF CREDIT DISTRIBUTION

B.E / B.TECH												
Sl. No.	**Course Work Subject Area**	**Credits Per Semester**								**Total Credits**	**% of credit**	**AICTE Credit Range**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**			
1	HS	3	-	-	-	3	3	3	-	**12**	**7.36**	**12**
2	BS	9.5	9.5	0	4	-	-	-	-	**23**	**14.11**	**25**
3	ES	7.5	8.5	4.5	4	-	-	-	-	**24.5**	**15.03**	**24**
4	PC	-	-	19	15	11.5	10	4.5	-	**60**	**36.81**	**48**
5	PE	-	-	-	-	-	3	9	6	**18**	**11.04**	**18**
6	OE	-	-	-	-	3	6	3	-	**12**	**7.36**	**18**
7	EEC	-	-	-	-	1.5	-	4	8	**13.5**	**8.28**	**15**
8	MC	0	-	-	0	0	-	-	-	**0**	**0**	**0**
	Total	**20**	**18**	**23.5**	**23**	**19**	**22**	**23.5**	**14**	**163**	**100**	**160**

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

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

OE – Open Elective; EEC– Employability Enhancement Course;

MC – Mandatory Course; VA-Value Added

18EHS101	COMMUNICATIVE ENGLISH *(Common to all Branches)*	SEMESTER: I

Category : HS

PRE-REQUISTE: NIL

L	T	P	C
2	1	0	3

COURSE OBJECTIVES:

The course is intended to

- Make learners listen to audio files and replicate in speaking contexts
- Make learners read widely and practice it in writing
- Make learners develop vocabulary and strengthen grammatical understanding

UNIT-I : LISTENING	**(6+3 Periods)**
Listening Comprehension, Pronunciation, Intonation, Stress, Pause, Rhythm, Listening to Short & Long Conversations/Monologues - Note-Taking.	
UNIT-II : SPEAKING	**(6+3 Periods)**
Self Introduction, Making Oral & Formal Presentation, Communication at Work Place, Mock Interviews, Role Play Activities, Group Discussions, Debates, Delivering Welcome Address, Proposing Vote of Thanks, Introducing the Chief Guest at a function.	
UNIT-III : READING	**(6+3 Periods)**
Reading Comprehension, Speed Reading, Interpreting Visual Materials (Signs, Post Cards Pictures, Labels Etc.), Reading for Specific Information-Reading to identify Stylistic Features (Syntax, Lexis, Sentence Structures)-Cloze Test.	
UNIT-IV : WRITING	**(6+3 Periods)**
Phrase, Clause And Sentence Structures, Punctuation, Discourse Markers, Coherence, Precision in Writing, Graph & Process Description-Definition, Writing Email-Paraphrasing, Note making, Job Application With Resume, Writing Review of a Book / Movie, Creative Writing.	
UNIT-V : GRAMMAR AND VOCABULARY	**(6+3 Periods)**
Word Formation with Prefix and Suffix, Synonyms and Antonyms, Tenses, Parts of Speech, Common Errors in English (Subject –Verb Agreement, Noun-Pronoun Agreement, Prepositions, Articles, Conditional statements, Redundancies, Clichés etc), Voices.	

Contact periods:

Lecture: 30 Periods Tutorial:15 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Board of Editors, **"Using English"**,* Orient Black Swan, 2015.

REFERENCE BOOKS:

1. ***"Practical English Usage"***, Michael Swan. OUP 1995.
2. ***"Cambridge BEC Vantage"*** - Practice Tests, Self-study Edition, CUP, 2002.
3. ***"Exercises in Spoken English"***. Parts. I –III. EFLU, Hyderabad, OUP, 2014.
4. ***"Indlish"***. Jyothi Sanyal, Viva Books, 2006.
5. ***"Communicative English"***. J.Anbazhagan Vijay, Global Publishers, Chennai. 2018.

WEB REFERENCES

1. *www.cambridgeenglish.org/exams/business.../business-**preliminary**/*
2. *http://www.examenglish.com/BEC/BEC_Vantage.html*
3. *www.splendid-speaking.com/exams/**bec**_speaking.htmlhtml*

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Enhance their listening capacity through various accents and discourse

CO2: Communicate better at various public meeting and work place environments

CO3: Read and strengthen their interpretive and linguistic skills

CO4: Write appropriately on technical, business and general contexts.

CO5: Understand the usage of grammar and vocabulary

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	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	M		H	H	M	H			H
CO2				H	H	L	M	M	H	H	M	L			H
CO3				H	H	L	M	M		H	M	H			H
CO4				H	H	L	M	M		H	M	L			H
CO5				L	H	L				H	M	H			H
18EHS101				M	H	L	M	L	L	H	M	M			H

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

18EBS102	CALCULUS AND DIFFERENTIAL EQUATIONS *(Common to EEE, ECE & EIE Branches)*	SEMESTER: I

Category: BS

PRE-REQUISTE: NIL

COURSE OBJECTIVES:

L	T	P	C
3	1	0	4

- To be familiarize with differentiation of single variable and its applications.
- To obtain the knowledge of integration and its applications.
- To acquire knowledge of differentiation for more than one variable and vector differentiation.
- To gain the knowledge of multiple integration and related applications and vector integration including theorems.
- To gain methods to solve second order differential equations with constant and variable coefficients.

UNIT-I: Differential Calculus	**(9+3 Periods)**
Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima, Evolute of a curve.	
UNIT-II: Integral Calculus	**(9+3 Periods)**
Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volume of revolution.	
UNIT-III: Multivariable Calculus (Differentiation)	**(9+3 Periods)**
Limit, continuity and partial derivatives, total derivative, Jacobians, Maxima, minima and saddle points, Method of Lagrange multipliers, Gradient, curl and divergence.	
UNIT-IV: Multivariable Calculus (Integration)	**(9+3 Periods)**
Multiple integration - Double integrals, change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Triple integrals (Cartesian), Change of variables (Cartesian to spherical polar). Theorems of Green, Gauss and Stokes, Simple applications involving cubes, sphere and rectangular parallelepipeds.	
UNIT-V : Ordinary differential equations of higher order	**(9+3 Periods)**
Second order linear differential equations with constant and variable coefficients: Cauchy-Euler equation, Cauchy-Legendre equation. Method of variation of parameters, Power series solutions of Bessel and Legendre equations.	

Contact periods:
Lecture: 45 Periods Tutorial:15 Periods Practical: 0 Periods Total: 60 Periods

TEXT BOOKS:

1. *Veerarajan T., "**Engineering Mathematics" (for first year)**, Tata McGraw-Hill, New Delhi,2008.*
2. *Srimanta Pal and suboth.C.Bhunia, **"Engineering Mathematics"**, Oxford university publications, New Delhi, 2015.*

REFERENCE BOOKS:

1. *B.S.Grewal, **"Higher Engineering Mathematics"**, Khanna Publishers, 43rdEdition,2015.*
2. *Erwinkreyszig, **"Advanced Engineering Mathematics"**, 9thEdition, John Wiley&Sons, 2006.*
3. *James Stewart, **"Essential Calculus"**, Cengage Learning, Delhi, 2ndEdition, 2013.*

4. *E. A. Coddington,* ***"An Introduction to Ordinary Differential Equations"****, Prentice Hall India, 1995.*
5. *G.F. Simmons and S.G. Krantz,* ***"Differential Equations"****, Tata McGraw Hill, 2007.*

COURSE OUTCOMES:

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

CO1: Understand the standard theorems and applications like maxima and minima, evolute of a curve using principles of differentiation.

CO2: Acquire fluency in integration of one variable for definite and improper integrals like beta and gamma functions and also applications of area and volumes.

CO3: Understand the techniques of partial differentiation and vector differentiation.

CO4: Understand multiple integration for finding area, surface and volume and applications to Green's, Stoke's and Gauss theorems under Vector Calculus.

CO5: Understand the general solutions to higher order differential equations and power series solutions to second order differential equations leading to Bessel and Legendre functions.

COURSE ARTICULATION MATRIX

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO2	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO3	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO4	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO5	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
18EBS102	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-

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

18EBS103	WAVES, OPTICS AND INTRODUCTION TO QUANTUM MECHANICS *(Common to EEE, ECE & EIE Branches)*	SEMESTER: I

Category: BS

PRE-REQUISTE: NIL

COURSE OBJECTIVES:

L	T	P	C
3	1	0	4

To improve the basic 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:

- Wave optics phenomenon, Huygens' principle, Interference of light
- Basic principles in lasers, characteristics, types of lasers and its applications
- Origin of quantum physics, Schrödinger's equation and its applications.
- Free electron theory, density of states in metals, Intrinsic and Extrinsic properties.
- Fiber optic principles and its applications.

UNIT-I : WAVE OPTICS	**(9+3 Periods)**
Huygens' Principle-superposition of waves and interference of light - Air wedge- Theory - Applications- Testing of flat surfaces –Thickness of a thin sheet of paper- Michelson interferometer-Theory-Applications-Determination of wavelength of monochromatic light.	
UNIT-II : LASER OPTICS	**(9+3 Periods)**
Einstein's theory of matter radiation interaction and A and B coefficients-amplification of light by population inversion-different types of lasers-gas laser-CO_2- solid state laser-Neodymium Nd-YAG laser-dye laser-properties of laser beams-monochromaticity-coherence-directionality and brightness-Applications of lasers in cutting, welding and materials processing.	
UNIT-III : INTRODUCTION TO QUANTUM MECHANICS	**(9+3 Periods)**
Limitations of classical Physics - Introduction to Quantum theory - Dual nature of matter and radiation- Properties of matter waves-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 .	
UNIT-IV : INTRODUCTION TO SOLIDS AND SEMICONDUCTORS	**(9+3 Periods)**
Quantum theory - Fermi distribution function - effect of temperature – density of energy states in metals-Semiconductors – Properties – elemental and compound semiconductors - Intrinsic and extrinsic semiconductors – properties - Carrier concentration in intrinsic Semiconductor - variation of Fermi level with temperature - extrinsic semiconductors - Carrier concentration in P-type and N-type semiconductors variation of Fermi level with temperature and impurity concentration.	
UNIT-V : FIBER OPTICS	**(9+3 Periods)**
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-Temperature and displacement.	

Contact periods:
Lecture: 45 Periods Tutorial:15 Periods Practical: 0 Periods Total: 60 Periods

TEXT BOOKS:

1. *Arumugam M-* **"*Engineering* Physics"**, *Anuradha Publishers, 2010. (Unit II, Unit III & Unit V)*
2. *P.K.Palanisamy-**"Engineering physics-II"** Scitech publications (India) pvt. Ltd 2015 (Unit IV)*

REFERENCE BOOKS:

1. *Avadhanulu M N and Kshirsagar P G,* **"*A Textbook of Engineering Physics*"**, *S.Chand and Company Ltd, New Delhi, 2010. (Unit I)*
2. *E.Hecht,* **"*Optics"**, McGraw Hill Education, 2012.*
3. *D.J.Griffiths,* **"*Quantum mechanics"**, Pearson Education, 2014*
4. *D.A.Neamen,* **"*Semiconductor Physics and Device's,* Times Mirror High Education Group, Chicago, 1997.*
5. *H.J.Pain,* **"*The physics of vibrations and waves",* Wiley, 2006.*
6. *O.Svelto,* **"*Principles of Lasers"**, Springer Science & Business Media, 2010.*

COURSE OUTCOMES:

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

CO1: Study the waves and optics phenomena- applications. [Familiarity& Assessment]

CO2: Analyze the construction and working of gas lasers and solid state lasers. [Familiarity & Applications]

CO3: Analyze the dual nature of matter using de-Broglie matter waves, Heisenberg's Uncertainty principle, Schrodinger's time independent and dependent wave equations. [Familiarity & Application]

CO4: List and analyze the properties of conducting and Semiconducting materials and devices. [Familiarity & Application]

CO5: Explain fiber optics and classify fibers based on index profiles and modes [Familiarity & Application]

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	L		L							L	M	L	
CO2	H	M	M		L							L	M	M	
CO3	H	H	L									L	M		
CO4	H	M	M		L							L	M	M	
CO5	H	M	M		L							L	L	L	
18EBS103	H	H	M		L							L	M	M	

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

18EES104	**PROGRAMMING IN C** *(Common to all branches except MECH & PRODN Branches)*	**SEMESTER: I**

Category :ES

PRE-REQUISTE: NIL

L	T	P	C
3	0	0	3

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.	

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

TEXT BOOKS:

1. *Pradip Dey, Manas Ghosh,* ***"Computer Fundamentals and Programming in C****", Second Edition, Oxford University Press, 2013.*
2. *Al Kelley, Ira Pohl,* ***"A Book on C-Programming in C"****, Fourth Edition, Addison Wesley, 2001.*

REFERENCE BOOKS:

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

COURSE OUTCOMES:

Upon completion of this 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 statements [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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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
18EES104	H	H	M	H	H		M	M	M	M	L	M	M	M	L

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

18EBS105	PHYSICS LABORATORY *(Common to all Branches)*	SEMESTER: I

Category: BS

PRE-REQUISTE: NIL

COURSE OBJECTIVES:

L	T	P	C
0	0	3	1.5

To improve the basic 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:

* To have a practical knowledge about the concepts of physics and its applications in the emerging fields of engineering and technology

LABORATORY EXPERIMENTS	
1.	Spectrometer - Diffraction Grating Normal Incidence Method
2	Air Wedge –Determination 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.	Determination of Bandgap Energy of Semiconductor
7.	Ultrasonic Interferometer - Velocity of sound & Compressibility of liquids.
8.	Torsional pendulum –Determination of Rigidity Modulus & Moment of Inertia

Contact periods:

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

COURSE OUTCOMES:

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

CO1: Determine all physical properties of any matter,

CO2: Calibrate electrical measuring instruments and thereby effectively using it for particular application

CO3: Understand principle of Laser diffraction and its application in particle size determination

CO4: Understand the concept of light propagation through optical fibers and determination of its parameters

CO5: Determine the Intrinsic characteristic features of electronic devices for electrical and electronic applications.

CO6: Understand the ultrasonic wave propagation in liquids and the determination of compressibility of liquids for engineering applications.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO															
CO1	H	M	L	L	M							L	M	M	M
CO2	H	M	L	M	L							L	M	M	M
CO3	H	M	L	L								L	L		
CO4	H	M	M	L	M							L	L	L	
CO5	H	M	M	L	M							L	M	M	M
CO6	H	M	M	M	M							L	M	M	M
18EBS105	H	M	M	M	M							L	M	M	M

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

18EES106	WORKSHOP PRACTICE *(Common to all branches)*	SEMESTER: I

Category : ES

PRE-REQUISTE: NIL

COURSE OBJECTIVES:

L	T	P	C
1	0	4	3

- 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	**(15+60 Periods)**
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	
9. CNC Machines demonstration and lecture on working principle.	
10. Additive manufacturing demonstration and lecture on working principle.	

Contact periods:

Lecture: 15 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total: 75 Periods**

COURSE OUTCOMES:

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

CO 1: Safely Use tools and equipment's used in Carpentry, Welding, Foundry and Sheet metal to create basic joints.

CO 2: Prepare sand mold for various basic pattern shapes.

CO 3: Fabricate parts like tray, frustum of cone and square box in sheet metal.

CO 4: Carry out minor works/repair related to electrical wiring and plumbing.

CO 5: Demonstrate the working of CNC machines and additive manufacturing.

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	H		L		L				L				L	L	
CO2	H		L		L				L				L	L	
CO3	H		L		L				L				L	L	
CO4	H		L		M				L				L	L	
CO5	H		L		H				L				L	L	
18EES106	H		L		M				L				L	L	

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

18EES107	PROGRAMMING IN C LABORATORY *(Common to all branches except MECH & PRODN branches)*	SEMESTER: I

Category : ES

PRE-REQUISTE: NIL

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

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

- 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

Contact periods:

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

COURSE OUTCOMES:

Upon completion of this course, 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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	M	H	H			M	M	M	M	M	H	M	L
18EES107	H	H	M	H	H			M	M	M	M	M	M	M	L

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

18EBS201	APPLIED CHEMISTRY *(Common to EEE, ECE, EIE, CSE & IT branches)*	SEMESTER: II

Category: BS

PRE-REQUISTE: NIL

L	T	P	C
3	1	0	4

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+3 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 - pH measurement using glass electrode and fluoride measurement by ISE.	
UNIT-II : BATTERIES	**(9+3 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+3 Periods)**
Corrosion- Spontaneity - Chemical corrosion- mechanism, nature of oxides – Pilliing Bedworth rule-electrochemical corrosion- mechanism-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 galvanizing – Organic coating- paints - constituents and functions.	
UNIT-IV : SPECTROSCOPIC TECHNIQUES AND APPLICATIONS	**(9+3 Periods)**
Beer Lambert's law -UV visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only)- Flame photometry- principle – instrumentation (block diagram only)- estimation of sodium by flame photometry- Atomic absorption spectroscopy – principles – instrumentation(block diagram only) – estimation of nickel by atomic absorption spectroscopy.	
UNIT-V : SILICON WAFER TECHNOLOGY	**(9+3 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.	

Contact periods:
Lecture: 45 Periods Tutorial:15 Periods Practical: 0 Periods Total: 60 Periods

TEXT BOOKS:

1. *Jain. P.C. and Monica Jain,* ***"Engineering Chemistry",*** *Dhanpat Rai Publications Pvt. Ltd, New Delhi, 16th Edition, 2017.*
2. *Vairam. S, Subha Ramesh,* ***"Engineering Chemistry"****, Wiley India, 2015.*

REFERENCE BOOKS:

1. *Dara. S.S, Umarae,* "***Text book of Engineering Chemistry",*** *S. Chand Publications, 2013.*
2. *M.S.Tyagi,* ***"Introduction to semiconductor materials and devices",*** *Wiley India, 2012.*
3. *Y R Sharma ,* ***"Elementary Organic Spectroscopy",*** *S. Chand Publications, 2013.*
4. *B.R. Puri, L.R. Sharma & M. S. Pathania,* **"*Principles of Physical Chemistry*"**, *S. Nagin Chand and Co., 2017*

COURSE OUTCOMES:

Upon completion of the course, the student 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 spectroscopic techniques and 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:

PO / **CO**	**PO 1**	**PO 2**	**PO 3**	**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	L	
CO2	L	L	L										H	L	
CO3	M	L	L										L		
CO4	L	M		L	L	L	L								
CO5	H	H				L	L						M	M	
18EBS201	M	M	L	L	L	L	L						M	L	

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

18EBS202	LINEAR ALGEBRA, NUMERICAL METHODS AND TRANSFORM CALCULUS *(Common to EEE, ECE & EIE branches)*	SEMESTER: II

Category: BS

PRE-REQUISTE: NIL

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To know about matrix theory to solve linear system and diagonalise a matrix by orthogonal transformation.
- To be familiar with numerical solutions of equation with one variable and 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.
- To be familiar with techniques of Laplace and Inverse Laplace transformation.

UNIT-I: Matrices	**(9+3 Periods)**
Inverse and rank of a matrix, System of linear equations, Eigenvalues and eigenvectors, Diagonalization of matrices, Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.	
UNIT-II: Interpolation, Numerical differentiation and integration	**(9+3 Periods)**
Solution of polynomial and transcendental equations: Newton-Raphson method. Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. Numerical Differentiation and integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.	
UNIT-III: Numerical solution of ordinary differential equations	**(9+3 Periods)**
Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods.	
UNIT-IV: Numerical solution of partial differential equations	**(9+3 Periods)**
Partial differential equations: Finite difference solution two dimensional Laplace equation and Poission equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.	
UNIT-V : Transform Calculus	**(9+3 Periods)**
Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ordinary differential equations by Laplace Transform method.	

Contact periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods

TEXT BOOKS :

1. *B.S.Grewal,* ***"Higher Engineering Mathematics"****, Khanna Publishers, New Delhi, 43rd Edition, 2015.*
2. *Srimanta Pal,* ***"Numerical Methods Principles, Analyses and Algorithms"****, Oxford University Press, New Delhi, I st Edition 2009.*

REFERENCE BOOKS:

1. *Erwinkreyszig,* ***"Advanced Engineering Mathematics"****,9th Edition, John Wiley & Sons, 2006.*
2. *N.P. Bali and Manish Goyal,B.,* ***"A text book of Engineering Mathematics"****, Laxmi Publications, Reprint, 2008.*
3. *D.Poole,* ***"Linear Algebra: A Modern Introduction"****, 2nd Edition, Brooks/Cole, 2005.*
4. *P. Kandasamy, K. Thilagavathy, K. Gunavathi,* ***"Numerical Methods"****, S. Chand & Company, 3rd Edition, Reprint 2013.*
5. *S.S. Sastry,* ***"Introductory methods of numerical analysis"****, PHI,New Delhi, 5th Edition, 2015.*
6. *Ward Cheney, David Kincaid,* ***"Numerical Methods and Computing",*** *Cengage Learning, Delhi, 7th Edition 2013.*

COURSE OUTCOMES:

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

CO1: Solve the linear system of equations by rank of a matrix and matrix inversion and understand the process of diagonalisation by orthogonal transformation.

CO2: Acquire fluency in numerical solution to equation by Newton Raphson method, numerical interpolation techniques with equal and unequal intervals, numerical differentiation and integration.

CO3: Understand numerical solution to first order ordinary differential equations by single step and multistep methods.

CO4: Understand numerical solution to second order partial differential equations using finite differences.

CO5: Understand how to find Laplace and Inverse Laplace transforms with applications.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO2	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO3	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO4	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
CO5	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-
18EBS202	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-

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

18EES203	BASICS OF CIVIL AND MECHANICAL ENGINEERING	SEMESTER: II

Category : ES

PRE-REQUISTE: NIL

COURSE OBJECTIVES:

L	T	P	C
4	0	1	4.5

- To impart knowledge on basics of Civil and Mechanical Engineering.
- To impart basic knowledge on manufacturing and machining processes.

PART A: CIVIL ENGINEERING	
UNIT-I : BUILDING MATERIALS AND CONSTRUCTION	**(10 Periods)**
Properties of Materials – Classification and Characteristics of building stones, bricks, timber, cement and concrete, reinforcing steel – Components of residential building – Ventilation and Lighting - Green building concepts. Precast construction. Soil classification – types of foundation.	
UNIT-II : WATER SUPPLY AND SANITARY ENGINEERING	**(10 Periods)**
Sources of water – Quality of water - Distribution of water - Hydrological cycle – methods of rain water harvesting. Sanitary Engineering – Systems of Sewerage - Collection, treatment and disposal of sewage.	
UNIT-III : IRRIGATION ENGINEERING AND TRANSPORTATION ENGINEERING	**(10 Periods)**
Irrigation Engineering – needs of irrigation – purpose and functions of storage structures – Dams – parts of the dam and their functions. Modes of transport – types, Roads – Classification of roads – Traffic signs and road marking. Railways – Components of permanent way.	
LABORATORY COMPONENT	**(15 Periods)**
BASICS OF CIVIL ENGINEERING • Visiting and demonstration of irrigation models available in Civil Department. • Study and demonstration of properties and uses of various building materials.	
PART B: MECHANICAL ENGINEERING	
UNIT-IV: ENERGY ENGINEERING	**(10 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	**(10 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	**(10 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	

Contact periods:

Lecture: 60Periods Tutorial: 0 Periods Practical: 15 Periods Total: 75 Periods

TEXT BOOKS:

1. *Ramamrutham S., **"Basic Civil Engineering"**, Dhanpat Rai Publishing Co.(P) Ltd. 2013*
2. *Seetharaman S., **"Basic Civil Engineering"**, Anuradha Agencies, 2005.*
3. *Bhavikaati S.S., **"Basic Civil Engineering and Engineering Mechanics"**, New Age International Publishers, New Delhi, 2011.*
4. *Kilbert C., **"Sustainable Construction: Green building design and delivery"**, John wiley & sons, 2005.*
5. *Venugopal. K **"Basic Mechanical Engineering"** Anuradha Publications, 3rd Edition, 2010.*
6. *Ramesh babu **"Basic Mechanical Engineering"** VRB Publishers Pvt. Ltd, 2007.*

REFERENCE BOOKS:

1. *R.C.Smith "**Materials of Construction**" Mc Graw Hill Publications, 1973.*
2. *Janardhana Jha "**Engineering materials**" Khanna Publishers, New Delhi, 1981.*
3. *P.C.Varghese "**Building Materials**" PHI Learning pvt. Ltd, New Delhi, 2015*
4. *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.*
5. *NPTEL Resource material "**Building Materials and Construction**"*
6. *Nagpal G.R "**Power Plant Engineering**" Khanna Publishers, New Delhi, 2002.*
7. *Jain R.K "**Production Technology**" Khanna Publishers, New Delhi, 2004*
8. *Shanmugam.G "**Basic Mechanical Engineering**" McGraw Hill Education (India) Pvt. Ltd, New Delhi, 4th Edition, 2013.*

COURSE OUTCOMES:

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

CO 1: To understand the properties and uses of building materials and concept of green building.

CO 2: To identify various sources of water, rain water harvesting and sewage disposal methods.

CO 3: To gain knowledge on various modes of transport and irrigation 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.

COURSEARTICULATIONMATRIX:

CO	PO 1	PO 2	PO 3	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	L		L	H						M		
CO2	M	M	L	L		L	H						H		
CO3	M	H	L	L		L	M						L		
CO4	M	M	L	L	M		L			M		M	L	M	M
CO5	M	L	M	L	M	M	H					M	L	H	H
CO6	H	H	M	M	M	L	M	M	L			M	M	M	M
18EES203	M	M	M	L	L	L	M	L	L	L		L	M	L	L

L-Low,M-Moderate(Medium),H–High

18EBS204	CHEMISTRY LABORATORY *(Common to all Branches)*	SEMESTER: II

Category: BS

PRE-REQUISTE: NIL

COURSE OBJECTIVES:

L	T	P	C
0	0	3	1.5

- To inculcate the practical applications of chemistry to students and make them apply in the fields of engineering and technology

LIST OF EXPERIMENTS	
1.	Estimation of hardness by EDTA method.
2	Estimation of chloride by Argentometric method.
3.	Conductometric titration of mixture of strong acid and weak acid using strong base.
4.	Potentiometric titration of ferrous iron by dichromate.
5.	Determination of Saponification value of an oil.
6.	Estimation of Iron by Spectrophotometry.
7.	Estimation of HCl by pH titration.
8.	Determination of the rate constant of reaction.
9.	Estimation of Dissolved Oxygen.

Contact periods:

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

REFERENCE BOOKS:

1. *A.O. Thomas, "**Practical Chemistry"**, Scientific Book Centre, Cannanore, 2003.*
2. *Vogel's "**Text book of Quantitative Analysis"**, Jeffery G H, Basset J. Menthom J, Denney R.C., 6th Edition, EBS, 2009.*

COURSE OUTCOMES:

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

CO1: Understand the nature of hardness using EDTA Complex

CO2 Iron present in water can be estimated and chloride level, pollution level using dissolved oxygen content.

CO3: Apply the EMF and conductometric measurements in quantitative analysis of Substances.

CO4: pH of the liquid sample will be analysed and hence strength of the sample can be estimated using pH Meter

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	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									
CO2	L	L	L		L	L							L		
CO3	M	L		M	M							L	M	L	
CO4	M	M		M	L										
18EBS204	M	L	L	L	L	L						L	L	L	

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

18EES205	ENGINEERING GRAPHICS *(Common to all Branches)*	SEMESTER: II

Category : ES

PRE-REQUISTE: NIL

COURSE OBJECTIVES:

L	T	P	C
2	0	4	4

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

UNIT-I : GEOMETRICAL CONSTRUCTIONS	**(6+12 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.	
UNIT-II : ORTHOGRAPHIC PROJECTIONS	**(6+12 Periods)**
Introduction to Orthographic Projection-Projection of points-Projection of straight lines with traces - Conversion of pictorial views to orthographic views-Projection of solids	
UNIT-III : SECTION OF SOLIDS AND DEVELOPMENT	**(6+12 Periods)**
Section of solids- Development of surfaces	
UNIT-IV : PICTORIAL VIEWS	**(6+12 Periods)**
Isometric projections - Conversion of orthographic views to pictorial views (simple objects).	
UNIT-V : COMPUTER AIDED DRAFTING	**(6+12 Periods)**
Introduction to computer aided drafting package to make 2-D Drawings. OBJECT CONSTRUCTION – page layout – Layers and Line type – Creating, Editing and selecting the Geometric Objects MECHANICS – Viewing, Annotating, Hatching and Dimensioning the drawing – Creating Blocks and Attributes, DRAFTING – Create 2D drawing. A number of chosen problems will be solved to illustrate the concepts clearly. (Demonstration purpose only, not be included in examinations)	

Contact periods:

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

TEXT BOOKS:

1. *K.Venugopal, **"Engineering Graphics"**, New Age International (P) Limited, 2015.*
2. *K.L.Narayana and P.Kannaiah, **"Text book on Engineering Drawing,"** 2nd Edition, SciTech Publications (India) Pvt. Ltd, Chennai, 2009.*

REFERENCE BOOKS:

1. *Dhananjay.A.Jolhe, **"Engineering Drawing"**, Tata McGraw Hill Publishing Co., 2007.*
2. *K.V.Nataraajan, **"A text book of Engineering Graphics"**, Dhanalakashmi Publishers, Chennai, 2006.*
3. *M.B.Shah and B.C. Rana, **"Engineering Drawing"**, Pearson Education, 2005.*
4. *Luzadder and Duff, **"Fundamentals of Engineering Drawing"**, Prentice Hall of India Pvt Ltd, XIth Edition, 2001.*
5. *Alan Kalameja, "**AutoCAD 2008: A tutor for Engineering Graphics",** Auto Desk Press 2007*
6. *CAD Software manuals of latest version.*

COURSE OUTCOMES:

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

CO1: Construct basic geometric shapes and dimension the drawing as per standards.

CO2: Project points, lines and solids in various positions, and convert 2D projections to pictorial projections.

CO3: Generate sectional views of solids and construct development drawings.

CO4: Generate and interrupt pictorial views.

CO5: Use AutoCAD to create simple Engineering Drawings.

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		M	L			M	M	L			M	
CO2			L		M	L			M	M	L			M	
CO3			L		H	L			M	M	L			M	
CO4			L		H	L			M	M	L			M	
CO5			L		H	L			M	M	L			M	
18EES205			L		H	L			M	M	L			M	

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

18EES301	OBJECT ORIENTED PROGRAMMING WITH C++	SEMESTER: III

Category : ES

PRE-REQUISITES:

1. 18EES104 Programming in C

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To be familiar with

- Basics of Object Oriented Programming Paradigms
- Classes and Objects
- Concepts of reusability using inheritance
- Basics of pointers and standard templates in C++
- File and String handling operations

UNIT – I : INTRODUCTION	**(9 Periods)**
Object Oriented Programming Paradigm – Advantages – Object Oriented Languages – I/O in C++. Declaration - Control Structures and Decision Making - if else, goto, break, continue, switch case statements. Loops in C++: for, while, do - Functions in C++ - Inline functions – Function Overloading.	
UNIT – II : CLASSES AND OBJECTS	**(9 Periods)**
Declaring Objects – Defining Member Functions – Static Member variables and functions – array of objects –friend functions – Overloading member functions – Bit fields and classes – Constructor and destructor with static members – Memory models – new and delete operators – dynamic object – binding, Polymorphism and Virtual Functions	
UNIT – III : INHERITANCE	**(9 Periods)**
Overloading unary, binary operators – Overloading Friend functions – type conversion – Inheritance: Types of Inheritance – Single, Multilevel, Multiple, Hierarchal, Hybrid, Multi path inheritance – Virtual base Classes – Abstract Classes. Exceptions - Exception Hierarchies and handlers.	
UNIT – IV : POINTERS AND TEMPLATES	**(9 Periods)**
Declaration – Pointer to Class, Object – this pointer – Pointers to derived classes and Base classes. Template Overview- Customizing a Templated Method - Standard Template Library Containers	
UNIT – V : FILE HANDLING	**(9 Periods)**
File stream classes – file modes – Sequential read / write operations – Binary and ASCII Files – Random Access Operation – String: Declaring and initializing string objects – String Attributes – Standard Streams - Miscellaneous functions.	

Contact Periods:

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

TEXT BOOKS:

1. *Herbert Schildt, "**The Complete Reference in C++**", Fourth Edition, 2003, Tata McGraw Hill.*
2. *HM Deitel and PJ Deitel, "**C++ How to Program**", Seventh Edition, 2010, Prentice Hall.*

REFERENCE BOOKS:

*1. Robert Lafore, "**Object Oriented Programming in C++**", 2002, Pearson education*

*2. Horstmann, "**Computing Concepts with C++ Essentials**", Third Edition,2003, John Wiley*

*3. Bjarne Stroustrup, "**The C++ Programming language**", Third edition, Pearson Education.*

COURSE OUTCOMES:

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

CO1: Write simple and effective C++ programs. **[Usage]**

CO2: Use polymorphism in C++ classes and objects **[Usage]**

CO3: Apply inheritance and explore reusability of code **[Assessment]**

CO4: Use pointers and templates in C++ programs. **[Usage]**

CO5: Handle file operations efficiently. **[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	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
18EES301	M	M	M	H	M	M	M	M	M	M	L	M	L	M	M

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

18EPC302	ELECTRIC CIRCUIT THEORY	SEMESTER: III

Category: PC

L	T	P	C
3	1	0	4

PRE-REQUISITES:

1. 18EBS202 Linear algebra, Numerical methods and Transform calculus

COURSE OBJECTIVES:

- To gain knowledge on the basic laws and theorems of Circuit Theory
- To make competent in analyzing electrical circuits and performing basic electrical measurements to verify circuit concepts experimentally.
- To gain thorough knowledge on analysis and design of electrical network.

UNIT – I : DC AND AC CIRCUIT ANALYSIS	**(9+3 Periods)**
Ohm's law and Kirchhoff's Laws – Classification of network elements – Waveform representation – Form Factor and Peak Factor for different patterns of alternating waveforms - R, L, C series-parallel circuits - Star-delta transformation - Source transformations - Mesh and nodal methods – Phase relation in R, L & C - Power factor - Real, reactive and apparent powers – Problems in AC and DC circuits.	
UNIT – II : NETWORK THEOREMS AND POLYPHASE CIRCUITS	**(9+3 Periods)**
Network Theorems: Superposition theorem – Thevenin's and Norton's theorems - Maximum power transfer theorem - Reciprocity theorem. Polyphase Circuits :Three phase system – Advantages - Interconnection of three- phase sources and loads - Balanced and unbalanced circuits - Power measurement by one, two and three wattmeter methods - Problems.	
UNIT – III : RESONANCE, COUPLED CIRCUITS AND TRANSIENTS	**(9+3 Periods)**
Resonance in series and parallel circuits – frequency response - derivation of bandwidth - Introduction to coupled circuits – Mutual inductance – Coefficient of coupling - 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 – IV : TWO PORT NETWORK S	**(9+3 Periods)**
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 – V : FILTERS DESIGN AND SYNTHESIS OF CIRCUITS	**(9+3 Periods)**
Classification of filters - Low pass and high pass filters - Band pass and Band stop filters- Constant K and m-derived filters. Hurwitz Polynomials – Positive Real Function – Synthesis of reactive one port RL, RC networks using Foster and Cauer methods.	

Contact Periods:

Lecture: 45 Periods Tutorial: 15 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., 2017*
2. *Charles K. Alexander, Matthew N.O. Sadiku **"Fundamentals of Electric Circuits"** McGraw Hill Book Co., V Ed. 2013.*
3. *A.Chakrabarti **"Circuit Theory – Analysis and Synthesis"** Dhanpat Rai & Co. New Delhi, V Ed. 2012*

REFERENCE BOOKS:

1. *Hayt W.H and Kemmerley J.E, "**Engineering Circuit Analysis**", Tata McGraw Hill Book Co., V Ed., 2014*
2. *Gangadhar K.A., "**Circuit Theory**", Khanna Publishers, II Ed., 2012*
3. *C.P. Kuriakose "**Circuit Theory: Continuous and Discrete – time systems – Elements of Network Synthesis**" PHI, Delhi, 2015*
4. *M.E.Van Valkenburg, "**Network Analysis**", PHI, Delhi, 2015*

COURSE OUTCOMES:

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

CO1: Study AC and DC circuits, apply electric circuit laws to DC and AC circuits.
CO2: Simplify complex circuits into simple circuits using theorems and analyze them.
CO3: Understand polyphase circuits in different Configurations.
CO4: Learn the basics of coupled circuits and solve problems.
CO5: Analyze the concepts of resonance and network functions
CO6: Design filter circuits and synthesize electric networks from network functions.

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	-	L	-	-	-	-	L	H	H	M
CO2	H	H	H	H	M	-	L	-	-	-	-	L	H	H	M
CO3	H	H	H	H	M	-	L	-	-	-	-	L	H	H	M
CO4	H	H	H	H	M	-	L	-	-	-	-	L	H	H	M
CO5	H	H	H	H	M	-	L	-	-	-	-	L	H	H	M
CO6	H	H	H	H	M	-	L	-	-	-	-	L	H	H	M
18EPC 302	H	H	H	H	M	-	L	-	-	-	-	L	H	H	M

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

18EPC303	FIELD THEORY	SEMESTER: III

Category : PC

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of electric, magnetic and electromagnetic fields and to apply knowledge for design.

UNIT – I : ELECTROSTATIC POTENTIAL AND FIELD	**(9 Periods)**
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 – Dielectrics – Capacitance - Electrostatic energy- Problems	
UNIT – II : MAGNETIC POTENTIAL AND FIELD	**(9 Periods)**
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 – Problems	
UNIT – III : ELECTRO MAGNETIC FIELDS	**(9 Periods)**
Problems in divergence and curl of vector fields in various co-ordinates - Faraday's laws - Maxwell's equations - Current densities - Time harmonics fields - Problems.	
UNIT – IV : ELECTRO MAGNETIC WAVES	**(9 Periods)**
Wave equations – Uniform plane waves in free space - Uniform plane waves in lossless dielectrics – Uniform plane waves in lossy dielectrics – Uniform plane waves in good conductor - Poynting's theorem - Problems.	
UNIT – V : FIELD MODELING EMI AND EMC	**(9 Periods)**
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 – EMI and EMC – Sources – Conducted and Radiated EMI – EMI Coupling modes - Elimination methods - Problems.	

Contact Periods:

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

TEXT BOOKS:

1. *John D. Kraus and Daniel A. Fleisch **" Electromagnetics with Applications"** McGrawHill International Ed., 2014.*
2. *William H.Hayt **"Engineering Electromagnetics"** McGraw Hill Book Co., 2015.*
3. *AshutoshPramanik **"Electromagnetism"** Prentice Hall of India Pvt. Ltd, 2013*

REFERENCE BOOKS:

1. *Dr.Dhananjayan.P. "**Engineering Electromagnetics**", Lakshmi Publications, 2015.*
2. *Mathew N.D Sadiku, "**Elements of Electromagnetic**", Oxford university press, Fourth Ed., 2015.*
3. *Joseph Edminister, "**Electromagnetics**", 2nd Ed., Tata McGraw Hill Book Co., 2016.*
4. *Gangadhar K.A., "**Field Theory**", Khanna Publishers, 2014*

COURSE OUTCOMES:

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

CO1: Understand the basics of electric field.
CO2: Grasp the information on magnetic field.
CO3: Learn the fundamental of electromagnetic field.
CO4: Illustrate the knowledge gained to analyze electromagnetic waves.
CO5: Estimate the field parameters for a given problem based on field modeling.

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	L	M	-	L	-	-	-	-	-	M	M	-
CO2	H	M	-	H	-	-	M	-	-	-	-	-	M	M	-
CO3	M	M	-	-	M	-	M	-	-	-	-	-	M	M	-
CO4	L	-	H	M	-	-	L	-	-	-	-	-	M	M	-
CO5	M	-	-	M	H	-	-	-	-	-	-	-	M	M	-
18EPC 303	M	M	H	M	M	-	M	-	-	-	-	-	M	M	-

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

18EPC304	ELECTRONIC DEVICES AND CIRCUITS	SEMESTER: III

Category : PC

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge about various electronic devices and circuits so as to identify their suitability for real time applications.

UNIT-I : DIODES, SPECIAL DIODES AND APPLICATIONS	**(9 Periods)**
PN diode –diode –biasing –voltage-current characteristics –transition and diffusion capacitance – reverse recovery time –diode models – applications –Half-wave and Full-wave rectifiers and filters –power supply regulators – **Clipping and clamping circuits** – Avalanche and Zener breakdown - zener diodes –applications –varactor and optical diodes.	
UNIT-II : BI-POLAR JUNCTION TRANSISTORS AND AMPLIFIERS	**(9 Periods)**
BJT–Structure –operation and characteristics with parameters – **amplifier and switch** –DC operating point –base, emitter and voltage-divider bias –Miller theorem –BJT amplifier –operation – AC equivalent circuits –**CE, CC, CB configurations** - multistage –RC coupled–transformer coupled–Darlington and differential amplifiers.	
UNIT-III : FIELD-EFFECT TRANSISTORS AND BIASING	**(9 Periods)**
JFET–Structure, operation and characteristics with parameters–biasing configurations –MOSFET– Structure –types (Depletion and Enhancement) –operation and characteristics –biasing configurations – VMOSFET– CMOS inverter	
UNIT-IV : AMPLIFIER ANALYSIS AND FEEDBACK TECHNIQUES	**(9 Periods)**
BJT and FET amplifiers – basics of frequency response – Low–high and total Frequency response – Power amplifiers –operation – characteristics– parameters of Class A,AB,B and C amplifiers –Op-Amp– Introduction – parameters –concepts of feedbacks –Negative feedback –shunt and series feedback- **Positive feedback- Wien Bridge and RC phase shift oscillators.**	
UNIT-V : THYRISTORS AND OTHER DEVICES	**(9 Periods)**
Basic constructions, characteristics curves, parameters and applications-SCR – Diac – Triac - Uni-Junction Transistors - programmable Uni-Junction Transistors – IGBTs – photo-transistors and optical couplers – New semiconductor material – Silicon Carbide- Gallium Arsenide.	

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

TEXT BOOKS:

1. *Thomas L. Floyd "**Electronic Devices**", 9th Edition., Prentice Hall Inc.,2012*
2. *Robert Boylestad **"Electronic Devices and Circuit Theory"** ,9th Edition, Pearson ,2010*

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*
3. *Adel S. Sedra and Kenneth C. Smith, "**Microelectronic Circuits**", 6th Ed., Oxford University Press, 2009*

COURSE OUTCOMES:

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

CO1: Understand the construction and working of semiconductor devices

CO2: Analyze the characteristics of the devices and their equivalent circuit models

CO3: Design of electronic circuits using devices and components

CO4: Explore the suitability the device for various applications

CO5: Study the special semiconductor and power electronic 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	-	H	-	H	M	H	-	-	-	H	-	H	-	L
CO2	H	H	-	M	M	-	H	-	-	-	L	-	-	H	L
CO3	M	-	H	H	H	L	H	-	-	M	-	-	H	M	-
CO4	M	H	H	H	M	-	H	H	M	-	L	-	H	M	M
CO5	H	M	H	H	H	-	-	-	-	-	-	-	H	M	M
18EPC 304	H	H	H	H	H	M	H	H	M	M	M	-	H	M	M

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

18EPC305	ELECTRICAL MACHINES - I	SEMESTER: III

Category : PC

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

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	**(9 Periods)**
Energy in magnetic system – Field energy and co energy - Force and torque equations- eddy currents and eddy current losses – flux distribution curve in the airgap – 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	**(9 Periods)**
Constructional details and principle of operation – Armature winding -Emf equation – Types of dc generators - Armature reaction – Effects of armature reaction - demagnetizing & cross magnetizing ampere-turns –compensating windings – interpoles – commutation – Characteristics of DC generators - losses and efficiency -Parallel operation of dc generators- applications of dc generators.	
UNIT – III : DC MOTORS	**(9 Periods)**
Constructional details and principle of operation- back emf – Types of dc motors - Torque equation- losses and efficiency – power flow diagram – Electrical and mechanical characteristics of different types of DC motors – DC motor Starters – Speed control methods – Types of Electric braking	
UNIT – IV : TRANSFORMERS	**(9 Periods)**
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	**(9 Periods)**
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: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Fitzgerald A. E., C. Kingsley and S. Umans**, "Electric Machinery"**, 5/e, McGraw Hill, 1990.*
2. *Bimbra P. S., **"Electrical Machinery"**, 7/e, Khanna Publishers, 2011.*
3. *Nagrath J. and D. P. Kothari, **"Theory of Electric Machines"**, Tata McGraw Hill, 2006.*

REFERENCE BOOKS:

1. *Jacek F. Gieras,* ***"Electrical Machines: Fundamentals of Electromechanical Energy Conversion",*** *CRC press,2016*
2. *Langsdorf M. N.,* ***"Theory of Alternating Current Machinery"****, Tata McGraw Hill, 2001.*
3. *Abhijith Chakrabarti, Sudipta Debnath,* ***"Electrical Machines"****, McGraw Hill Education, NewDelhi 2015.*
4. *Deshpande M. V.,* ***"Electrical Machines"****, Prentice Hall India, New Delhi, 2011.*
5. *Theodore Wilde,* ***"Electrical Machines, Drives and Power System"****, Pearson Ed. Asia 2001.*

COURSE OUTCOMES:

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

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	H	L	M
CO2	H	M	-	L	-	-	L	-	-	-	M	H	M	M	H
CO3	M	H	-	M	-	-	M	-	-	-	H	H	H	L	M
CO4	H	M	-	H	-	-	L	-	-	-	L	M	H	H	M
CO5	M	M	-	H	-	-	M	-	-	-	-	L	H	M	L
18EPC 305	H	H	-	M	-	-	M	-	-	-	L	M	H	M	M

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

18EPC306	DIGITAL CIRCUITS	SEMESTER: III

Category : PC

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce about the fundamental concepts and design techniques used in digital electronics.

UNIT-I : BOOLEAN ALGEBRA AND LOGIC GATES	**(9 Periods)**
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.	
UNIT-II :COMBINATIONAL LOGIC	**(9 Periods)**
Combinational circuits - Analysis and Design Procedure- Binary adder subtractor - Decimal adder – Binary multiplier – Magnitude comparator – Decoders – Encoders – Multiplexers.	
UNIT-III : SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL LOGIC	**(9 Periods)**
Sequential circuits- Latches – Flip flops – Analysis of Clocked 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	**(9 Periods)**
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 : HARDWARE DESCRIPTION LANGUAGE	**(9 Periods)**
Introduction to Verilog: Structure of Verilog module, Operators, data types, Styles of description- Data flow description, Implement logic gates, half adder and full adder using Verilog data flow description. Behavioral description: Structure, variable assignment statement, sequential statements, loop statements, Verilog behavioral description of Multiplexers (2:1,4:1,8:1) and De-multiplexers - Encoders (8 to 3), Decoders (2 to 4). latches-flipflops .	

Contact Periods:

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

TEXT BOOKS:

1. *Morris Mano,M**"Digital Design"** Pearson Education,New Delhi, 4th Ed., 2011*
2. *Charles H.Roth**"Fundamentals of Logic Design"** SixthEd., Jaico Publishing House, 2000*
3. *Nazeih M. Botros , "**HDL Programming VHDL and Verilog** "Dreamtech press ,2009 reprint.*

REFERENCE BOOKS:

1. *Ronald J. Tocci, Neal S Widmer, Gregory L Moss, "**Digital Systems: Principles and Applications**", Pearson/Prentice Hall, 2007.*
2. *Floyd, Floyd Thomas L., **"Digital fundamentals"** Pearson Education, New Delhi 9th Ed.,2008.*

COURSE OUTCOMES:

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

CO1: Understand the fundamental of digital electronics and logic families.
CO2: Analyse and predict the behaviour of simple digital circuits.
CO3: Outline the formal procedures for the analysis and design of combinational circuits.
CO4: Analyse the design capability in synchronous and asynchronous sequential circuits.
CO5: Design optimal digital circuits for given specification.
CO6: Acquire knowledge on the fundamental concepts and programming techniques used in HDL.

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	-	-	-	-	-	-	M	H	M	H
CO2	H	H	H	H	-	-	-	-	-	-	-	-	H	L	H
CO3	M	H	M	H	M	-	-	-	-		-	-	M	M	M
CO4	M	H	H	H	H	-	-	-	-	-	-	M	H	H	M
CO5	M	H	M	H	-	-	-	-	-	-	-	-	L	L	L
CO6	H	H	M	H	H	-	-	-	-	-	-	H	H	H	H
18EPC 306	H	H	M	H	H	-	-	-	-	-	-	M	H	M	M

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

18EES307	OBJECT ORIENTED PROGRAMMING USING C++ LABORATORY	SEMESTER: III

Category : ES

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To understand the principles of object oriented programming and to transform the physical problem domain into a hierarchy of objects, use OOP technique to solve simple engineering problems and to acquire skill sets to become a proficient C++ programmer with development of solution for complex problems in the real world.

LIST OF EXPERIMENTS:

1. Write a C++ program to understand Classes and Objects
2. Implement Arrays and Structures in C++
3. Write a C++ program to implement inline functions
4. Demonstrate various types of Inheritance
5. Implement Operator Overloading and Function Overloading
6. Implement Virtual Functions in C++
7. Write a C++ program to understand Pointers
8. Demonstrate the usage of Templates
9. Implement Exception handling in C++
10. Write a C++ program to illustrate file operations
11. Write a C++ program to illustrate Streams
12. Mini project

Contact Periods:

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

COURSE OUTCOMES:

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

CO1: Design an object oriented program using classes and objects. [Usage]

CO2: Apply inheritance to reuse the C++ code. [Usage]

CO3: Apply polymorphism to extend the code and reduce the complexity of the program. [Usage]

CO4: Implement exception handling in projects using generic types. [Usage]

CO5: Implement files and streams in C++ programs. [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	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	-	-
18EES 307	M	M	M	M	M	M	M	M	M	M	M	M	M	H	M

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

18EPC308	ELECTRIC CIRCUITS AND ELECTRONIC DEVICES LABORATORY	SEMESTER: III

Category : PC

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To observe and understand the basic laws circuit theory and analyze the performance characteristics of semiconductor devices.

LIST OF EXPERIMENTS:

1. Verification of Ohm's Law and Kirchhoff's laws.
2. Verification of various network theorems.
3. Determination of parameters of coupling circuits.
4. Parameters of Fluorescent light circuit.
5. Measurement of three phase power by two wattmeter method.
6. Semiconductor diode characteristics.
7. Zener diode characteristics and voltage regulation.
8. Transistor characteristics - common emitter mode.
9. Transistor characteristics - common base mode.
10. Characteristics of UJT and generation of saw tooth waveforms.
11. Characteristics of FET.
12. Circuit analysis using technical software..
13. IV and PV characteristics of solar panel.

Contact Periods:

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

COURSE OUTCOMES:

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

CO1: Verify the basic laws of circuit theory and various network theorems.

CO2: Infer the characteristics of basic semiconductor devices.

CO3: Measure the real and reactive power in three phase network

CO4: Analyze the circuits and devices using simulation tool.

CO5: Determine the parameters of electronic circuits.

CO6: Design the 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
18EPC 308	H	H	H	M	M	-	M	-	-	M	-	L	H	H	M

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

18EPC309	ELECTRICAL MACHINES LABORATORY – I	SEMESTER:III

Category : PC

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

* To give hands on training for evaluating the performance and characteristics of DC Machines and Transformers.

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. Separation of losses in dc machines
14. Three phase transformer connections.
15. Field test

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

COURSE OUTCOMES:

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

CO1: Analyze the electrical / mechanical / performance characteristics of DC machines/transformer.
CO2: Identify suitable DC motor speed control method for applications.
CO3: Develop the transformer model and analyse the performance.
CO4: Interpret component of iron loss of DC machine / transformer.
CO5: Identify the given identical DC machine/ transformer and finding the performance characteristics by suitable test.

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
18EPC 309	H	H	H	H	L	L	M	M	M	M	H	M	M	H	M

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

18EBS401	PROBABILITY AND APPLIED STATISTICS *(Common to EEE & EIE)*	SEMESTER: IV

Category : BS

PRE-REQUISITES: NIL

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To gain the knowledge of basic probability concepts
- To understand the statistical distributions both discrete and continuous cases
- To be familiar with statistical averages regarding one or more random variables
- To gain the knowledge of test of hypothesis applicable to small and large samples.
- To acquire knowledge of Random process and Markov chains.

UNIT I: PROBABILITYAND RANDOM VARIABLES	**(9+3 Periods)**
Samplespaces–Events-ProbabilityAxioms–ConditionalProbability–IndependentEvents–Baye'sTheorem. Random Variables**:** Distribution Functions–Expectation–Moments -Moment Generating Functions.	
UNIT II:PROBABILITY DISTRIBUTIONS	**(9+3 Periods)**
Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Gamma, Weibull (Mean, Variance and Simple problems). Functions of random variables.	
UNIT III: TWO DIMENSIONAL RANDOM VARIABLES	**(9+3 Periods)**
Joint distributions – Marginal Distributions – Conditional distributions – Covariance – Correlation and Regression – Transformation of random variables – Central Limit Theorem.	
UNIT IV: TESTING OF HYPOTHESIS	**(9+3 Periods)**
Large samples: Tests for Mean and proportions– Small samples: Tests for Mean, Variance and Attributes using t, F, Chi–Square distribution.	
UNITV: RANDOM PROCESSES	**(9+3 Periods)**
Definition and Examples-first and Second order, Strictly stationary, Wide sense stationary and ergodic processes- Markov processes – Poisson processes-Birth and Death processes-Markov chains-Transition probabilities-Limiting distributions.	

Contact Periods:

Lecture: 45 Periods **Tutorial: 15 Periods** **Practical: 0 Periods** **Total: 60 Periods**

TEXT BOOKS:

1. *Veerarajan. T., **"Probability and Random Processes"** (with Queueing Theory and Queueing Networks), Mc Graw Hill Education (India) Pvt Ltd., New Delhi, Fourth Edition, 2016.*

REFERENCE BOOKS:

1. *Gupta S.C and Kapoor V.K., **"Fundamentals of Mathematical Statistics"**, Sultan Chand & Sons, New Delhi, 2015.*
2. *Gupta S.P, **"Statistical Methods"**, Sultan Chand & Sons, New Delhi, 2015.*
3. *Trivedi K.S, **"Probability and Statistics with Reliability, Queuing and Computer Science Applications"**, Prentice Hall of India, New Delhi.*
4. *Hwei Hsu, **"Schaum's outline series of Theory and Problems of Probability and Random Process"**,Tata McGraw Hill Publishing Co., New Delhi, 2015.*
5. *Roy D Yates, **"Probability and Stochastic Processes a friendly introduction for Electrical and Computer engineers"**, John Wiley & sons, third edition 2015.*

COURSE OUTCOMES:

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

CO1: Understand probability axioms and calculate expected values through moment generating functions.

CO2: Identify various probability distributions of discrete and continuous random variables.

CO3: Understand the concept of two dimensional random variables.

CO4: Understand testing hypothesis connected to small and large samples

CO5: Understand the first and second order stationary process and Markovian processes.

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	H	M	M	H	M	M	H	H	H	H
CO2	H	H	M	M	L	M	L	L	L	M	H	M	H	M	H
CO3	H	H	M	M	L	M	L	L	M	M	H	M	H	M	M
CO4	H	H	L	M	L	M	M	L	L	M	H	M	H	M	M
CO5	H	H	H	M	M	M	M	M	H	M	M	H	H	H	H
18EBS 401	H	H	M	M	L	M	M	L	M	M	H	M	H	M	H

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

18EES402	ENGINEERING MECHANICS *(Common to MECH., EEE, PROD., EIE & CSE Branches)*	SEMESTER: IV

Category : ES

PRE-REQUISITES: NIL

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

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

- To understand the force systems, geometrical properties and frictions in real life applications.
- To understand the dynamics behaviour of particles and impulse momentum principle.

UNIT – I : INTRODUCTION TO MECHANICS AND FORCE CONCEPTS	**(9+3 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+3 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+3 Periods)**
Centroids – Determination by integration – centroid of an area – simple figures - composite sections – bodies with cut parts - moment of inertia – theorems of moment of inertia – moment of inertia of composite sections – principal moment of inertia of plane areas - radius of gyration.	
UNIT – IV : BASICS OF DYNAMICS	**(9+3 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. 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	
UNIT – V : IMPULSE MOMENTUM AND IMPACT OF ELASTIC BODIES	**(9+3 Periods)**
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.	

Contact Periods:

Lecture: 45 Periods **Tutorial: 15 Periods** **Practical: 0 Periods** **Total: 60 Periods**

TEXT BOOKS:

1. *S.S. Bhavikatti and K.G. Rajasekarappa **"Engineering Mechanics"** New Age International (P) Ltd. 1999.*
2. *S.C. Natesan **"Engineering Mechanics"** Umesh Publications, 5-B north market, Naisarak, Delhi , 2002.*
3. *Domkundwar V.M and Anand V. Domkundwar**, "Engineering Mechanics (Statics and Dynamics)",** Dhanpat Rai and Co. Ltd, 1 st Edition, 2006.*

REFERENCE BOOKS:

1. *F.B. Beer and E.R. Johnson, **"Vector Mechanics for Engineers"**, Tata Mc.Graw Hill Pvt. Ltd, 10th Edition,2013.*
2. *S. Timoshenko and Young, **"Engineering Mechanics",** Mc.Graw Hill, 4th Edition, 1995.*
3. *Irving Shames and Krishna Mohana Rao, **"Engineering Mechanics"**, Prentice Hall of India Ltd, Delhi, 2006.*
4. *R.C. Hibbeller, **"Engineering Mechanics"**, Prentice Hall of India Ltd,13th Edition,2013.*
5. *Vela Murali, **"Engineering Mechanics",** Oxford university Press,1st Edition,2010.*

COURSE OUTCOMES:

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

CO1: Know the concept of mechanics and system of forces.

CO2: Calculate the frictional properties at different bodies.

CO3: Identify the locations of centre of gravity and moment of inertia for different sections.

CO4: Understand the basics of dynamics of particles.

CO5: Know the impulse and momentum principle and impact of elastic bodies.

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	-	L	L	L
CO2	L	H	L	-	L	-	-	-	L	-	L	-	L	-	L
CO3	L	H	L	-	L	-	-	-	L	-	L	-	L	-	L
CO4	M	H	L	M	L	-	-	-		-	-	-	L	-	L
CO5	L	H	-	M	-	L	-	-		-	-	-	L	-	L
18EES 402	L	H	L	M	L	L	-	-	L	-	L	-	L	L	L

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

18EPC403	PRINCIPLES OF SIGNALS AND SYSTEMS	SEMESTER: IV

Category : PC

PRE-REQUISITES:

L	T	P	C
3	0	0	3

1. 18EBS202 Linear algebra, Numerical methods and Transform calculus

COURSE OBJECTIVES:

- To understand the basic properties of signal and systems and characterization of systems in time and frequency domains

UNIT-I : CLASSIFICATION OF SIGNALS AND SYSTEMS	**(9 Periods)**
Standard signals : Step – Ramp –Pulse –Impulse – Sinusoids –Classification of signals : Continuous time (CT) and Discrete Time (DT) signals–Periodic and Aperiodic signals –Deterministic and Random signals –Energy and Power signals –Classification of systems :CT systems and DT systems –Linear and Nonlinear –Time-variant and Time-invariant –Causal and Non-causal –Stable and Unstable	
UNIT-II : ANALYSIS OF CONTINUOUS TIME SIGNALS	**(9 Periods)**
Fourier series : Spectrum of Continuous Time signals – Properties -Fourier transform: continuous time aperiodic signals and periodic signals- properties– Fourier and Laplace Transform in signals Analysis	
UNIT-III : LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS	**(9 Periods)**
Differential Equation :CT system representations– Frequency response of systems characterized by Differential Equations -Block diagram representation – Impulse response, convolution integrals – State space representation	
UNIT-IV : ANALYSIS OF DISCRETE TIME SIGNALS	**(9 Periods)**
Z transforms – Properties - Inverse Z transforms - Initial and final value theorems - Convolution theorem Baseband Sampling of CT signals – Aliasing, Reconstruction of signal from DT signal, Discrete Time Fourier series representation of DT periodic signals – Properties – Representation of DT aperiodic signals by Discrete Time Fourier Transform (DTFT) – **Fast Fourier Transform (FFT)– Properties**	
UNIT-V : LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS	**(9 Periods)**
Difference Equations – Block diagram representation – Impulse response – Convolution sum – DTFT and Z Transform analysis of Recursive and Non-Recursive systems – Frequency response of systems characterized by Difference Equations – State space representation	

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

TEXT BOOKS:

*1. Alan V. Oppenheim, Alan S. Willsky and S. Hamid Nawab, "**Signals and Systems**", Prentice-Hall of India Second Edition, 2011*
*2. Simon Haykin and Barry Van Veeh, "**Signals and Systems**", Wiley India, New Delhi, 2010*

REFERENCE BOOKS:

1. *H P Hsu, Rakesh Ranjan, "**Signals and Systems**", Tata McGraw Hill, 7th Reprint, 2010*
2. *John Alan Stuller, "**An Introduction to Signals and Systems**", Thomson, 2008*

COURSE OUTCOMES:

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

CO1: Acquire knowledge about various test signals

CO2: Investigate properties of signals and corresponding systems

CO3: Review of mathematical concepts for analyzing systems

CO4: Analyze continuous and discrete time signals in frequency domain

CO5: Modelling of time invariant systems using different methodologies

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H	H	-	-	-	-	-	M	H	H	-	-
CO2	H	H	H	H	H	-	-	-	L	-	-	H	M	H	-
CO3	H	H	H	H	H	-	-	-	M	M	-	H	M	H	-
CO4	H	H	H	H	H	-	-	-	M	M	-	H	H	H	-
CO5	H	H	H	H	H	-	-	-	-	-	-	H	H	H	-
18EPC 403	H	H	H	H	H	-	-	-	M	M	M	H	H	H	-

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

18EPC404	LINEAR INTEGRATED CIRCUITS	SEMESTER: IV

Category : PC

PRE-REQUISITES:

L	T	P	C
3	0	0	3

1. 18EPC304 Electronic Devices and Circuits

COURSE OBJECTIVES:

- To learn the concept IC fabrication technology, OPAMP characteristics and applications.

UNIT – I : IC FABRICATION	**(9 Periods)**
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	**(9 Periods)**
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 – Instrumentation amplifier – inverting and non inverting amplifiers	
UNIT – III : APPLICATIONS OF OPERATIONAL AMPLIFIERS	**(9 Periods)**
Differential amplifiers - Integrator and differentiator - Active Filters – Voltage to frequency converters – Sample and Hold circuits - Comparators – Zero crossing detectors – Square and triangular waveform generator.	
UNIT – IV : 555 TIMERS, A/D AND D/A CONVERTERS	**(9 Periods)**
555 timer – Functional block diagram - Astable and monostable operation of 555 timer – Applications – Frequency counters – A/D converters - D/A converters.	
UNIT – V : APPLICATION ICs	**(9 Periods)**
Positive and negative voltage regulators (IC723) Adjustable voltage regulators (LM117/LM317) – Dual tracking regulators (78xx & 79xx Series) – Programmable supply –VCO and PLL - 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"**.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to
CO1: Understand the fabrication of ICs.
CO2: Study the OPAMP characteristics.
CO3: Identification of suitable solutions to real time applications.
CO4: Use of general purpose OPAMP circuits to specific applications.
CO5: Application of circuits for interfacing and generation of waveforms.
CO6: Utility of OPAMP 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	L	L	L	L	L	L	L	L	L	H	M	L
CO2	L	H	M	L	H	L	L	L	L	L	L	L	H	M	L
CO3	L	H	H	M	L	H	M	M	L	H	H	H	M	H	H
CO4	L	H	L	L	H	H	M	L	L	M	H	H	M	H	H
CO5	L	H	L	L	H	L	L	L	L	M	H	H	M	L	H
CO6	L	L	H	L	M	L	L	L	L	L	L	H	M	L	M
18EPC 404	L	H	M	L	M	L	M	L	L	M	M	M	M	M	M

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

18EPC405	ELECTRICAL MACHINES - II	SEMESTER: IV

Category : PC

PRE-REQUISITES:

L	T	P	C
3	0	0	3

1. 18EPC303 Field Theory
2. 18EPC305 Electrical Machines - I

COURSE OBJECTIVES:

- To acquire the knowledge of working principles and performance of rotating AC machinery and special machines.

UNIT – I : SYNCHRONOUS GENERATOR	**(9 Periods)**
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	**(9 Periods)**
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 – Applications.	
UNIT – III : THREE PHASE INDUCTION MACHINE	**(9 Periods)**
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	**(9 Periods)**
Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star - Delta starters—Speed control – Voltage control, Frequency control, V/f control ,pole changing and inject emf method	
UNIT – V : SPECIAL ELECTRICAL MACHINES	**(9 Periods)**
Single phase induction motor-Construction details-Double field revolving theory and operation-Equivalent circuit-No load and Blocked rotor tests-Performance analysis –Starting methods - Universal 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 - Synchronous Reluctance Motors - magnetic levitation systems-BLDC motor	

Contact Periods:

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

TEXT BOOKS:

1. *E.G. Janardanan, "**Special electrical machines**", PHI learning Private Limited, Delhi, 2014.*
2. *Fitzgerald A.E., Charles Kingsly C. Stephen D. Umans., "**Electric Machinery**" Tata McGraw Hill, 6th Ed., 2013.*
3. *Kothari D. P. and Nagrath I. J., "**Electric Machines**" Tata McGraw Hill, 5 TH Ed., 2017.*
4. *Bimbhra P.S., "**Electrical Machinery**" Khanna Publishers, New Delhi, 7TH Edition, 2011.*

REFERENCE BOOKS:

*1. Sen. S. K, "**Electric Machinery**", Khanna Publishers, New Delhi, 2008*

*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 OUTCOMES:

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

CO1: Understand the operating principle of rotating AC machines.
CO2: Familiarize the characteristics of synchronous and induction machines.
CO3: Apply the knowledge of Induction and synchronous machines for specific application.
CO4: Execute speed control and starting methods for various AC motors.
CO5: Familiarize 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	H	L	M
CO2	H	M	-	L	-	-	L	-	-	-	M	H	M	M	H
CO3	M	H	-	M	-	-	M	-	-	-	M	H	H	L	L
CO4	H	M	-	H	-	-	L	-	-	-	L	M	H	H	M
CO5	H	M	-	H	-	-	M	-	-	-	-	H	H	M	L
18EPC 405	H	H	-	M	-	-	M	-	-	-	L	H	H	M	M

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

18EPC406	ELECTRICAL AND ELECTRONIC MEASUREMENTS	SEMESTER: IV

Category : PC

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the construction and operation of measuring instruments and the importance of instruments in measurements

UNIT-I : MEASUREMENTS OF ELECTRICAL QUANTITIES AND ERROR ANALYSIS	**(9 Periods)**
Functional elements of Instruments -Standards and calibrations - Principle of operation of permanent magnet moving coil, moving iron, dynamometer, induction, thermal and rectifier instruments - Extension of instrument ranges Limiting errors of instruments - Combination of limiting errors – Gross, systematic and random errors in measurements - Statistical analysis of errors	
UNIT-II : DC AND AC BRIDGES	**(9 Periods)**
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	**(9 Periods)**
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 - types and errors - Instruments for measurement of frequency and power factor - Trivector meter-maximum demand Indicator	
UNIT-IV : ELECTRONIC INSTRUMENTATION	**(9 Periods)**
Sensors and Transducers – Signal Conditioning - Digital voltmeter – DMM – Digital Clamp meter - True RMS meter - Standard signal generators - Function generator - Spectrum analyzer - Power Quality analyzer- Distortion factor meter - Frequency meters	
UNIT-V : DISPLAY DEVICES AND RECORDERS	**(9 Periods)**
Digital storage oscilloscope –- Active and passive probes - Errors in measurement – calibration of probes - Seven segment display – LED, LCD, Dot matrix - Strip-chart and X-Y recorders – Concepts of Smart meters – Net metering - Data logger.	

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**" DhanpatRai & Sons, 19th edition 2015.*
2. *David A Bell, **"Electronic Instrumentation and Measurements"**, Third Edition, Ox for University Press, 2013.*

REFERENCE BOOKS:

1. *Golding E.W. and Widdis F.G., **"Electrical Measurements and Measuring Instruments"**, A.H. Wheeler & Co., Ahmedabad , 2003*
2. *A.D. Helfrick and W.D. Cooper, **"Modern Electronic Instrumentation and Measurement Techniques"**, Prentice Hall India Private Ltd., New Delhi, 2010*
3. *H.S. Kalsi, **"Electronic Instrumentation"**, Tata McGraw-Hill, New Delhi, 2010.*

COURSE OUTCOME:

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

CO1: Understand the standards, characteristics and errors of measurements

CO2: Demonstrate the operation of electrical and electronics measuring instruments

CO3: Analyze the Performance characteristics of each instrument

CO4: Identify the kind of instrument for measurement of different quantities.

CO5: Measure electrical and electronic parameters using 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	H	H	H	M	-	L	-	-	-	-	L	H	H	M
CO2	H	H	H	H	M	-	L	-	-	-	-	L	H	H	M
CO3	H	H	H	H	M	-	L	-	-	-	-	L	H	H	M
CO4	H	H	H	H	M	-	L	-	-	-	-	L	H	H	M
CO5	H	H	H	H	M	-	L	-	-	-	-	L	H	H	M
CO6	H	H	H	H	M	-	L	-	-	-	-	L	H	H	M
18EPC 406	H	H	H	H	M	-	L	-	-	-	-	L	H	H	M

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

18EMC4Z7	CONSTITUTION OF INDIA *(Common to all Branches)*	SEMESTER: IV

Category : MC

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

L	T	P	C
3	0	0	0

- To know about Indian constitution.
- To know about central and state government functionalities in India.
- To know about Indian society.

UNIT – I : INTRODUCTION	**(9 Periods)**
Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Role of the Election Commission.	
UNIT – II : STRUCTURE AND FUNCTION OF CENTRAL AND STATE GOVERNMENT	**(9 Periods)**
Union Government – Structures of the Union Government and Functions – President – Vice President– Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review. State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.	
UNIT – III : CONSTITUTION FUNCTIONS OF INDIA AND INDIAN SOCIETY	**(9 Periods)**
Indian Federal System – Central – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India. Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	
UNIT – IV : POLICIES AND ACTS - GENERAL	**(9 Periods)**
Insurance and Bonding – Laws Governing Sale, Purchase and use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax , Excise and Custom duties and their Influence on Construction Cost – Legal Requirements for Planning – Property Law– Agency Law – Local Government Laws for Approval.	
UNIT – V : POLICIES AND ACTS ON INFRASTRUCTURE DEVELOPMENT	**(9 Periods)**
A Historical Review of the Government Policies on Infrastructure – Current Public Policies on Transportations – Power and telecom Sector – Plans for Infrastructure Development – Legal framework for Regulating Private Participation in Roads and Highways – Ports and Airport and Telecom	

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

TEXT BOOKS:

1. *Durga Das Basu, **"Introduction to the Constitution of India"**, Prentice Hall of India, New Delhi,2018*
2. *R.C.Agarwal., **"Indian Political System"**,S.Chand and Company, New Delhi,2004.*
3. *Maciver and Page, **"Society: An Introduction Analysis"**, Mac Milan India Ltd., New Delhi,2007*

REFERENCE BOOKS:

1. *M.Laxmikanth, **"Indian Polity"**, Mcgraw Hill Education (India)Private limited,2016.*
2. *Sharma, Brij Kishore, **"Introduction to the Constitution of India"**, Prentice Hall of India, New Delhi,2018*

COURSE OUTCOMES:

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

CO1: Understand and abide the rules of the Indian constitution.
CO2: Understand the functions of Central government.
CO3: Understand the function of state government.
CO4: Understand the various constitutional functions.
CO5: Understand the different culture among the people of India.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	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
CO2						L						M		L	
CO3						L						M			
CO4						L						L		L	
CO5						L	L					L		L	L
18EMC 4Z7						L	L					M		L	L

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

18EPC408	ANALOG CIRCUITS AND DIGITAL IC LABORATORY	SEMESTER: IV

Category : PC

L	T	P	C
0	0	3	1.5

PRE-REQUISITES:

1. 18EPC304 Electronic Devices and Circuits
2. 18EPC306 Digital Circuits

COURSE OBJECTIVES:

- To design and develop various electronic circuits for real time applications.

LIST OF EXPERIMENTS:

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

Contact Periods:

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

COURSE OUTCOMES:

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

CO1: Acquire knowledge about internal circuitry and logic for digital circuits.

CO2: Fabricate electronic circuit depends on applications.

CO3: Test various waveform generation circuits using Opamps, Comparators and IC‘s.

CO4: Design and test various combinational logic circuits.

CO5: Design and test various sequential logic circuits.

CO6: Develop and demonstrate troubleshooting ability in 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	M	M	M	-	-	-	-	-	-	-	-	H	M	M
CO2	M	M	H	H	-	-	-	-	-	-	-	L	M	H	H
CO3	M	M	H	M	H	-	-	-	-	-	-	L	H	M	H
CO4	M	M	H	M	M	-	-	-	-	-	-	L	H	H	H
CO5	M	H	M	H	L	-	-	-	-	-	-	L	M	M	M
CO6	M	H	M	H	-	-	-	-	-	-	-	L	M	H	M
18EPC 408	M	M	H	H	M	-	-	-	-	-	-	L	H	H	H

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

18EPC409	ELECTRICAL MACHINES LABORATORY-II	SEMESTER:IV

Category : PC

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

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:

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

COURSE OUTCOMES:

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

CO1: Apply the knowledge of electromagnetism and electromechanical energy conversion
CO2: Suggest suitable test for performance determination of Rotating AC Machines
CO3: Analyse and evaluate the performance of A.C. rotating machines
CO4: Identify suitable speed control method of rotating machines
CO5: 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	H	H	H	M	M	L	H	H	H	L	H	H	L
CO2	H	H	H	H	H	M	M	L	H	H	H	L	H	H	L
CO3	H	H	H	H	H	M	M	L	H	H	H	L	H	H	L
CO4	H	H	H	H	H	M	M	L	H	H	H	L	H	H	M
CO5	H	H	H	H	H	M	M	L	H	H	H	L	H	H	M
18EPC 409	H	H	H	H	H	M	M	L	H	H	H	L	H	H	L

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

18EHS501	**BUSINESS COMMUNICATION SKILLS** *(Common to MECH, EEE, PRODN. & EIE)*	SEMESTER:V

Category : HS

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on effective Business Communication Skills.

UNIT I: ACQUISITION OF GOOD ENGLISH	**(9 Periods)**
Parts-of-speech, Tenses, Vocabulary, Choice of words, Synonyms, Antonyms, Homonyms, Homophones, Prefixes, Suffixes, One word substitutes, Idioms, Phrasal verbs, Abbreviations, Acronyms.	
UNIT II: BUSINESS WRITING	**(9 Periods)**
Sentence structure & patterns, SV Agreement, Punctuation, Email, Letter writing: Application, Interview, Appointment, Confirmation, Reference, Good will, Congratulatory, and thanking letters, Report writing, Precise writing: Summarizing matters reported in dailies & journals, decisions taken in meetings & conferences.	
UNIT III: BUSINESS CORRESPONDENCE	**(9 Periods)**
Enquiry: Types, Purpose, Notice inviting Tenders, Placing order, Making, Handling & Rejecting complaints, Sales letters, Market surveys, Status reports, Advertisements, Classifieds, Memo reports, Office circulars, Memorandums, and Report writing.	
UNIT IV: BUSINESS COMMUNICATION	**(9 Periods)**
Verbal & Non-Verbal communication, Body language, Soft skills, Pronunciation, Stress & Intonation, Inviting people, Accepting or Declining offers, Conveying or leaving messages over phone, Presentation, Negotiation, Speaking at a meeting.	
UNIT V: INTERPERSONAL COMMUNICATION IN ORGANIZATIONS	**(9 Periods)**
Skills needed to develop effective teams, Group Communication, Professional etiquettes, Interpersonal communication, Team roles, Effective listening and speaking, Critical thinking, Technology and communication	

Contact Periods:

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

TEXT BOOKS:

1. *Bisen, Vikram & Priya.* ***"Business Communication"****, New Age International Publishers, New Delhi, 2009*
2. *Thomas.L.Means.* ***"Business Communication"****. South-Western Cengage Learning, USA, 2010.*
3. *Adhikari, Bhavana & Sethi, Anjanee.* ***"Business Communication"****, Tata McGraw Hill Education Private Ltd., New Delhi, 2010*

REFERENCE BOOKS:

1. *Simon Sweeney.* ***"English for Business Communication"****, Cambridge University Press, Cambridge, 2007.*
2. *Hartley, Peter & Bruckmann G. Clive.* ***"Business Communication"****, Routledge, New York, 2007.*
3. *Locker O. Kitty. "****Business Communication"*** *McGrill, New York, 2009.*

COURSE OUTCOMES:

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

CO1: Acquire English language skills.

CO2: Familiarize English language usage for business contexts.

CO3: Develop business correspondence.

CO4: Execute effective business communication.

CO5: Practice good interpersonal communication.

CO6: Examine the standard practices followed in business communication.

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	M	-	M	L
CO2	L	-	-	-	-	-	-	-	-	M	L	M	-	M	L
CO3	L	-	-	-	-	-	-	-	-	M	L	M	-	M	L
CO4	L	-	-	-	-	-	-	-	-	M	L	M	-	M	L
CO5	-	-	-	-	-	-	-	-	-	M	L	M	-	M	L
CO6	L	-	-	-	-	-	-	-	-	M	L	M	-	M	L
18EHS 501	L	-	-	-	-	-	-	-	-	M	L	M	-	M	L

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

18EPC502	POWER GENERATION, TRANSMISSION AND DISTRIBUTION	SEMESTER: V

Category : PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18EPC302 Electric circuit Theory
2. 18EPC303 Field Theory
3. 18EPC405 Electrical Machines - II

COURSE OBJECTIVES:

- To acquire knowledge on various power generation techniques and to design electric utility substation with respect to electrical and mechanical point of view and thereby assesses the new plan of power system.

UNIT-I : CONVENTIONAL ENERGY GENERATION	**(9 Periods)**
Structure of electric power system – Prediction of load and energy requirements – Different types of conventional energy sources -Hydro electric plant-Large hydro plants – 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 : TRANSMISSION LINE - PARAMETERS AND DESIGN	**(9 Periods)**
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 neighboring communication circuits. Mechanical design of transmission line between towers – Sag and tension calculations -Effect of ice and wind. Corona discharge characteristics – Critical voltage and power loss.	
UNIT-III : MODELLING AND PERFORMANCE OF TRANSMISSION LINES	**(9 Periods)**
Transmission line classification – Short, medium 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. Power angle diagram – Surge Impedance loading, load ability limits based on thermal loading; angle and voltage stability.	
UNIT-IV : INSULATORS AND CABLES	**(9 Periods)**
Classification of insulators for transmission and distribution system – 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 AND DISTRIBUTION SYSTEM	**(9 Periods)**
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 one and a-half breaker with two main buses, double bus-bar with bypass isolators. Concept of neutral grounding and earthing practices in substations. Distribution system: Feeders, distributors and service mains, Types of DC distribution: 2-wire, 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. *A. Chakrabarti, Soni Ml, P. V. Gupta, U.S. Bhatnagar,* ***"A Text Book On Power System Engineering"*** *, Dhanpat Rai Publishing Company, 2008*
2. *C.L.Wadwa,* ***"Electrical Power Systems",*** *7th Edition, New Age International , 2017*

REFERENCE BOOKS:

1. *D.P.Kothari and I.J.Nagrath, "**Power System Engineering**", 2nd edition, Tata McGraw Hill, Third Reprint 2007*
2. *Mehta V.K., Rohit Mehta.,"**Principles of Power Systems**", S.Chand and Co., Fourth Revised Ed.,2006*
3. *Luces M. Fualkenberry, Walter Coffer, "**Electrical Power Distribution and Transmission**", Pearson Education,1st Edition 1996*
4. *"**Tamil Nadu Electricity Board Handbook"**, 2003*
5. *S.N.Singh* ***"Electric Power Generation, Transmission and Distribution"*** *Prentice Hall of India Pvt.Ltd, New Delhi, 2002.*

COURSE OUTCOMES:

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

CO1: Apply knowledge for electrical power generation from various resources available.
CO2: Understand the structure of power system and derive methods of determining the electrical parameters of the Transmission and Distribution network.
CO3: Develop model and analyze the performance of transmission network
CO4: Evaluate the performance of Distribution network
CO5: Design transmission and distribution network with respect to electrical and mechanical aspects.

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	-	-	-	-	-	-	M	H	-	M
CO2	H	H	M	M	L	-	-	-	-	-	-	M	H	L	-
CO3	H	H	H	H	M	-	L	-	-	-	M	M	H	H	M
CO4	H	H	H	H	M	-	L	M	M	L	M	M	H	H	M
CO5	H	H	H	H	M	-	L	M	M	-	M	M	H	H	M
18EPC 502	H	H	H	H	M	-	L	M	M	L	M	M	H	H	M

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

18EPC503	MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS	SEMESTER: V

Category : PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18EPC306 Digital Circuits

COURSE OBJECTIVES:

- To learn the architecture of microprocessor and microcontroller, assembly language programming, interfacing techniques and applications of Microprocessors and Microcontrollers.

UNIT – I : 8085 AND ARM PROCESSOR	**(9 Periods)**
Architecture and Addressing modes of 8085 processors - Instruction set of 8085 - ARM Processor architecture – ARM organization and implementation – instruction set - Basic ARM Assembly language program.	
UNIT – II : PIC16F87X MICRO CONTROLLER	**(9 Periods)**
Architecture - Instruction set - Memory organizations - Register file structure - CPU registers - Addressing modes - Assembly language programming.	
UNIT – III : REAL TIME CONTROL	**(9 Periods)**
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 – IV : PERIPHERALS OF PIC MICROCONTROLLER	**(9 Periods)**
I^2C bus for peripherals chip access – I^2C Bus operation - A/D converters- overview - Characteristics and Interface - UART wave forms and baud rate accuracy – UART data handling circuitry - UART uses	
UNIT – V : ARM AND MICRO CONTROLLER APPLICATIONS	**(9 Periods)**
Micro Controller Applications : LEDs, push buttons, relays and latch connection - Key board interfacing-interfacing 7segment displays – LCD interfacing - ADC/DAC Interfacing - Measurement applications - Automation and control applications. Arm Applications : Smart phones, Set top boxes , digital television, digital cameras.	

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., 2004*
2. *John B.P.Peatman "Design with PIC Microcontroller" Pearson edition , India 2004.*
3. *Rajkamal "**Microcontrollers (Architecture, programming, interfacing and system design)**", Dorling Kindersley Pvt Ltd, 2009*
4. *Tim Wilmshurst, "**Designing Embedded systems with PIC Microcontrollers-Principles and Applications**",Newnes, 2007.*
5. *Steave Furber, **"ARM system – on – chip architecture",** Addison Wesley, 2000.*

REFERENCE BOOKS:

1. *Deshmhmukh L M, "**Microcontrollers (Theory and applications)**", Tata McGraw-Hill Publishing Co. Ltd, New Delhi, 2008*
2. *Vijayendran.V, "**Fundamentals of Microprocessor-8085: Architecture, Programming & Interface**", Vijay Nicole Pvt. Ltd, 2004*
3. *John Crisp, "**Introduction to Microprocessors and Microcontrollers**", Newnes publications (Imprint of Elsevier), 2nd Ed., 2004*

COURSE OUTCOMES:

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

CO1: Explore the architecture of 8085, ARM and PIC microcontrollers.
CO2: Create interface between digital system and input/output devices.
CO3: Design and develop microcontroller based real-time applications.
CO4: Illustrate the architecture of processors and employ assembly language programming.
CO5: Impart the knowledge about the instruction set of various processors.
CO6: Design and Develop skills in simple program writing for 8085, ARM and PIC microcontroller based control 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	L	L	L	L	L	L	L	L	L	M	H	M	L
CO2	H	H	L	L	L	L	L	L	L	L	L	M	H	M	L
CO3	L	L	H	H	M	H	H	L	M	M	H	H	H	H	H
CO4	H	H	L	L	L	H	H	L	M	M	H	H	L	H	H
CO5	M	H	L	L	M	L	L	L	M	L	L	M	L	M	M
CO6	M	H	L	L	M	L	L	L	M	L	L	M	L	M	M
18EPC 503	H	H	L	L	M	M	M	L	M	L	M	M	M	M	M

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

18EPC504	CONTROL SYSTEMS ENGINEERING	SEMESTER:V

Category : PC

PRE-REQUISITES:

L	T	P	C
3	1	0	4

1. 18EBS102-Calculus and differential Equations
2. 18EBS202-Linear algebra, Numerical methods and Transform calculus

COURSE OBJECTIVES:

- To understand the concepts of mathematical modeling, feedback Control and analyze the signals of the system in time and frequency domain including stability aspects.

UNIT – I : CONTROL SYSTEM MODELING	**(9+3 Periods)**
Basic Elements of Control System – Open loop and Closed loop systems - Transfer function models of linear time-invariant systems- Modelling of Electric systems, Mechanical systems - Block diagram reduction Techniques - Signal flow graph.	
UNIT – II : TIME DOMAIN ANALYSIS	**(9+3 Periods)**
Standard test signals- Time response of first and second order systems for standard test inputs- Application of initial and final value theorem. Design specifications for second-order systems based on the time response.	
UNIT – III : FREQUENCY DOMAIN ANALYSIS	**(9+3 Periods)**
Relationship between time and frequency response, Polar plots, Bode plots, Nyquist plot– gain and phase margin. Closed-loop frequency response.	
UNIT – IV : STABILITY ANALYSIS AND COMPENSATORS	**(9+3 Periods)**
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-PID Controller.	
UNIT – V : STATE SPACE ANALYSIS	**(9+3 Periods)**
Concepts of state variables- State space model – Decomposition of transfer function – Canonical state model – Transfer function from state model – Solution of state equations – State transition matrix – Concept of Controllability and Observability.	

Contact Periods:

Lecture: 45 Periods **Tutorial: 15 Periods** **Practical: 0 Periods** **Total: 60 Periods**

TEXT BOOKS:

*1. Sivanandam S.N, Deepa , 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. 2015*
*2. Gopal M., "**Control systems – Principles and Design**", Fourth Ed., Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2012*

*3.Richard C. Dorf and Robert H. Bishop, "**Modern Control Systems**", Pearson Education Pvt. Ltd., New Delhi,12th Ed., 2011*

COURSE OUTCOMES:

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

CO1: Apply the fundamental concepts of control systems and develop the mathematical model of the physical systems

CO2: Analyze the response of the closed and open loop systems

CO3: Examine the stability of the open loop and closed loop systems

CO4: Design suitable compensators for the system

CO5: Develop and analyze the state space models of 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	H	M	L	L	-	M	-	H	H	L	-
CO2	H	H	M	M	M	M	L	L	-	M	-	H	M	M	-
CO3	H	H	H	H	M	M	M	M	-	L	-	H	M	L	-
CO4	M	M	H	H	H	M	M	M	-	M	-	H	M	M	L
CO5	M	M	H	H	L	L	L	L	-	M	-	H	M	M	M
18EPC 504	H	H	H	H	M	M	L	L	-	M	-	H	M	M	M

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

18EMC5Z6	ENVIRONMENTAL SCIENCES AND ENGINEERING *(Common to all Branches)*	SEMESTER: V

Category: MC

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

L	T	P	C
3	0	0	0

- 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_2, 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.	

Contact Periods:

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

TEXT BOOKS:

1. *Sharma J.P., **"Environmental Studies"**, 3rd Edition, University Science Press, New Delhi 2009.*
2. *Anubha Kaushik and C.P.Kaushik, **"Environmental Science and Engineering"**, 3rd Edition, New age International Publishers, New Delhi, 2008.*

REFERENCE BOOKS:

1. *R.K.Trivedi, **"Hand book of Environmental laws, Rules, Guidelines, Compliances and Standards"**, Vol. I & II, Environ Media, 2006.*
2. *G.TylerMiller, JR, **"Environmental Science"**, Tenth Edition, Thomson BROOKS / COLE Publishing, 2004.*
3. *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 sources 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	M	L	H	L	M	M	M	M	M	M	L	L	L	L	M
CO2	M	L	L	L	L	L	L	L	L	L	L	L	M	L	L
CO3	L	L	H	L	L	L	M	M	L	M	L	L	L	L	L
CO4	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L
CO5	M	L	H	L	L	L	H	H	L	M	L	L	M	L	M
18EMC 5Z6	M	L	H	L	L	L	M	M	L	M	L	L	L	L	L

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

18EPC507	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	SEMESTER:V

Category :PC

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

* To learn the practical aspects of Microprocessors and Microcontroller.

LIST OF EXPERIMENTS:

1. 8085 Microprocessor Programming
2. ARM processor Programming
3. PIC Microcontroller Programming
4. Interfacing of switches and display devices using Microprocessors and Microcontrollers
5. Interfacing of D/A and A/D converters using Microprocessors and Microcontrollers
6. Interfacing of key board and display using Microprocessors and Microcontrollers
7. Interfacing of stepper Motor using Microprocessors and Microcontrollers.
8. Programming of MPPT algorithms for solar PV system using Microprocessors and Microcontrollers
9. PIC Microcontroller – study and applications.

Contact Periods:

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

COURSE OUTCOMES:

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

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: 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: Apply the concepts to acquire in depth knowledge 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	M	L	M	M	L	H	-	-	-	-	-	-	M	L	M
CO2	H	H	H	H	M	-	-	-	-	-	-	-	M	M	L
CO3	H	L	H	L	L	-	-	-	-	-	-	-	L	L	M
CO4	H	M	H	H	M	-	-	-	-	-	-	M	M	L	M
CO5	H	H	H	M	M	-	-	-	-	-	-	-	L	M	M
CO6	H	H	M	L	H	H	-	-	-	-	-	-	M	L	L
18EPC 507	H	M	H	M	M	H	-	-	-	-	-	M	M	L	M

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

18EEE508	COMMUNICATION SKILLS LAB	SEMESTER:V

Category : EEC

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- Usage of English language.
- Improve one's English standard.
- Different methods of presentation needed for doing GD, Debate and Mock Interview.
- Scheme of writing English for personal and professional needs.
- Ways of comprehending different contexts of English.
- Process of getting successful in writing competitive exams and developing soft skills.

UNIT I: LISTENING/WATCHING	**(9 Periods)**
Listening to conversations – Ted talks, Motivating speeches – Watching video files on personalities, places, socio-cultural events, TV news programmes, Interviews and Lectures.	
UNIT II: SPEAKING	**(9 Periods)**
Conversation practice – Interview Skills – Mock interview - Introducing oneself and others – Role play – Debate – Presentation (Technical & General) and Extempore.	
UNIT III: READING	**(9 Periods)**
Reading texts on literature, media, newspapers and philosophical treatises - Reading graphs and charts – Sequencing sentences – Reading Idioms and phrasal verbs, e- books and e journals.	
UNIT IV: WRITING	**(9 Periods)**
Writing descriptions on charts and tables - job applications – cover letter – resume – emails – letters – memos – reports – blogs – writing for publications.	
UNIT V: ENGLISH FOR COMPETITIVE EXAMINATIONS AND SOFT SKILLS	**(9 Periods)**
Focus on International English Language Testing System (IELTS) – Test of English as a Foreign Language (TOEFL) – Graduate Record Examination (GRE) – Civil Service (Language related) – Verbal ability. Focus on Motivation – Self image – Goal setting – Managing changes – Time management – Stress management – Leadership traits – Team work – Career and Life planning. Focus on Multiple intelligences – Emotional intelligence – Spiritual quotient (ethics) – Intercultural communication – Creative and critical thinking	

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

REFERENCE BOOKS:

1. ***Business English Certificate Materials***, *Cambridge University Press.*
2. ***International English Language Testing System Practice Tests***, *Cambridge University Press.*
3. *Robert M Sherfield and et al. "**Developing Soft Skills**" 4th edition, New Delhi: Pearson Education, 2009.*
4. *Barker, A. "**Improve Your Communication Skills"**. New Delhi: Kogan Page India Pvt. Ltd., 2006.*
5. *Craven, Miles. "**Listening Extra – A resource book of multi-level skills activities"**. Cambridge University Press, 2004.*
6. *John Seely. "**The Oxford Guide to Writing and Speaking"**. New Delhi: Oxford University Press, 2004.*
7. *Ramesh, Gopalswamy and Mahadevan Ramesh. "**The ACE of Soft Skills"**. New Delhi: Pearson, 2010.*

COURSE OUTCOMES:

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

CO1: Listen to and understand spoken English
CO2: Speak English with confidence
CO3: Do presentation, GD, Debate, Role play and Mock interview
CO4: Write good English for personal and professional requirements
CO5: Read and comprehend English
CO6: Develop competitive examination skills and soft 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	L	-	-	-	-	-	-	-	-	M	L	M	-	M	L
CO2	L	-	-	-	-	-	-	-	-	M	L	M	-	M	L
CO3	L	-	-	-	-	-	-	-	-	M	L	M	-	M	L
CO4	L	-	-	-	-	-	-	-	-	M	L	M	-	M	L
CO5	-	-	-	-	-	-	-	-	-	M	L	M	-	M	L
CO6	L	-	-	-	-	-	-	-	-	M	L	M	-	M	L
18EEE 508	L	-	-	-	-	-	-	-	-	M	L	M	-	M	L

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

18EHS601	TECHNOLOGY MANAGEMENT *(Common to EEE, EIE, CSE, IT & IBT Branches)*	SEMESTER: VI

PRE-REQUISITES: **Category: HS**

NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Intricacies of technology selection.
- Role of technology in today's business.

UNIT – I : INTRODUCTION	**(9 Periods)**
Evolution, growth of technology, role and significance of technology management, forms of technology – process, product technology, impact of technology on society and business, technology and competition.	
UNIT – II : TECHNOLOGY FORECASTING	**(9 Periods)**
Technology forecasting, characteristics, principles, process, forecasting methods and techniques.	
UNIT – III : ACQUISITION OF NEW TECHNOLOGY	**(9 Periods)**
Alternative for acquiring new technology, reasons to obtain new technology, management of acquired technology, measures of scale and mechanisms for acquiring technologies. Technology transfer-models, modes of transfer, dimensions of technology transfer, features of technology package- routes of technology transfer.	
UNIT – IV : HUMAN ASPECTS OF TECHNOLOGY MANAGEMENT	**(9 Periods)**
Integration of people and technology, factors considered in technology management – organizational, psychological, organizational structure and technology –technological change and industrial relations.	
UNIT – V : SOCIAL ASPECTS OF TECHNOLOGY MANAGEMENT	**(9 Periods)**
Technology assessment and environmental impact analysis(EIA)-EIA-process, scope, issues in report preparation, elements of environmental problem, case study on social impact of technology.	

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

TEXT BOOKS:

1. *Sanjiva Shankar Dubey,* ***"Technology and Innovation Management",*** *PHI Learning Private Ltd., 2017.*

REFERENCE BOOKS:

1. *Gerard H. Gaynor,* ***"Hand Book Technology of Management"****, McGraw Hill professional, 2009.*
2. *Khalil, T,* ***"Management of technology: The Key to competitiveness and wealth creation"*** *Tata McGraw Hill, Delhi, 2013.*
3. *Ralph Katz****, "The human side of Managing Technological Innovation: A Collection of Readings",*** *2nd Edition Oxford University Press, 2003*

COURSE OUTCOMES:

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

CO1: Learn to manage ideas and knowledge in a technology-based organization.

CO2: Equipped with skills needed to implement technology policies and strategies.

CO3: Formulate technology policies and strategies for businesses.

CO4: Appropriately choose the new technologies.

CO5: Ability to foresee future technological requirements.

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	M	H	-	H	M	H	H	M	M
CO2	M	L	H	M	M	M	M	-	-	-	-	H	H	H	M
CO3	H	M	M	M	-	-	M	-	-	-	H	M	M	M	M
CO4	H	M	H	M	-	-	-	-	-	-	-	-	M	M	H
CO5	H	M	H	M	-	-	-	-	-	-	-	L	H	H	H
18EHS 601	H	M	H	M	M	M	M	H	-	H	H	M	H	M	M

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

18EPC602	POWER SYSTEM ANALYSIS	SEMESTER: VI

Category : PC

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18EPC302 Electric Circuit Theory
2. 18EPC502 Power Generation, Transmission and Distribution

COURSE OBJECTIVES:

- To analyze the power system under normal and abnormal operating conditions.

UNIT-I : INTRODUCTION	**(9 Periods)**
Need for system planning and operational studies – Basic components of a power system - 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	**(9 Periods)**
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 : ANALYSIS OF BALANCED FAULTS	**(9 Periods)**
Importance of short circuit analysis – Assumptions in fault analysis – Analysis using Thevenin's theorem – Fault analysis using Z-bus – Computations of short circuit capacity, post fault voltages and currents.	
UNIT-IV : ANALYSIS OF UNBALANCED FAULTS	**(9 Periods)**
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	
UNIT-V : STABILITY ANALYSIS	**(9 Periods)**
Importance of stability analysis in power system planning and operation – Classification of power system stability – Rotor 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: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 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 MC Graw Hill, Publishing Co. Ltd., New Delhi, 3rd Edition 2003.*

*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 OUTCOMES:

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

CO1: Model the power system under steady state operating conditions.

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 under fault conditions.

CO5: Evaluate the power system network for the stable 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	H	H	-	M	-	-	-	-	-	-	-	H	-	M
CO2	H	H	H	-	H	-	-	-	-	-	-	M	H	H	M
CO3	H	H	H	-	M	M	M	-	-	-	L	H	H	H	M
CO4	H	H	H	-	M	M	M	-	-	-	L	H	H	H	M
CO5	H	H	H	H	-	H	H	M	M	L	H	H	H	H	H
18EPC 602	H	H	H	H	M	M	M	M	M	L	M	H	H	H	M

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

18EPC603	POWER ELECTRONIC DEVICES AND CIRCUITS	SEMESTER: VI

Category : PC

PRE-REQUISITES:

1. 18EPC304 Electronic Devices and Circuits

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize the principle of operation, design and synthesis of different power conversion circuits.

UNIT-I : INTRODUCTION	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
Classification and operation of different types of choppers - Control strategies – Forced commutation-Operation of voltage - Current and load commutated choppers - Cuk and SEPIC converters - SMPS.	
UNIT-IV : INVERTERS	**(9 Periods)**
Types of inverters - Operation of 1-phase - 3 phase bridge inverters (120^o and 180^o modes) – Current Source Inverter - 1-phase ASCSI, basic and modified series inverter - 1-phase parallel inverter - 1 phase and 3 phase PWM inverters – types of PWM (single pulse, multiple pulse and sine PWM)- Modulation Index-Fourier analysis of PWM inverter output voltage. Introduction to Multilevel inverter – Types – Operation - Applications(Qualitative treatment only)	
UNIT-V : AC VOLTAGE CONTROLLERS	**(9 Periods)**
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.	

Contact Periods:

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

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

CO1: Acquire knowledge about fundamental concepts and techniques used in power electronics.

CO2: Illustrate and compare performance of various power semiconductor devices and switching circuits.

CO3: Demonstrate the operation of power electronic converters.

CO4: Select suitable devices by assessing the circuits for various applications.

CO5: Analyze and evaluate the performance of a power electronic circuit.

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	-	-	-	-	M	H	M	M
CO2	H	H	H	H	H	-	-	-	-	H	-	H	H	M	L
CO3	H	H	H	H	H	M	H	-	H	M	-	H	H	M	H
CO4	M	H	H	H	H	M	H	-	H	H	H	H	H	H	H
CO5	M	M	H	H	H	M	H	-	H	H	H	H	H	H	M
18EPC 603	H	H	H	H	H	M	H	-	H	H	H	H	H	H	H

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

18EPC607	POWER ELECTRONICS AND DRIVES LABORATORY	SEMESTER: VI

Category : PC

L	T	P	C
0	0	3	1.5

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To design, evaluate and analyze the performance of power electronic converters circuits and drives.

LIST OF EXPERIMENTS:

1. V-I characteristics of SCR and TRIAC
2. V-I characteristics of MOSFET and IGBT
3. Triggering circuits for SCR,MOSFET and IGBT
4. Single phase half controlled rectifier
5. Single phase fully controlled bridge rectifier
6. Buck, Boost and Buck-Boost converter
7. Single phase PWM inverter
8. Series inverter
9. Single phase voltage control using SCR and TRIAC
10. Speed control of chopper fed separately excited DC drive
11. V/f speed control 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: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES:

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

CO1: Analyze the characteristics of power semiconductor devices
CO2: Build and test various power electronic converters
CO3: Design of control techniques and circuits for power converters
CO4: Evaluate the performance of solid state drives
CO5: Study of special machines drives

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	-	L	-	L	-	H	H	H	M	M
CO2	H	H	H	H	H	-	M	-	M	-	H	H	H	M	M
CO3	H	H	H	H	H	L	M	-	M	-	H	H	H	H	H
CO4	H	H	H	H	H	M	H	-	H	-	H	H	H	H	H
CO5	H	H	H	H	H	M	H	-	H	-	H	H	H	H	H
18EPC 607	H	H	H	H	H	M	M	-	M	-	H	H	H	H	H

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

18EPC608	MEASUREMENTS AND CONTROL SYSTEMS LABORATORY	SEMESTER: VI

Category : PC

L	T	P	C
0	0	3	1.5

PRE-REQUISITES:

1. 18EPC406 Electrical and Electronic Measurements
2. 18EPC504 Control Systems Engineering

COURSE OBJECTIVES:

- To impart practical experience on the theoretical knowledge gained in the field of measurements, instrumentation and control systems.

LIST OF EXPERIMENTS:

1. Measurement of Resistance, Inductance and Capacitance using Bridge Circuits.
2. Burden Characteristics of Current Transformers.
3. Measurement of Sequence Impedances of Synchronous Machines.
4. Instrumentation Amplifier.
5. Phase angle Measurement.
6. Data Acquisition through Virtual Instrumentation
7. Strain and Temperature measurement with NI ELVIS.
8. Power Quality Measurement.
9. Transfer function of armature controlled DC motor.
10. Transfer function of field controlled DC motor.
11. Transfer function of separately excited DC generator
12. Design and Simulation of PI and PID controllers for a second order system.
13. Simulation of Digital position control system.
14. Speed control of DC Motor through Ladder Logic using PLC

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

COURSE OUTCOMES:

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

CO1: Experiment the various measuring techniques for electrical quantity
CO2: Analyze and calculate all the parameters related to Electrical Circuits.
CO3: Perform measurements through Software based approach
CO4: Develop Transfer Function Model of Electrical Systems like DC machines
CO5: Design suitable controllers for closed loop operation of first and second order systems
CO6: Automate the system operation through Ladder Logic programming

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
18EPC 608	M	M	M	H	L	L	L	L	L	L	L	L	H	H	H

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

18EVL609	VIRTUAL LABORATORY IN ELECTRICAL ENGINEERING	SEMESTER VI

PRE-REQUISITES:

- 18EPC302 – Electric Circuit Theory
- 18EPC306 – Digital Circuits
- 18EPC504- Control Systems Engineering

Category: PC

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

* To visualize the theoretical knowledge acquired through virtual platform in real time.

LIST OF EXPERIMENTS:

1. RLC Series and parallel circuits.
2. Digital Applications.
3. Frequency response plots- Bode plot, Nyquist plot and Root Locus.
4. PID Controller.
5. Computation of sub – transient and transient reactances of synchronous machines.

Contact Periods:

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

COURSE OUTCOMES

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

CO1: Infer the frequency response characteristics of RLC Circuits.

CO2: Realize the logical gating circuits for real time applications.

CO3: Analyze the performance of system with various controllers.

CO4: Evaluate the stability of system in using frequency response plots.

CO5: Assess the transient parameters of synchronous machines.

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	PS0 3
CO1	M	L	M	M	L	H							M	L	M
CO2	H	H	H	H	M								M	M	L
CO3	H	L	H	L	L								L	L	M
CO4	H	M	H	H	M							M	M	L	M
CO5	H	H	H	M	M	H							L	M	M
18EVL 609	H	M	H	M	M	H						M	M	L	M

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

18EHS701	PROFESSIONAL ETHICS *(Common to MECH., EEE, ECE, EIE & IT Branches)*	SEMESTER:VII

Category: HS

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To possess knowledge on ethics, safety, rights, responsibilities and global issues on engineering and technology.

UNIT I : **ENGINEERING ETHICS**	**(9 Periods)**
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	**(9 Periods)**
Engineering as experimentation - Engineers as responsible experimenters - Codes of ethics - A balanced outlook on law - The challenger case study.	
UNIT III : **SAFETY**	**(9 Periods)**
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**	**(9 Periods)**
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	**(9 Periods)**
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: 45 Periods**

TEXT BOOKS:

1. *Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, **"Engineering Ethics – Concepts and Cases",** Cengage Learning, 2009*
2. *Mike Martin and Roland Schinzinger **"Ethics in Engineering"** McGraw-Hill, New York 1996*
3. *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:

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

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
18EHS 701	H	M	M	M	M	M	M	M	L	M	M	M	M	M	M

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

18EPC702	POWER SYSTEM OPERATION, CONTROL AND PROTECTION	SEMESTER: VII

PRE-REQUISITES:

1. 18EPC502 - Power Generation, Transmission and Distribution

Category : PC

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize students with various operation, control and protection techniques as applied to power system for the normal operation.

UNIT-I : OPERATION OF POWER SYSTEM	**(9 Periods)**
Economics of power generation- Load curves-Load Factor-Diversity Factor, Reserve requirements- Overview of load forecasting –unit commitment : Constraints in unit commitment –Problem Formulation- Solution using Priority List method and Brute Force Method. Economic dispatch problem – Thermal system dispatching with network losses considered – Solution Methods-The Lambda – iteration method – Gradient method	
UNIT-II : REAL POWER CONTROL	**(9 Periods)**
Real Power-Frequency Control: 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.	
UNIT-III : REACTIVE POWER CONTROL	**(9 Periods)**
Reactive Power-Voltage control: Typical excitation system, modeling- static and dynamic analysis; Production and absorption of reactive power- Methods of Voltage Control – Shunt reactors – Shunt Capacitors – Series Capacitors – Synchronous condensers – Static VAR systems –tap changing transformers. Computer control of power system (quantitative treatment only)	
UNIT-IV : PROTECTIVE RELAYS AND CIRCUIT BREAKERS	**(9 Periods)**
Attributes of Protection schemes- Electromagnetic relays – Construction, operations and applications, Types: Differential relay – Distance relay – Over current relay. Principles of operation of static relays – Static over current relay. Circuit Breaker: Elementary principles of arc extinction – arc control devices- restriking and recovery voltages – bulk oil, minimum oil, air blast, vacuum and SF6 circuit breaker-Selection of circuit breakers.	
UNIT-V : POWER APPARATUS PROTECTION	**(9 Periods)**
Protective relays for the protection of generators – motors – transformers – Bus and Lines. Generation of Over voltage: Lightning – switching – Insulation failure – methods of protection: ground line – Peterson coil – surge absorbers and diverters	

Contact Periods:

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

TEXT BOOKS:

1. *A. Chakrabarti, Soni Ml, P. V. Gupta, U.S. Bhatnagar* ***"A Text Book On Power System Engineering"*** *Dhanpat Rai Publishing Company, 2008.*
2. *Olle. I. Elgerd, "****Electric Energy Systems Theory – An Introduction****", Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2012.*
3. *MehtaV.K & Mehta Rohit,* ***"Principles of Power Systems"****, S Chand & Co Ltd, Fourth Revised Ed.,2006*

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. *HadiSaadat, **"Power System Analysis"**, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.*
4. *Pai M A, **"Computer Techniques in Power System Analysis"**, Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.*
5. *Allen J.Wood and Bruce.F.Wollenberg, **"Power Generation Operation and Control"**, John Wiley & Sons New York, 2013.*

COURSE OUTCOMES:

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

CO1: Understand the concepts of power system

CO2: Analyze the performance of the power system for different operation and control techniques.

CO3: Study the operation and computerized control of power system.

CO4: Understand the basic protection schemes.

CO5: Identify the various apparatus used in protection 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	H	H	H	H	M	M	M	L	L	M	L	H	M	L
CO2	H	H	H	H	H	M	M	M	L	L	L	L	H	M	L
CO3	H	H	H	H	H	M	M	M	L	M	L	L	H	M	M
CO4	H	H	H	H	H	M	M	M	M	L	M	L	H	M	L
CO5	H	H	H	H	H	M	M	M	M	L	L	L	H	M	L
18EPC 702	H	H	H	H	H	M	M	M	L	L	L	L	H	M	L

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

18EPC707	POWER SYSTEM LABORATORY	SEMESTER: VII

Category: PC

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

* To remember previously learned information about power system problem and apply to practical situations for planning and evaluation.

LIST OF EXPERIMENTS:

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

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

COURSE OUTCOMES:

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

CO1: Demonstrate the 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 and 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	L	H	M	L	M	L	M	M	M	L	H	L	L
CO2	H	H	M	H	H	L	M	M	M	M	H	M	H	M	L
CO3	M	H	H	H	M	M	L	M	M	H	H	H	L	L	M
CO4	H	H	H	H	L	M	M	M	H	H	M	H	L	M	M
CO5	M	M	H	H	M	M	M	M	H	M	H	H	M	L	M
18EPC 707	H	H	M	H	M	M	M	M	M	M	H	M	M	L	M

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

18EEE708	MINI PROJECT	SEMESTER: VII

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 concepts related to the following topics:
  Electric Circuits, Analog and Digital Electronics Circuits, DC Machines, AC machines, Eliminator transformer, Using power devices and operational amplifiers, Applications of Electronic circuits, hobby circuits, Control of Electrical, Electronics and measuring instruments, Intelligent devices and 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:

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

CO1: Acquire practical knowledge within the chosen area of technology for project development

CO2: Identify, analyze, formulate and handle programming projects with a comprehensive and Systematic approach

CO3: Contribute as an individual or in a team in development of technical projects

CO4: 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
18EEE 708	H	H	H	H	H	H	M	H	H	H	H	H	M	H	H

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

18EEE803	PROJECT WORK	SEMESTER: VIII

Category : EEC

L	T	P	C
0	0	16	8

PRE-REQUISITES : NIL

COURSE OBJECTIVES:

* To use the knowledge acquired in various subjects of Electrical and Electronics Engineering.
* To motivate students come up with new designs and Fabrication, algorithms and software programs expressing their ideas in a novel way.
* To learn methodology for selecting a good project and work in a team for developing the hardware/software product.

PROJECT:

* A Project topic must be selected either from research literature or their own innovative technical ideas in consultation with the guide. 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/Actuator/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 the completion of the course, Students 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 and 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
18EEE 803	H	M	H	H	M	M	M	M	M	M	H	H	H	M	M

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

18EPE$01	PRINCIPLES OF VIRTUAL INSTRUMENTATION

PRE-REQUISITES: **Category: PE**

1. 18EPC406 Electrical and Electronic Measurements

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* To understand the Virtual instrumentation concepts towards measurements and control

UNIT – I : VIRTUAL INSTRUMENTATION	**(9 Periods)**
Introduction - Block diagram and architecture of a virtual instrument - Conventional Instruments versus Virtual Instruments – Data flow techniques, graphical programming in data flow, comparison with conventional programming	
UNIT – II : GRAPHICAL PROGRAMMING	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
VI toolsets, Distributed I/O modules Instrument Control -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 "**LabVIEW graphical programming**", Tata McGraw Hill, 2011*

COURSE OUTCOMES:

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

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	H	M	M
CO2	M	H	M	M	H	-	-	-	-	-	-	L	H	H	M
CO3	M	H	H	H	H	-	-	-	-	-	-	L	H	H	H
CO4	M	H	H	H	H	-	-	-	-	-	-	-	H	H	H
CO5	H	M	M	M	H	-	-	-	-	-	-	-	H	M	M
CO6	M	H	H	H	H	-	-	-	-	-	-	L	H	H	H
18EPE $01	M	H	H	H	H	-	-	-	-	-	-	L	H	H	H

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

18EPE$02	NEURAL AND FUZZY SYSTEMS

Category : PE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

UNIT-I : INTRODUCTION TO NEURAL NETWORKS	**(9 Periods)**
Introduction – Biological and Artificial neural networks - Learning rules – Training - ADALINE - MADALINE – BAM – Discrete Hopfield networks.	
UNIT-II : ARTIFICIAL NEURAL NETWORKS	**(9 Periods)**
Theory, Architecture and Applications of Back propagation network – Counter propagation network – Kohenen's Self Organising Maps.	
UNIT-III : INTRODUCTION TO FUZZY LOGIC	**(9 Periods)**
Fuzzy sets and membership – Chance Vs ambiguity – Classical sets – Fuzzy sets – Fuzzy relations – Tolerance and Equivalence relations – Value assignments.	
UNIT-IV : FUZZIFICATION AND DEFUZZIFICATION	**(9 Periods)**
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	**(9 Periods)**
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. S.Rajasekaran, G.A.Vijayalakshmi Pai **"Neural Networks, Fuzzy Logic and Evolutionary Algorithm: Synthesis and Applications"** PHI Learning Pvt. Ltd., 2017*
*3. 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. Fakhreddine O. Karray and Clarence De Silva., **"Soft Computing and Intelligent Systems Design, Theory, Tools and Applications",** Pearson Education, India, 2009*
*5. S N Sivanandam., S N Deepa, "**Principles of Soft Computing**", Wiley India Pvt. Ltd., 2nd Ed., 2011*

COURSE OUTCOMES:

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

CO1: Understand the behavior of human neural network and concept of fuzziness.

CO2: Explore the methods of training of Artificial Intelligent systems

CO3: Able to implement 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: Select suitable 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
18EPE $02	H	M	H	H	M	M	-	-	M	M	H	M	H	H	M

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

18EPE$03	POWER SYSTEM ECONOMICS

Category : PE

PRE-REQUISITES:

1. 18EPC502 Power Generation, Transmission and Distribution

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

UNIT – I CHARACTERISTICS AND OPERATION OF POWER PLANTS	**(9 Periods)**
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 OPERATION OF GENERATING PLANTS	**(9 Periods)**
Economic scheduling -Cost and Loss Calculation for Optimum Economy – Practical Calculation, Evaluation and application of Generation - Analog and Digital methods – Simple problems.	
UNIT – III : HYDRO THERMAL COORDINATION	**(9 Periods)**
Long term co-ordination – Mathematical formulation- short term co-ordination: methods and scheduling by Kirchmayer's method –gradient approach – hydro units in series – Evaluation and applications of Economic Scheduling of Thermal and Hydro Stations.	
UNIT – IV : UNIT COMMITMENT	**(9 Periods)**
Constraints in unit commitment for thermal and hydro plants –Cost function formulation- solution methods : priority list , dynamic programming methods- optimal UC with security constraint	
UNIT – V : GENERATION SYSTEM RELIABILITY ANALYSIS	**(9 Periods)**
Purpose and classification of Load forecasting and system reliability – Generation system reliability – Co-ordination methods – economic operation of power systems – Simple problems	

Contact Periods:

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

TEXT BOOKS:

1. *Elgerd O.I "**Electric Energy System Theory an Introduction**" Tata McGraw Hill, New Delhi, 2008*
2. *Sivanagaraju. S and Sreenivasan.G "**Power System Operation and Control**", Pearson Education Indiai, 2010*
3. *Kirchmayer E. K "**Economic Operation of Power Systems**" John Wiley and sons, New Delhi, 1985*

REFERENCE BOOKS:

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

COURSE OUTCOMES:

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

CO1: Understand the Thermal and Hydro generator characteristics
CO2: Evaluate the optimal operating point of generators
CO3: Apply mathematical tool to examine the performance of different generating sources in coordination
CO4: Evaluate the optimal scheduling of generators in power system using conventional optimization techniques
CO5: Analyze the importance of maintaining reliability of generation 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	H	L	L	L	M	H	H	L	L	M	M	-	M	H
CO2	M	H	M	H	M	H	L	M	M	M	M	M	H	H	M
CO3	M	H	M	H	H	M	H	M	L	L	H	H	M	H	H
CO4	M	H	M	H	M	H	L	M	M	M	M	M	-	M	M
CO5	M	H	L	L	L	M	H	H	L	L	M	M	H	H	M
18EPE $03	M	H	M	M	M	M	M	M	L	L	M	M	H	H	M

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

18EPE$04	POWER QUALITY ENGINEERING

Category : PE

PRE-REQUISITES:

1. 18EPC502 Power Generation, Transmission and Distribution

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

UNIT-I : INTRODUCTION TO POWER QUALITY	**(9 Periods)**
Overview of power quality phenomena-classification of power quality issues-power quality measures and standards-THD-TIF-DIN-C-message weights-flicker factor-transient phenomena-occurrence of power quality problems-power acceptability curves-IEEE guides, standards and recommended practices.	
UNIT-II : VOLTAGE SAGS AND INTERRUPTIONS	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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, IEEEpress, 2006.*
4. *G.T.Heydt, "**Electric power quality**", Stars in a Circle Publications, 1991*
5. *Math H. Bollen , "**Understanding Power Quality Problems**", IEEE Press,2000.*

REFERENCE BOOKS:

1. PSCAD User Manual

COURSE OUTCOMES:

Upon the completion of the 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	L	-	-	-	-	-	-	H	L	-
CO2	M	M	L	-	-	L	-	-	-	-	-	-	H	M	-
CO3	L	H	L	-	M	L	L	-	-	-	-	-	-	L	M
CO4	H	L	M	-	-	M	-	-	-	-	-	-	L	M	-
CO5	L	L	M	H	M	L	-	-	-	L	L	L	M	M	-
CO6	L	L	L	L	L	-	-	-	-	M	M	H	M	H	-
18EPE $04	M	M	L	M	M	L	L	-	-	M	M	M	M	M	M

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

18EPE$05	HVDC TRANSMISSION SYSTEMS

Category : PE

PRE-REQUISITES:

1. 18EPC502 Power Generation, 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	**(9 Periods)**
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	**(9 Periods)**
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 - Simple problems	
UNIT – III : CONVERTER CONTROL	**(9 Periods)**
Principle 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 – Starting and stopping of DC link- Power control	
UNIT – IV : FAULTS AND PROTECTION	**(9 Periods)**
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	**(9 Periods)**
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, 2016.*

REFERENCE BOOKS:

*1. Adamson and Hingorani H.G., "**High Voltage DC Power Transmission**", Garaway Ltd. England 1960.*
*2. WadhwaC.L.,"**Electrical Power Systems**", New Age International Pvt. Ltd, New Delhi, 2011.*
*3. Arillaga J., "**High Voltage Direct Current Transmission**", Peter Peregrinus, London, 1998*

COURSE OUTCOMES:

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

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: Select suitable protection method for various converter faults.
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	-	-	-	-	-	-	-	L	H	M	M
CO2	H	H	M	M	-	-	-	-	-	-	-	L	H	H	M
CO3	H	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO4	H	M	H	M	-	-	-	-	-	-	-	-	M	M	H
CO5	H	M	H	M	-	-	-	-	-	-	-	L	H	H	H
CO6	H	M	H	H	-	-	-	-	-	-	-	-	H	H	M
18EPE $05	H	M	H	M	-	-	-	-	-	-	-	L	H	H	M

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

18EPE$06	FACTS CONTROLLERS

Category : PE

PRE-REQUISITES:

1. 18EPC502 Power Generation, 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 TO POWER TRANSMISSION CONTROL	**(9 Periods)**
The concept of flexible AC transmission - Reactive power control in electrical power transmission lines - Uncompensated transmission line – Series and shunt compensation. Calculation of surge impedance loading and midpoint voltage, Transmission problems and needs: the emergence of FACTS- Challenges of Deregulation, Objectives of FACTS - Thyristor Controlled FACTS Controllers and Converter Based FACTS Controllers	
UNIT – II : STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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, Interline Power Flow Controllers (IPFC) - Basic Operating Principles and Characteristics, Control Structures.	
UNIT – V : CO-ORDINATION OF FACTS CONTROLLERS	**(9 Periods)**
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., 2002*
2. *K.R.Padiyar, "**FACTS Controllers in Power Transmission and Distribution**", New Age International (P) Limited, Publishers, New Delhi, 2008.*

REFERENCE BOOKS:

1. *Yong Huo Song, A.T.John, "**Flexible AC Transmission System**", Institution of Electrical Engineers(IEE), 1999.*
2. *Xiao – Ping Zang, Christian Rehtanz and Bikash Pal, "**Flexible AC Transmission System: Modelling And Control**" Springer, 2012.*
3. *Narain G.Hingorani, Laszio. Gyugyl, "**Understanding FACTS Concepts and Technology of Flexible AC Transmission System**", IEEE Press, A John Wiley & Sons, Inc. Publication, 2000.*

COURSE OUTCOMES:

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

CO1: Understand the problems and issues associated with AC transmission systems.

CO2: Comprehend the operation and control of various FACTS Controllers.

CO3: Develop the modeling of various FACTS Controllers.

CO4: Analyze the performance of Power System with FACTS Controllers.

CO5: Suggest suitable FACTS device 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
18EPE $06	H	M	H	M	M	M	L	M	L	L	M	M	M	M	M

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

18EPE$07	ENERGY AUDITING AND MANAGEMENT

Category : PE

PRE-REQUISITES:

1. 18EPC305 Electrical Machines - I
2. 18EPC405 Electrical Machines - II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To comprehend energy management schemes and perform economic analysis and load management in electrical systems.

UNIT – I : BASICS OF ENERGY MANAGEMENT	**(9 Periods)**
Energy Scenario – Energy Sector Reforms – Impact on environment – Strategy for future and conservation – Basics of Energy and it forms (Thermal and Electrical). Energy Audit: Need – Types and Methodology - Audit Report – Energy Cost, Benchmarking and Energy performance – System Efficiency. Facility as an energy system – Methods for preparing process flow, Material and energy balance diagrams.	
UNIT – II : ACTION PLANNING AND MONITORING	**(9 Periods)**
Energy Management System – Performance assessment – Goal setting by Manager – Action plan implementation – Financial Management: Investment - Financial analysis techniques, ROI, Risk and sensitivity analysis, role of Energy Service Companies. Project management: Steps in detail. – Energy monitoring and interpretance of variances for remedial actions. Environmental concerns: UNFCC – Kyoto protocol – COP – CDM – PCF – Sustainable development.	
UNIT – III : STUDY OF THERMAL UTILITIES	**(9 Periods)**
Combustion of Oil, Coal and Gas – Performance Evaluation of Boilers – Boiler blow down – Boiler water treatment – Energy Conservation Opportunity – Cogeneration: Principal – Options - Classification – Influencing Factors and technical parameters. Waste heat recovery: Classification – application – benefits - Different heat recovery devices.	
UNIT – IV : STUDY OF ELECTRICAL UTILITIES	**(9 Periods)**
Electricity Billing – Electricity load management – Motor efficiency and tests – Energy efficient motors – Factors affecting motor efficiency and loss minimization – Motor load survey. Lighting System: Types and features – recommended luminance levels – Lighting system energy efficiency study – Energy Efficient Technologies: Maximum demand controllers – Intelligent PF controllers – Soft starters and VFDs – Variable torque load uses – Energy efficient transformers, Light controllers and Electronic ballasts.	
UNIT – V : ENERGY ASSESSMENT IN UTILITY SYSTEMS	**(9 Periods)**
Performing Financial analysis: Fixed and variable costs – Payback period – methods – factors affecting analysis – Waste Minimization Techniques: Classification – Methodology. Performance assessment of HVAC Systems: Measurements, Procedure – Evaluation. Assessment of Pumps: Measurements, Procedure – Evaluation.	

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, 2013.*
2. *Paul o' Callaghan, "**Energy Management**", Mc-Graw Hill Book Company – 1st edition; 2012.*

REFERENCE BOOKS:

1. *John.C.Andreas,* ***"Energy Efficient Electric Motors",*** *Marcel Dekker Inc Ltd – 2nd edition; 2015.*
2. *W.C.Turner****, "Energy Management Handbook",*** *John Wiley and Sons, Fifth edition, 2013.*
3. *www.em-ea.org/gbook1.asp*

COURSE OUTCOMES:

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

CO1: Possess knowledge on energy management.
CO2: Analyze the feature of energy audit methodology and documentation of report.
CO3: Able to plan energy management action and develop the understanding of implementation
CO4: Familiarize with thermal utilities.
CO5: Familiarize with electrical utilities.
CO6: Perform assessment of different 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	M	-	-	-	-	-	-	M	-	-	-	M	M	M
CO2	H	-	M	M	-	-	-	-	-	-	-	-	M	M	M
CO3	M	M	H	M	-	-	M	-	H	-	-	-	M	M	M
CO4	M	-	M	-	-	-	-	-	-	-	-	-	M	M	M
CO5	M	M	M	-	-	-	-	-	-	-	-	-	M	M	M
CO6	H	M	-	-	M	-	-	-	M	-	-	-	M	M	M
18EPE $07	M	M	M	M	M	-	M	-	M	-	-	-	M	M	M

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

18EPE$08	AUTOMOTIVE ELECTRONICS FOR ELECTRICAL ENGINEERING

Category : PE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize the role of power train, In-vehicle networking and comfort/safety in automotive electronics development.

UNIT-I : FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
Control modes for fuel control, engine control subsystems, ignition control methodologies, different ECUs used in engine management. Vehicle networks: CAN standard. Diagnostic systems in modern automobiles.	
UNIT-V : CHASSIS AND SAFETY SYSTEMS	**(9 Periods)**
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, Newness Publishers, 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.*

COURSE OUTCOMES:

Upon the completion of the course, 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: Analyze the safety issues that occur in automotive 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	L	L	L	L	-	-	-	-	-	-	-	H	M	L
CO2	H	M	L	L	L	-	-	-	-	-	-	-	H	M	L
CO3	H	H	H	H	L	M	-	-	-	-	H	-	H	M	M
CO4	M	M	H	M	L	L	-	M	H	M	M	M	H	H	H
CO5	M	M	H	L	L	M	-	H	M	M	L	M	M	H	H
18EPE $08	H	M	M	M	L	M	-	H	H	M	M	M	H	M	M

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

18EPE$09	POWER SYSTEM STABILITY

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18EPC502 Power Generation, Transmission and Distribution

COURSE OBJECTIVES:

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

UNIT-I : INTRODUCTION TO STABILITY	**(9 Periods)**
Stability of power system – Simple two machine stability problems – Mechanical Analogy of power transmission systems – Importance of stability to system operation and design – Effect of instability – Representation of power system components – Stability studies on network analysis	
UNIT-II : STEADY STATE STABILITY	**(9 Periods)**
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-SWING EQUATION	**(9 Periods)**
General background - Swing equation for synchronous machine – Numerical solution of swing equation – Multi machine stability – Factors affecting transient stability	
UNIT-IV : TRANSIENT STABILITY -EQUAL AREA CRITERION	**(9 Periods)**
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	**(9 Periods)**
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: 45 Periods 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, year.*

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."**Small Signal Analysis of Power System**", Alpha Science International, 2004.*

*3. Paul M.Anderson and A.A. Fouad, "**Power system Control and stability**" IEEE Press, 2003.*

COURSE OUTCOMES:

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

CO1: Establish the modeling of power system suitable for performing stability analysis.

CO2: Analyze the stability of simple power systems using Analytical and graphical approach.

CO3: Apply computer simulation tools for stability analysis of large power systems.

CO4: Apply control methods for tuning of turbine of voltage controllers in power system.

CO5: Evaluate the power system for stable 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	M	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
18EPE $09	M	M	H	M	M	M	M	M	M	H	M	M	M	H	M

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

18EPE$10	**POWER PLANT INSTRUMENTATION** *(Common to EEE & EIE)*

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18EPC406 Electrical and Electronic Measurements
2. 18EPC502 Power Generation, Transmission and Distribution

COURSE OBJECTIVES:

- To understand the important process variables and their measurements and thereby develop control loops for optimal performance of power plant.

UNIT - I : METHODS OF POWER GENERATION	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
Analysis of impurities in feed water and steam- Flue gas oxygen analyzer - dissolved oxygen analyzer - chromatography - pH Meter - Fuel analyzer -pollution monitoring instruments.	
UNIT - IV : CONTROL LOOPS IN BOILER	**(9 Periods)**
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	**(9 Periods)**
Types of steam turbines – impulse and reaction turbines – compounding – Turbine governing system– Speed and Load control – Transient response 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:

Upon the completion of the course, 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 turbine monitoring system and able to analyze the problems related to turbine governing.
CO5: Design instrumentation systems for generating plants.
CO6: Apply the instrumentation and control in Power plants

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	H	M
CO2	H	M	M	M	M	-	-	-	-	-	-	M	H	H	H
CO3	H	H	M	H	-	-	-	-	-	-	-	L	H	M	M
CO4	H	M	M	M	-	-	-	-	-	-	-	-	H	M	M
CO5	H	H	H	M	M	-	-	-	-	-	-	M	H	H	H
CO6	H	M	H	M	-	-	-	-	-	-	-	M	H	M	H
18EPE $10	H	M	M	M	M	-	-	-	-	-	-	M	H	H	H

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

18EPE$11	DIGITAL SIGNAL PROCESSING AND PROCESSORS

Category : PE

PRE-REQUISITES:

L	T	P	C
3	0	0	3

1. 18EBS202 - Linear Algebra, Numerical methods and Transform Calculus
2. 18EPC504 - Control Systems Engineering

COURSE OBJECTIVES:

* To emphasize intuitive understanding of the concepts of Digital Signal Processing .To design theoretically the FIR and IIR Filters and to acquire knowledge on DSP processors and their applications in simple control systems.

UNIT – I : DISCRETE TIME LINEAR SYSTEMS	**(9 Periods)**
Discrete Linear systems – Time invariance –Causality, Stability, Difference Equations-Transfer functions of linear discrete systems – Impulse, step and frequency response – Linear and circular convolution- Recursive and non-recursive filters – Digital filter realization – Direct, Canonic, Cascade, Parallel and ladder realizations.	
UNIT – II : TRANSFORMATIONS IN DSP	**(9 Periods)**
Discrete Fourier Transform – Properties – IDFT- Convolution: Linear and Circular-Fast Fourier Transform: Introduction to Radix- 2 FFT – Properties – Decimation in time – Decimation in frequency – Computation of IDFT using DFT.	
UNIT – III : DIGITAL FILTERS - IIR	**(9 Periods)**
Approximation of analog filters – Butterworth -Chebyshev – Properties of IIR filter – IIR filter design- Bilinear transformation and Impulse invariance method – Digital transformation – Characteristic of FIR filter - Frequency response of linear phase FIR filter - Design of FIR filter – Fourier series method–Window function- Rectangular, Kaiser and Bartlett window methods.	
UNIT – IV : DIGITAL SIGNAL CONTROLLER	**(9 Periods)**
dsPIC30F4011 – Architecture - MCU and DSP features - Hardware DMA - Interrupt Controller - Digital I/O, On-chip Flash, Data EE and RAM - Peripherals - Timers, Communication Modules Motor Control Peripherals - Capture/Compare/PWM, Analog-to-Digital Converters	
UNIT – V : DIGITAL SIGNAL PROCESSOR	**(9 Periods)**
Introduction to DSP architecture- computational building blocks - Address generation unit, Program control and sequencing- Parallelism, Pipelining - Architecture of TMS320LF2407 - Addressing modes- I/O functionality, Interrupt. ADC, PWM, Event managers, Elementary Assembly Language Programming for control applications.	

Contact Periods:

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

TEXT BOOKS:

1. *B.Venkataramni, M.Bhaskar, "**Digital Signal Processors – Architecture, Programming and Applications**", Tata McGraw Hill, Fourth Edition, 2010.*
2. *C. Ramesh Babu Durai, **"DFFeigital Signal Processing",** Tata McGraw Hill, Fourteenth Reprint, 2008.*

REFERENCE BOOKS:

1. *John.G.Proakis, Dimitrias.G. and Manolakis. "**DSP Principles Algorithms and Applications",** Prentice Hall of India – Fourth Edition, 2014.*
2. *Emmanuel C.Ifeachor, University of Plymouth. Barrie.W.Jervis, Sheffield Hallam University, "**Digital Signal Processing. A Practical Approach"**, Pearson Education, II Edition, 2015.*
3. *SanjitK.Mitra, "**Digital Signal Processing: A computer Based approach**" Tata Mc Graw Hill, Fourth Edition, 2014.*
4. *Farzad Nekoogar, Gene moriarty. "**Digital Control Using Digital Signal Processing"** P.H. International Inc. New Jersey.2012.*

COURSE OUTCOMES:

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

CO1: Classify the digital signals and systems and apply various transformation techniques to solve problems.
CO2: Develop the ability to realize simple filter for difference equation.
CO3: Design digital IIR and FIR filters for the given specifications.
CO4: Design and simulate digital filters with signal processing algorithm.
CO5: Examine the DSP controllers and understand its functioning for control 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	-	L	-	-	-	-	-	-	-	M	M	-	-
CO2	M	M	-	-	-	-	-	-	-	-	-	M	M	-	-
CO3	M	M	-	L	L	-	-	-	-	-	-	M	M	-	-
CO4	L	L	-	M	L	-	-	-	M	-	-	M	M	-	-
CO5	M	M	-	M	L	-	L	-	M	-	-	M	M	-	-
18EPE $11	M	M	-	M	L	-	L	-	M	-	-	M	M	-	-

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

18EPE$12	COMPUTER SYSTEM ARCHITECTURE

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18EPC306 Digital Circuits
2. 18EPC503 Microprocessors, Microcontrollers 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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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 OUTCOMES:

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

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
18EPE$12	H	M	H	H	M	H	M	M	M	M	M	M	H	M	L

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

18EPE$13	PRINCIPLES OF EMBEDDED SYSTEMS

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18EES104 Programming in C
2. 18EES301 Object Oriented Programming with C++
3. 18EPC503 Microprocessors, Microcontrollers and applications.

COURSE OBJECTIVES:

- To impart the knowledge on embedded systems and to make familiarity with tools used to develop in an embedded environment.

UNIT – I : FUNDAMENTALS OF EMBEDDED SYSTEMS	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
Overview - Principles - Encapsulating Semaphores and Queues - Hard Real-time Scheduling Consideration - Saving Memory Space - Saving Power.	
UNIT – V : EMBEDDED SOFTWARE DEVELOPMENT TOOLS	**(9 Periods)**
Host and Target Machines - Linker / Locators for Embedded Software - Getting Embedded Software into Target - Testing on Host Machine - Instructions Set Simulators	

Contact Periods:

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

TEXT BOOKS:

*1. David E. Simon "**An Embedded Software Primer**", Pearson Education, Reprint 2008*
*2. Navabi "**Embedded Core Design with FPGA's**", Tata McGraw-Hill, First Ed. 2008*
*3. Raj Kamal "**Embedded Systems**" Tata McGraw-Hill, Second Ed. 2008*

REFERENCE BOOKS:

*1. Peckol, "**Embedded system Design**", John Wiley & Sons, 2010.*
*2. Lyla B Das, "**Embedded Systems-An Integrated Approach**", Pearson, 2013.*

COURSE OUTCOMES:

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

CO1: Acquire the functional understanding of communication between digital system.
CO2: Able to model the organization and understand the digital system.
CO3: Demonstrate the practical use of embedded system.
CO4: Interpret the software and hardware components and their usage.
CO5: Provide in-depth knowledge of embedded processor architecture behavior of embedded system.
CO6: 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	H	H	M	-	-	-	-	-	-	-	L	H	M	M
CO2	H	H	M	M	-	-	-	-	-	-	-	L	H	H	M
CO3	H	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO4	H	M	H	M	-	-	-	-	-	-	-	-	M	M	H
CO5	H	M	H	M	-	-	-	-	-	-	-	L	H	H	H
CO6	H	M	H	H	-	-	-	-	-	-	-	-	H	H	M
18EPE $13	H	M	H	M	-	-	-	-	-	-	-	L	H	H	M

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

18EPE$14	SPECIAL MACHINES AND CONTROLLERS

Category : PE

PRE-REQUISITES:

1. 18EPC303 Field Theory

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To grasp the working of special electrical machines and to cater the knowledge to real world applications.

UNIT – I : STEPPING MOTORS	**(9 Periods)**
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	**(9 Periods)**
Constructional features – Principle of operation – Torque equation – Power controllers – Characteristics and control –Microprocessor based controller.	
UNIT – III : SYNCHRONOUS RELUCTANCE MOTORS	**(9 Periods)**
Constructional features –Types –Axial and radial air gap motors –Phasor diagram –Characteristic– Vernier motor.	
UNIT – IV : PERMANENT MAGNET BRUSHLESS DC MOTORS	**(9 Periods)**
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	**(9 Periods)**
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

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 OUTCOMES:

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

CO1: Develop the deep knowledge in concepts of electromechanical energy conversion
CO2: 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: 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
18EPE $14	H	M	M	M	M	L	M	-	-	M	-	M	H	H	M

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

18EPE$15	LOGIC AND DISTRIBUTED CONTROL SYSTEMS

Category : PE

PRE-REQUISITES:

1. 18EPC504 Control Systems Engineering

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To 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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
Field bus: Introduction – Concept – International field bus standards – HART protocol: Method of operation – Structure – Operating conditions – Applications – Foundation Field bus - Profibus.	
UNIT – IV : DISTRIBUTED CONTROL SYSTEMS OPERATION	**(9 Periods)**
Evolution of DCS – Building blocks – Detailed descriptions and functions of field control units – Process – Interfacing issues - Operator stations– Data highways – Redundancy concepts	
UNIT – V : COMMUNICATION IN DCS	**(9 Periods)**
DCS – Supervisory computer tasks and configuration – System Integration with PLC and computers - 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*

*3. Bela. G.Lipkak, **"Process software and digital networks –** vol 3", CRC press,4th edition ,2012.*

COURSE OUTCOMES:

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

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 Programmes.

CO6: Gain knowledge on 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
18EPE $15	H	H	H	M	M	L	L	L	M	L	H	H	H	L	M

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

18EPE$16	RESTRUCTURED POWER SYSTEMS

Category : PE

PRE-REQUISITES:

1. 18EPC502- Power Generation, Transmission and Distribution

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide a comprehensive treatment towards understanding of the new dimensions associated with the power systems tackling issues involving techno-commercial solutions, fundamentals of microeconomics, design of power markets and market architectural aspects and new operational challenges like congestion management and ancillary service management.

UNIT – I: INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY	**(9 Periods)**
Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process - Entities involved, The levels of competition, The market place mechanisms, Sector-wise major changes required. Introduction to issues involved in deregulation, Reasons and objectives of deregulation of various power systems across the world. Fundamentals of Economics - Introduction, Consumer behavior, Supplier behavior. Market equilibrium, Short-run and Long-run costs, Various costs of production, Relationship between short-run and long-run average costs, Perfectly competitive market.	
UNIT – II : MARKET MODELS AND TRANSMISSION CONGESTION MANAGEMENT	**(9 Periods)**
Introduction, Market models based on contractual arrangements, Comparison of various market models, Electricity vis-à-vis other commodities, Four pillars of market design. Market architecture. Definition of congestion, Reasons for transfer capability limitation, Importance of congestion management in deregulated environment, desired features of congestion management schemes. Classification of congestion management methods, Calculation of ATC - Definition of various terms, ATC calculation using PTDF and LODF based on DC model, Calculation of ATC using AC model. Non-market methods, Market based methods, Nodal pricing, Inter-zonal Intra-zonal congestion management, Price area congestion management, Capacity alleviation method.	
UNIT – III : LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS	**(9 Periods)**
Mathematical preliminaries, Fundamentals of locational marginal pricing, Lossless DCOPF model for LMP calculation, Loss compensated DCOPF model for LMP calculation, ACOPF model for LMP calculation, Introduction to Financial Transmission Rights, Risk Hedging Functionality Of financial Transmission Rights, Simultaneous feasibility test and revenue adequacy, FTR issuance process, Treatment of revenue shortfall, Secondary trading of FTRs, Flow Gate rights, FTR and market power, FTR and merchant transmission investment.	

UNIT – IV : ANCILLARY SERVICE MANAGEMENT, PRICING OF TRANSMISSION NETWORK USAGE AND LOSS ALLOCATION	(9 Periods)
Introduction to ancillary services, Types of ancillary services, Classification of ancillary services, Load-generation balancing related services, Voltage control and reactive power support services, Black start capability service, Co-optimization of energy and reserve services, International comparison. Pricing of transmission network usage and loss allocation - Introduction to transmission pricing, Principles of transmission pricing, Classification of transmission pricing methods, Rolled-in transmission pricing methods, Marginal transmission pricing paradigm, Composite pricing paradigm, Merits and de-merits of different paradigms, Debated issues in transmission pricing, Introduction to loss allocation, Classification of loss allocation methods and comparison.	
UNIT – V : MARKET POWER, GENERATORS BIDDING & REFORMS IN INDIAN POWER SECTOR	**(9 Periods)**
Attributes of a perfectly competitive market, The firm's supply decision under perfect competition, Imperfect competition, Market power, Financial markets associated with electricity markets, Introduction to optimal bidding by a generator company, Optimal bidding methods. Reforms in Indian power sector -Introduction, Framework of Indian power sector, Reform initiatives during 1990-1995. Availability Based Tariff (ABT), The Electricity Act 2003, Open Access issues, Power exchange, Reforms in near future.	

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

TEXT BOOKS:

1. *Fundamentals of Power System economics, "**Daniel Kirschen and Goran Strbac"**, John Wiley & Sons Ltd, 2004.*

REFERENCE BOOKS:

1. *Sally Hunt, "**Making competition work in electricity"**, John Wiley & Sons, Inc., 2002.*
2. *Kankar Bhattacharya, Jaap E. Daadler, Math H.J Bollen**, "Operation of restructured power systems"** , Kluwer Academic Pub., 2001.*

COURSE OUTCOMES:

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

CO1: Understand the new dimensions associated with the power systems with techno-commercial issues

CO2: Apply various solutions for the commercial problems through study of fundamentals of micro economics

CO3: Design power markets and market architectural aspects as per the restructuring of power system

CO4: Identify Operational Challenges and manage the same with optimum solution

CO5: Suggest reform practices in developing countries with special focus on Indian 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	H	L	L	L	L	L	L	M	L	L	L	L
CO2	H	H	H	H	H	L	M	M	M	L	H	M	H	L	L
CO3	H	H	H	H	M	M	L	M	L	H	H	M	L	L	L
CO4	H	H	H	H	M	M	L	M	L	H	H	M	L	M	L
CO5	M	M	M	M	M	M	M	L	M	L	M	M	L	L	M
18EPE $16	H	H	H	H	M	M	L	M	L	M	H	M	L	L	L

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

18EPE$17	SOLID STATE RELAYS

Category : PE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge on the operational characteristics of relays and to design the relay circuits using Analogue and Digital IC's and processors.

UNIT-I : INTRODUCTION TO STATIC RELAYS	**(9 Periods)**
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: OVER CURRENT RELAYS	**(9 Periods)**
Static relay circuits (Using Analog and Digital IC's) for over current, inverse – Time characteristics, differential relay and directional relay	
UNIT-III : DISTANCE AND FREQUENCY RELAYS	**(9 Periods)**
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	**(9 Periods)**
Static relay circuits for carrier current protection - Steady state and transient behaviour of static relays - Testing and maintenance - Tripping circuits using thyristors	
UNIT-V : MICROPROCESSOR BASED RELAYS	**(9 Periods)**
Hardware and software for the measurement of voltage, current, frequency, phase angle - Microprocessor 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 2011*
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.1968*
2. *Ravindranath B. and Chander M., "**Power System Protection and Switchgear**", Wiley Eastern, 2007*

COURSE OUTCOMES:

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

CO1: Illustrate the operational characteristics of relays

CO2: Explain the functional blocks of various protections relaying schemes

CO3: Analyze different applications of static the relay

CO4: Gain knowledge on different protection circuits and maintenance of equipment

CO5: Test the different high frequency static relays

CO6: Compare and evaluate the conventional and digitized relaying 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	H	H	L	-	-	-	-	-	-	-	H	H	-
CO2	H	H	H	H	L	-	-	-	-	-	-	H	H	H	-
CO3	H	H	H	H	L	-	-	-	-	-	-	H	H	H	-
CO4	H	H	H	H	H	-	-	-	-	-	-	H	H	H	H
CO5	H	H	H	H	L	M	-	-	-	-	-	H	H	H	H
CO6	H	H	H	H	L	H	-	M	M	M	H	H	M	M	H
18EPE $17	H	H	H	H	L	H	M	M	M	M	H	H	H	H	H

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

18EPE$18	MEMS AND APPLICATIONS

Category : PE

PRE-REQUISITES:

1. 18EPC406 Electrical and Electronic Measurements

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	**(9 Periods)**
Basic principles of measurement systems - Primary Transduction Mechanisms Physical variables – Sensor defects – Sensing mechanisms – Enabling Technologies – Silicon – Thick film – Optical.	
UNIT – II : TRANSDUCER MODELLING	**(9 Periods)**
Electronic Techniques – Bridge circuits – Amplifiers – Data conversion – Noise and recovery of signal from noise – Sensor Networks and Protocols.	
UNIT – III : SMART TRANSDUCERS	**(9 Periods)**
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	**(9 Periods)**
Bulk micromachining – Surface micromachining – Other micromachining techniques – Packaging techniques – Micro scaling considerations	
UNIT – V : APPLICATIONS	**(9 Periods)**
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: 45 Periods

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:

Upon the completion of the 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 performance

CO6: Recognize the importance of MEMS 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
18EPE $18	M	M	L	M	L	L	L	-	-	-	-	-	M	M	M

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

18EPE$19	BIOMEDICAL INSTRUMENTATION *(Common to EEE & EIE)*

Category : PE

PRE-REQUISITES:

1. 18EPC406 Electrical and Electronic Measurements

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of human physiology and learn the operating principle of necessary Instrumentation associated with it.

UNIT – I : PHYSIOLOGY	**(9 Periods)**
Cell and its structure – Resting and action potential – Propagation of action potentials – The heart and cardiovascular system - Electrophysiology of cardiovascular system – Physiology of the respiratory system – Nervous system - Central nervous system and Peripheral nervous system – Electrode theory – Bio-potential electrodes - Transducers for biomedical applications.	
UNIT - II : ELECTRO PHYSIOLOGICAL MEASUREMENT	**(9 Periods)**
ECG – Vector cardiographs – EEG – EMG – ERG – EOG – Lead system and recording methods – Typical waveforms. Electrical safety in medical environment, shock hazards– leakage current- Instruments to protect against electrical hazards.	
UNIT - III : NON- ELECTRICAL PARAMETER MEASUREMENTS	**(9 Periods)**
Measurement of blood pressure, blood flow and cardiac output – Plethysmography – Measurement of heart sounds – Gas analysers – Blood gas analysers – Oximeters.	
UNIT - IV : MEDICAL IMAGING AND TELEMETRY	**(9 Periods)**
X-ray machine – Echocardiography – Computer tomography – MRI – Diagnostic ultrasound – PET – SPECT – Electrical impedance tomography – Thermograph – Biotelemetry.	
UNIT - V : ASSISTING AND THERAPEUTIC DEVICE	**(9 Periods)**
Pacemakers – Defibrillators – Ventilator – Anaesthesia machine – Nerve and muscle stimulator – Heart lung machine – Kidney machine – Audiometers – Diathermy –Endoscopes – Lasers in biomedicine.	

Contact Periods:

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

TEXT BOOKS:

1. *Leslie Cromwell "**Biomedical Instrumentation and Measurement**" PHI, New Delhi, 2007.*
2. *Khandpur. R.S "**Handbook of Biomedical Instrumentation**" 2nd edition, Tata McGraw Hill, 2011.*

REFERENCE BOOKS:

1. *Joseph J Carr and John M.Brown, **"Introduction to Biomedical Equipment Technology''**, John Wiley and sons, New York, 4th edition, 2012*
2. *John G. Webster, **"Medical Instrumentation Application and Design"**, John Wiley and sons,New York, 2009.*
3. *Ed. Joseph D. Bronzino **"The Biomedical Engineering Handbook"** Third Edition, BocaRaton, CRC Press LLC, 2014.*
4. *M.Arumugam, **"Bio-Medical Instrumentation"**, Anuradha Agencies, 2018.*

COURSE OUTCOMES:

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

CO1: Understand the physical foundations of biological systems

CO2: Realize the various electro physiological measurements in the human body.

CO3: Acquire knowledge on the measurement of non-electrical parameters in the human body.

CO4: Analyze the various medical imaging techniques and their applications.

CO5: Apply the concepts on the working of medical assisting and therapy 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	L	-	L	L	H	H	-	-	-	-	-	-	L	L	-
CO2	L	-	L	L	H	H	-	-	-	-	-	-	L	L	-
CO3	L	-	L	L	H	H	-	-	-	-	-	-	L	L	-
CO4	L	-	L	L	H	H	-	-	-	-	-	-	L	L	-
CO5	L	-	L	L	H	H	-	-	-	-	-	-	L	L	-
18EPE $19	L	-	L	L	H	H	-	-	-	-	-	-	L	L	-

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

18EPE$20	INDUSTRIAL DRIVES AND CONTROL

Category : PE

PRE-REQUISITES:

L	T	P	C
3	0	0	3

1. 18EPC305 Electrical Machines - I
2. 18EPC405 Electrical Machines - II
3. 18EPC603 Power Electronics Devices and Circuits.

COURSE OBJECTIVES:

* To learn the concepts of electrical drives and their applications in carrying out modern industry processes.

UNIT – I : SPEED CONTROL OF DC MOTORS	**(9 Periods)**
Concept of Electric Drive – Classification of Electric Drives – Speed/Torque characteristics Braking methods –Methods of speed control – Ward Leonard drives –Semi, Full converter fed DC drives – Single, Two and Four quadrant operations –Dual converter fed DC drives.	
UNIT – II : DIGITAL CONTROL OF DC MOTORS	**(9 Periods)**
Digital technique in speed control of DC motors – Advantages – Limitations – Closed loop control of DC drives – Analog, Digital and Hybrid speed control –Microprocessor applications to control of DC motor.	
UNIT – III : SPEED CONTROL OF AC MOTORS	**(9 Periods)**
Speed control of AC motors – Speed / Torque characteristics – Braking methods. AC -AC controller fed AC drives, Inverter fed AC drives, Frequency control, V/F control of induction and synchronous motor - Self control, Margin angle control and power factor control.	
UNIT – IV : ROTOR SIDE CONTROL OF FREQUENCY CONTROLLED INDUCTION MOTOR DRIVES	**(9 Periods)**
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 Microprocessor to AC motor speed control .	
UNIT – V : INDUSTRIAL APPLICATIONS	**(9 Periods)**
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. *Sen, P.C., **"Thyristor DC Drives"**, Krieger Publishing Company 1991*

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,NewDelhi,2001*
4. *Pillai S.K., **"A First Course on Electrical Drives"**, Wiley Eastern Ltd., Bombay, 2nd Ed. 2007.*

COURSE OUTCOMES:

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

CO1: Illustrate the role of power electronics in modern drives.
CO2: Design the digital controller for drives.
CO3: Understand the speed control techniques for AC drives.
CO4: Select drive for particular application considering the present and future needs of industries.
CO5: Understand microprocessors in control of electric drives.

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	H	M
CO2	H	H	H	M	M	L	L	-	-	-	-	-	M	M	H
CO3	H	H	H	M	M	L	L	-	-	-	-	-	H	M	H
CO4	H	M	M	M	H	M	H	-	-	-	-	-	M	M	H
CO5	H	M	L	M	M	L	M	-	-	-	-	-	H	L	L
18EPE $20	H	M	M	M	M	L	M	-	-	-	-	-	M	M	M

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

18EPE$21	ENERGY STORAGE TECHNOLOGY

Category : PE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To explore the fundamentals, technologies and applications of energy storage.

UNIT-I : ENERGY STORAGE: HISTORICAL PERSPECTIVE, INTRODUCTION AND CHANGES	**(9 Periods)**
Storage Needs - Variations in Supply and energy demand Interruptions in Energy Supply- Transmission Congestion - Demand for Portable Energy-Demand and scale requirements - Environmental and sustainability issues.	
UNIT-II : TECHNICAL METHODS OF STORAGE	**(9 Periods)**
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)- Different Types of Energy Storage Systems.	
UNIT-III PERFORMANCE FACTORS OF ENERGY STORAGE SYSTEMS	**(9 Periods)**
Energy capture rate and efficiency- Discharge rate and efficiency- Dispatch ability and load flowing 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 : APPLICATION CONSIDERATION	**(9 Periods)**
Comparing Storage Technologies- Technology options- Performance factors and metrics- Efficiency of Energy Systems- Energy Recovery - Battery Storage System: Introduction with focus on Lead Acid and Lithium- Chemistry of Battery Operation, Power storage calculations, Reversible reactions, Charging patterns, Battery Management systems, System Performance, Areas of Application of Energy Storage: Waste heat recovery, Solar energy storage, Green house heating, Power plant applications, Drying and heating for process industries, energy storage in automotive applications in hybrid and electric vehicles.	
UNIT-V : HYDROGEN FUEL CELLS AND FLOW BATTERIES	**(9 Periods)**
Hydrogen Economy and Generation Techniques, Storage of Hydrogen, Energy generation - Super capacitors: properties, power calculations – Operation and Design methods - Hybrid Energy Storage: Managing peak and Continuous power needs, options - Level 1: (Hybrid Power generation) Bacitor "Battery + Capacitor" Combinations: need, operation and Merits; Level 2: (Hybrid Power Generation) Bacitor + Fuel Cell or Flow Battery operation-Applications: Storage for Hybrid Electric Vehicles, Regenerative Power, capturing methods.	

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, 2014.*
2. *Jiujun Zhang, Lei Zhang,Hansan Liu, Andy Sun, Ru-Shi Liu**, "Electrochemical Technologies for Energy Storage and Conversion",** John Wiley and Sons, 2012.*

REFERENCE BOOKS:

1. *Francois Beguin and ElzbietaFrackowiak,**"Super capacitors"**, Wiley, 2015.*
2. *Doughty Liaw, Narayan and Srinivasan, **"Batteries for Renewable Energy Storage"**, The Electrochemical Society, New Jersy, 2016.*

COURSE OUTCOMES:

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

CO1: Recollect the historical perspective and technical methods of energy storage

CO2: Learn the basics of different energy storage methods.

CO3: Evaluate the performance factors of energy storage systems.

CO4: Identify the field of applications for renewable energy systems.

CO5: Understand the basics of Hydrogen Fuel Cell and flow batteries.

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	L	-	M	-	L	-	M	-	L	L	L
CO2	M	M	M	L	L	-	M	-	L	-	L	-	L	L	L
CO3	L	-	M	M	L	M	M	-	L	-	-	-	L	L	L
CO4	M	L	M	L	L	-	L	-	M	-	-	-	L	L	L
CO5	L	M	L	M	-	-	M	-	M	-	-	-	L	L	L
18EPE $21	M	L	M	M	L	M	M	-	L	-	M	-	L	L	L

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

18EPE$22	OPTIMIZATION TECHNIQUES

Category : PE

PRE-REQUISITES:

1. 18EBS202 Linear Algebra, Numerical methods and Transform Calculus

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of optimization techniques and algorithms for solving various electrical engineering problems.

UNIT – I: CLASSICAL OPTIMIZATION TECHNIQUES	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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 : EVOLUTIONARY ALGORITHM	**(9 Periods)**
Genetic Algorithms (GA) -principles of random search methods- Similarities and differences between GAs and traditional methods - GAs for constrained optimization- GAs operators - Real-coded GAs - Advanced GAs - solution of simple problems. Particle Swarm Optimization (PSO) – Background, operation and basic flow of PSO – Applications of PSO. Ant Colony Optimization (ACO): Ant Foraging behavior-Theoretical considerations-ACO algorithm-- Comparison between GA, PSO and ACO.	
UNIT – V : OPTIMIZATION TOOLBOX	**(9 Periods)**
Relevant software 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– Use of GA toolbox	

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.*
3. *S.N.Sivanandam, S.N.Deepa, **— " Introduction of Genetic Algorithms"**, Springer, Newyork, 2010.*

REFERENCE BOOKS:

1. *Rudra Pratap "**Getting Started with MATLAB 7**" Oxford University Press, 2005.*
2. *"**Optimization Toolbox Manual**", The Mathworks Inc., 2000, www.mathworks.com*

COURSE OUTCOMES:

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

CO1: Understand the fundamental concept of optimization techniques.
CO2: Formulate deterministic mathematical programs for practical system
CO3: Interpret the results of the model and present the insights
CO4: Recognize the limitations of different solution methodology
CO5: Impact the knowledge on the concepts of various classical and modern methods for constrained and unconstrained with single and multivariable form of problems
CO6: Analyze real life problems through the use of mathematical modeling 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	M	M	-	-	-	L	-	-	-	L	L	-
CO2	H	H	M	M	L	M	-	-	-	-	-	H	H	L	M
CO3	L	H	M	M	H	-	-	-	-	-	-	-	L	H	L
CO4	M	M	H	M	M	L	L	-	-	-	-	-	H	L	L
CO5	H	H	H	H	H	M	M	-	-	-	-	-	M	L	-
CO6	H	H	H	H	H	M	L	-	-	-	-	-	L	-	M
18EPE $22	H	H	M	M	M	M	L	-	L	-	-	H	M	L	M

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

18EPE$23	ELECTRICAL MACHINE DESIGN

Category : PE

PRE-REQUISITES:

1. 18EPC305 Electrical Machines - I
2. 18EPC405 Electrical Machines - II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

UNIT – I :INTRODUCTION TO ELECTRICAL MACHINE DESIGN	**(9 Periods)**
Major considerations in Electrical Machine Design - Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings- Concept of magnetic circuit- MMF calculation for various types of electrical machines - Thermal considerations - Heat flow – Temperature rise and Insulating Materials - Rating of machines – Standard specifications.	
UNIT – II : DESIGN OF DC MACHINES	**(9 Periods)**
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, air gap, field poles, field coil and brushes – Performance prediction using design values	
UNIT – III : DESIGN OF TRANSFORMERS	**(9 Periods)**
Output Equations – Main Dimensions - kVA output for single and three phase transformers – Window space factor – Design of core, yoke and winding – Overall dimensions – Operating characteristics – No load current – Temperature rise in Transformers – Design of Tank and cooling tubes of transformers	
UNIT – IV : DESIGN OF INDUCTION MOTORS	**(9 Periods)**
Output equation of Induction motor – Main dimensions - Design of stator – 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 : DESIGN OF SYNCHRONOUS MACHINES	**(9 Periods)**
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: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *K. G. Upadhyay,' **Design of Electrical Machines'**, New Age International, 2011*
2. *Padi A.K.Sawhney, '**A Course in Electrical Machine Design**', Dhanpat Rai and Sons, New Delhi, 2005.*
3. *S.K.Sen, '**Principles of Electrical Machine Design with Computer Programmes**', Oxford and IBH Publishing Co.Pvt Ltd., New Delhi, 1987.*

REFERENCE BOOKS:

1. *Thomas A. Lipo,' **Introduction to AC Machine Design**', John Wiley & Sons, 2017*
2. *R.K.Agarwal, '**Principles of Electrical Machine Design**',S.K.Kataria and Sons, Delhi,2002.*
3. *V.N.Mittle and A.Mittle, '**Design of Electrical Machines**', Standard Publications Distributors, Delhi, 2002.*

COURSE OUTCOMES:

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

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	M	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	H	H
18EPE $23	M	H	H	H	L	L	M	H	M	M	H	H	M	H	M

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

18EPE$24	SMART GRID TECHNOLOGY

Category : PE

PRE-REQUISITES:

1. 18EPC502 Power Generation, Transmission and Distribution

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge on the fundamentals of smart grid technologies, its architecture and its managements, learn many of the challenges facing the smart grid as part of its evolution.

UNIT – I : SMARTGRIDS: MOTIVATION, STAKES AND PERSPECTIVES	**(9 Periods)**
Introduction – Information and Communication technologies serving the electrical system – Integration of advanced technologies – Definitions of Smart Grids – Objectives addressed by the Smart Grid concept – Socio-economic and environmental objectives – Stakeholders involved the implementation of the Smart Grid concept – Research and scientific aspects of the Smart Grid – Smart Grids from the customer's point of view.	
UNIT – II : INFORMATION AND COMMUNICATION TECHNOLOGY	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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 Smart Grids – The standardization of Smart Grids - 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. *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, August 2010.*
3. *Nouredine Hadjsaid, Jean-Claude Sabonnadiere "****Smart Grids****" Wiley Publishers Ltd., 2012.*

COURSE OUTCOMES:

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

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: Create 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	M	-	-	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	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
18EPE $24	M	L	M	M	M	M	M	L	M	M	M	H	M	M	M

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

18EPE$25	MODERN CONTROL THEORY

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. 18EPC403 Principles of Signals and Systems
2. 18EPC504 Control Systems Engineering

COURSE OBJECTIVES:

- To understand the concepts of Non-Linear system, Optimal Control and analyze the stability of Non-Linear system.

UNIT I : Z – TRANSFORM AND SAMPLED DATA SYSTEMS	**(9 Periods)**
Sampled data theory – Sampling process – Sampling theorem – Signal reconstruction – Sample and hold circuits – Z Transform – Theorems on Z Transforms – Inverse Z Transforms. Pulse transfer function- Response of sampled data system to step and ramp inputs- Steady state error- Stability studies- Jury's test and bilinear transformation.	
UNIT II : STATE SPACE ANALYSIS OF DISCRETE SYSTEMS	**(9 Periods)**
State variables – Canonical forms – Diagonalisation – Solutions of state equations – Controllability and observability – Effect of sampling time on controllability – Pole placement by state feedback – Linear observer design – First order and second order problems.	
UNIT III : NON-LINEAR SYSTEMS	**(9 Periods)**
Types of non linearity – Typical examples –Singular points – Limit cycles. Describing function – Stability analysis of Non-Linear systems through describing functions. Phase plane analysis — Construction of phase trajectories.	
UNIT IV : STABILITY ANALYSIS	**(9 Periods)**
Liapunov stability analysis – Stability in the sense of Liapunov – Definiteness of scalar functions – Quadratic forms- Second method of Liapunov – Liapunov stability analysis of linear time invariant systems and non-linear system.	
UNIT V : OPTIMAL CONTROL	**(9 Periods)**
Introduction to Optimal Control, statement of the optimal control problem, general introduction to the principle of optimality, discrete time linear quadratic problem, optimal state feedback solution. Formation of optimal control problems- Hamiltonian formulation-solution of optimal control problems- Evaluation of Riccati s equation State and output Regulator problems	

Contact Periods:

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

TEXT BOOKS:

1. *Gopal M., "**Digital Control and State Variable Methods**", Tata MC Graw Hill, 3rd Edition2008*
2. *Richard C. Dorf and Robert H. Bishop, "**Modern Control Systems**", 12th Edition, Pearson Education, 2004.*
3. *D.E. Kirk, "**Optimal Control Theory-An Introduction**", Prentice Hall, 2nd Edition 1998.*

REFERENCE BOOKS:

1. *Nagrath I.J. and Gopal M., "**Control Systems Engineering**", Wiley Eastern Limited, New Delhi, 5th Ed. 2008.*
2. *B.C. Kuo, "**Digital Control Systems**", Oxford University Press, Second Edition, 2007.*
3. *Loan D. Landau, Gianluca Zito, "**Digital Control Systems, Design, Identification and Implementation**", Springer, 2006.*
4. *Katsuhiko Ogato, "**Discrete-Time Control Systems**", Pearson Education Pvt., New Delhi, 2nd Edition, 2001.*

COURSE OUTCOMES:

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

CO1: Realization of the discrete systems and mathematical modeling.
CO2: Examine the properties of non-linear systems.
CO3: Analyze the stability of nonlinear systems
CO4: Design and Evaluate the optimal controller.
CO5: Able to apply advanced control strategies to practical 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	L	L	M	M	M	H	H	L	-
CO2	H	H	H	H	M	M	L	L	M	M	M	H	M	M	-
CO3	H	H	H	H	M	M	M	M	M	L	L	H	M	L	-
CO4	H	H	H	H	H	M	M	M	M	M	H	H	M	M	L
CO5	H	H	M	M	L	L	L	M	L	M	L	H	M	M	M
18EPE $25	H	H	H	H	M	M	L	M	M	M	M	H	M	M	M

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

18EPE$26	DISTRIBUTED GENERATION AND MICROGRID

Category : PE

PRE-REQUISITES:

1. 18EPC502 Power Generation, Transmission and Distribution

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study about the theory of distributed generations, operation, control and protection of Micro grid in standalone and grid integrated mode.

UNIT – I : INTRODUCTION TO DISTRIBUTED GENERATION	**(9 Periods)**
Renewable sources in distributed generation – Current scenario in distributed generation – Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems. Standards for interconnecting Distributed resources to electric power systems: IEEE 1547	
UNIT – II : DISTRIBUTED GENERATIONS	**(9 Periods)**
Solar energy - Photo voltaic system-Solar cells-PV modules-System design - Solar water heating-Types; Solar thermal power generation - water pumping applications; Wind power generation-power extraction- types of Wind Mills. Fuel cells- types- losses in fuel cell –applications.	
UNIT – III : GRID INTEGRATION OF DGs AND ENERGY STORAGE SYSTEMS	**(9 Periods)**
Different types of interfaces – Inverter based DGs and rotating machine based interfaces – Aggregation of multiple DG units – Energy storage systems – Batteries, ultra-capacitors, flywheels.	
UNIT – IV : MICROGRIDS	**(9 Periods)**
Types of micro-grids – Autonomous and non-autonomous grids – Sizing of micro-grids – Modeling and analysis - Micro-grids with power electronic interfacing units - AC and DC microgrids.	
UNIT – V OPERATION OF MICROGRID	**(9 Periods)**
Modes of operation: grid connected and islanded mode - Transients in micro-grids – Protection of microgrids - power quality issues in microgrids, microgrid economics - Introduction to smart microgrids - Case studies.	

Contact Periods:

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

TEXT BOOKS:

1. *G.D. Rai, "**Non Conventional energy Sources**", Khanna Publications ,New Delhi.2004*
2. *H. Lee Willis, Walter G. Scott , **"Distributed Power Generation – Planning and Evaluation"**, Marcel Decker Press, 2000.*
3. *Robert Lasseter, Paolo Piagi, **"Micro-grid: A Conceptual Solution"**, PESC 2004, June 2004.*

REFERENCE BOOKS:

1. *Loi Lei Lai, Tze Fun Chan, **"Distributed Generation- Induction and Permanent Magnet Generators"**, IEEE Press, John Wiley & Sons, Ltd., England. 2007.*
2. *John Twidell and Tony Weir, **"Renewable Energy Resources"**, Taylor and Francis Publications, Second edition 2006.*

COURSE OUTCOMES:

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

CO1: Understand the technical impacts of DGs in power systems

CO2: Comprehend the technical and economical issues occur during the grid integration of DGs

CO3: Familiarize the different Distributed Energy Resources of PV, Wind, fuel cell.

CO4: Operate and control the DC and AC Microgrid

CO5: Analyze the performance of Microgrid

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	-	-	-	-	L	M	H	L
CO2	H	H	M	M	L	L	M	-	-	-	-	L	M	H	L
CO3	H	H	M	M	L	L	M	-	-	-	-	L	M	H	L
CO4	H	H	H	H	H	M	M	-	-	-	M	M	M	H	M
CO5	H	M	H	H	H	M	M	-	-	-	M	M	M	H	M
18EPE $26	H	H	M	M	M	L	M	-	-	-	M	L	M	H	L

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

18EPE$27	ELECTRONIC CIRCUIT DESIGN (Common to EEE & EIE Branches)

Category : PE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Understand broad knowledge of the electronic circuit design from power supplies to SoCs including the connectivity solutions.
- Understand the nuances of electronic product design
- Understand the practical aspects of circuit design and analysis
- Analyze circuits for their static and dynamic behavior through Simulation

UNIT – I	INTRODUCTION TO ADAS, POWER SUPPLY, SWITCH AND DRIVES	(9 Periods)

Introduction: SAE ADAS Levels – Sensors - Connectivity Solutions - AI/ML - HW requirements - Design Challenges.

Non-ideal behavior of Components – Resistors , Capacitors; Inductors; Ferrite Beads; Fundamentals of BJT, MOSFET and IGBT gate driver circuits - Effect of Impedance mismatch and Signal Quality – Terminations & TDR. Linear and Switching regulators- Buck and Boost Converters - Stability, Performance, Dynamic Behavior - Voltage References - EMI Filters - high-side and low-side switches - H-bridge - Current Sensing Techniques.

UNIT – II	DATA CONVERTERS AND I/O INTERFACES	(9 Periods)

Digital IOs; PWM, Frequency Inputs; Data conversion; Quantization; Reference Voltages; Sampling Time; Resolution; ADC Errors – Non-linearity; Offset; Gain; Noise – reference Voltage signal - Dynamic Range – ENOB - Parasitic capacitance - Channel cross-talk - ADC/DAC interface – Design and Case Study

UNIT – III	SYSTEM ON CHIP (SOC)	(10 Periods)

Need for SoC - Components of a SoC - Heterogeneous processing cores : microprocessors, DSPs, hardware processing engines like audio, video, accelerators, memories, and I/O interfaces - System level On-chip Communication Architectures – Bus and NoC based, Application Specific Hardware Accelerators – GPU, Neural, MMA - device management, memory hierarchy, and data movement, virtualization - security, and power - Challenges and optimization of Interconnects, Partitioning and Mapping of a software function to hardware - Power/Performance/Area Trade Offs vs Reliability - Safety and Security Features - Interfaces – External Memory, I/O, ADC/DAC, UART, CAN, Ethernet, USB, MIPI; Insight into SoC Design Process (from RTL to Chip, Requirements and Design Iteration) - Dealing with Design Complexity (Buying IP and Reconfiguration); Comparison of SoCs from iMx8 (NXP); Jacinto 7(TI); Orin (nVidia); SDA series (Qualcomm) - MobiliEye (Intel); SoC from Tesla - Case studies from Automotive (ADAS)

UNIT – IV	PMICs and WIRED COMMUNICATIONS	(9 Periods)
Need for PMIC – On Chip Power Management, State Machine, Compensation Techniques - Voltage and Frequency Scaling - Applications; Examples – PF8101 (NXP), TPS659119-Q1 (TI), MAX20430 (Maxim) - Input and Output Supply Ranges - Power Sequence – Supervisory - Watchdog Operation. High Speed Links – Transmitter, Channel, Receiver - Common Mode Rejection – Serializer, De-Serializer - Controller Area Networks (CAN) - Ethernet (Automotive)-MII, RGMII, SGMII, XFI - Universal Serial Bus (USB) - Camera Interfaces (FPD or GMSL) - Power over Data Link (PoDL).		
UNIT – V	**WIRELESS COMMUNICATIONS**	**(8 Periods)**
Fundamentals of RF-Transmission Lines, Resonators, Antennas, Wave Propagation, Transmitters, Receivers - Digital Modulation Techniques - Channel Impairments - MIMO; WLAN; Bluetooth; Cellular – LTE/5G - Navigation Systems - Identification Systems-NFC, RFID; UWB; Case Study with WLAN (TI-CC3200 series)		

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

TEXT BOOK:

1 Ke-Horng Chen, Power Management for Integrated Circuit Design, Wiley, 2016

2 G. Manganaro, Advanced Data Converters. Cambridge: Cambridge Univ. Press, 2012

3 Michael.J. Flynn and Wayne Luk, Computer System Design: System-On-Chip, Hoboken, New Jersey: Wiley 2011

REFERENCES:

1 W. A. Kester, Data Conversion Handbook. Amsterdam: Elsevier Newnes, 2005

2 Beuchat R D, et.al, Fundamentals of System-on-Chip Design on Arm Cortex-M Microcontrollers, Arm Education Media, 2021

3 Joseph Yiu, System-on-Chip Design with Arm Cortex-M Processors: Reference Book, Cambridge: ARM Education Media, 2019

4 Mona M. Hella, and Patrick Mercier, Eds., Power management integrated circuits, CRC Press, 2016

5 Forouzan B A, Data Communications and Networking, 5th ed. India: McGraw-Hill, 2017

6 Maniktala S, Power over ethernet interoperability, New York, NY: McGraw-Hill, 2013.

7 Qizheng GU – RF System Design of Transceivers for Wireless Communications

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Given an application, break down a product into various functional blocks and realize an effective Hw architecture	Create
CO2	Read through data sheets and identify right devices for each functional block	Evaluate
CO3	Design a practical circuit for each functional block	Create
CO4	Analyze a functional circuit for its static and dynamic behavior through simulation using existing models	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	PSO 3
CO1	**H**	**H**	**H**	**H**	**M**	**-**	**L**	**-**	**-**	**L**	**L**	**-**	**M**	**M**	**M**
CO2	**H**	**H**	**H**	**H**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**M**	**L**
CO3	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**-**	**M**	**L**	**M**	**H**	**H**	**M**	**M**
CO4	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**-**	**M**	**L**	**M**	**H**	**H**	**H**	**M**
18EPE$27	**H**	**H**	**H**	**H**	**M**	**M**	**M**	**-**	**M**	**L**	**M**	**H**	**H**	**M**	**M**

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

18EPE$28	ELECTRONIC SYSTEM DESIGN AND PRODUCTIZATION *(Common to EEE & EIE Branches)*

PRE-REQUISITES: NIL

Category : PE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Understand broad knowledge of the design, development and fabrication of electronic products, printed circuit boards and systems
- Understand manufacturability requirements of an electronic product
- Understand the nuances of designing a "Reliable" product
- Understand Product Safety, Compliance & Certification; and knows what it takes to bring a product to the market

UNIT – I	PCB DESIGN, RULES, AND MANUFACTURABILITY	(8 Periods)

PCB Technology – Component Packaging, Layer Stackup, Via Technology, HDI Concept; PCB Materials – Grades and Specification, example - FR4, Weaving Concept, Low Loss & High Performance Materials, Mechanical and Thermal Properties; Layer Stackup – Copper Foil, Pre-pegs and Base Material (Core), Dimensional Stability, CAF Growth; PCB Design Process – Influence from Package types, Material Choices, Fabrication Methods, Lead-free Assembly; Current Capacity; Thermal Signatures, File Format, Rule Checks – ERC and DRC, Power, Ground, and Signal Trace Consideration; Choice of CAD tools; IPC Standards for PCB – Introduction.

UNIT – II	ELECTROMAGNETIC COMPATIBILITY AND COMPLIANCE	(10 Periods)

Introduction – History of Accidents, Impact of Technology Evolution, Importance of EMC and Regulations; EMC Concepts – Conducted, Radiated, Emissions, Susceptibility/Immunity; EMC Control Methods – Impedance Matching, Resonances, Balancing, Filtering, ESD Protection, Shielding, Grounding; PCB Design; Enclosure Design; EMC Prediction using Simulations; EMC Compliance – CISPR Test Setups, IEC Test Standards; Government Regulatory Requirements – FCC, RED, UNCECR10.

UNIT – III	THERMAL MANAGEMENT FOR ELECTRONICS AND LAB VISIT	(10 Periods)

Introduction, Heat Transfer Theory; Concept of thermal resistance; Use of datasheets; Passive and Active Cooling – Forced Air, Liquid, Thermo Electric Cooling; Aspects of Heat Sink Design; Thermal Modeling and Measurement – CFD; Heat Management in Automotive Applications.

Lab Visit : EMS Facility and EMC Test Lab.

UNIT – IV	DESIGN FOR RELIABILITY AND MANUFACTURING	(8 Periods)
Basic Concepts – Quality and Reliability Assurance; Analysis during the Design Phase; Qualification tests for Components and Assemblies; Design guidelines for Reliability and Maintainability; Statistical Quality Control and Reliability Tests; Check lists for Design Reviews; Design FMEA/DRBFM; MTBF Calculation.		
UNIT – V	**PRODUCT SAFETY, SECURITY, COMPLIANCE AND CERTIFICATION**	**(9 Periods)**
Need for Product Safety; Examples – Automotive; CE/ISO/IEC/BIS; Safety Education: Products-Hazards-Age; Voltage Faults – Surge, Ringing, Polarity reversal, Current fault – short circuit, Inrush, Reverse; Thermal – Over temperature, thermal protection; Battery Safety Standards; Product Construction Requirements; Resistance to Fire and Flame Rating; Human Factors – Ergonomic Hazards; Safety Instructions - Cautions and Warnings. Regulatory compliance – Product Specific - EMC, Safety, & RF; Substance Regulation – RoHS, WEEE, REACH etc; Labeling, Documentation, Marking, Packaging and Testing; Industry Compliance – Industry specific; Technical documentation; EU declaration of conformity; Regional (states, districts) Specific compliance – data security and material; Usage Instructions; Traceability; IATF 16949; ISO 9000; ISO140000; ASPICE; GDPR. Process of Certification : ISO/IEC 17065 Conformity Assessment; ISO 17011; Certifying Bodies; Standards; Marking/Certificate; Accreditation Bodies; IAF, FCC, CE, BIS, NABL.		

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

TEXT BOOK:

1 Clyde F. Coombs and Happy Holden – Printed Circuits Handbook, 7th Edition

2 Clayton R. Paul – Introduction to Electromagnetic Compatibility, Wiley 2006;

3 T. Yomi Obidi, Thermal Management in Automotive Applications, Warrendale, Pennsylvania, USA, SAE International 2015

REFERENCES:

1 Wilson, P, The Circuit Designer's Companion, 3rd Edition, Oxford, Newnes, 2011

2 Terence Rybak and Mark Stefafika – Automotive EMC, Kluwer Academic Publishers

3 Ralph Remsburg, Thermal Design of Electronic Equipment, CRC Press 2001

4 Alessandro Birolini – Reliability Engineering: Theory and Practice, 8 th Edition;

5 K. C. Kapur and M. Pecht, Reliability engineering, Hoboken, NJ; Wiley, 2014.

6 Swart, Jan, et.al, Electrical Product Compliance and Safety Engineering; Artech House, 2017

7 J. Doherty, Wireless and Mobile Device Security, 2nd ed. Jones and Bartlett Learning, 2021

8 Swart, Jan, et.al, Electrical Product Compliance and Safety Engineering; Artech House, 2017

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Engineer a product for large scale production	Create
CO2	Analyze a design for its failure modes; and design a reliable, safe product and compute its failure rate or MTBF	Analyze, Evaluate
CO3	Identify and fulfil all requirements for the Product compliance and certification considering EMC, RF, Safety and Security	Apply

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**	**-**	**-**	**L**	**M**	**-**	**M**	**M**	**H**	**H**	**H**
CO2	**H**	**H**	**H**	**H**	**M**	**M**	**M**	**L**	**M**	**M**	**L**	**M**	**M**	**M**	**M**
CO3	**H**	**H**	**H**	**H**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**H**
18EPE$28	**H**	**H**	**H**	**H**	**M**	**M**	**M**	**L**	**M**	**M**	**M**	**M**	**M**	**M**	**H**

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

18COE$01	CLIMATE CHANGE AND ADAPTATION *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Able get knowledge about Climate system and its changes and causes
- Able to learn about impacts, adaptation and mitigation of climate change
- Able to learn about clean technology and clean energy

UNIT – I : EARTH'S CLIMATE SYSTEM	**(9 Periods)**
Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes - The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.	
UNIT – II : OBSERVED CHANGES AND ITS CAUSES	**(9 Periods)**
Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.	
UNIT – III : IMPACTS OF CLIMATE CHANGE	**(9 Periods)**
Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.	
UNIT – IV : CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES	**(9 Periods)**
Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.	
UNIT – V : CLEAN TECHNOLOGY AND ENERGY	**(9 Periods)**
Clean Development Mechanism – Carbon Trading - examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.	

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

TEXT BOOKS:

1 *Jan C. van Dam,* ***"Impacts of Climate Change and Climate Variability on Hydrological Regimes"****, Cambridge University Press, 2009.*
2 *Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds.,* ***"Climate Change and Water"****. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 2008.*
3 *Dash Sushil Kumar,* ***"Climate Change – An Indian Perspective"****, Cambridge University Press India Pvt. Ltd, 2007.*
4 *IPCC Report Technical paper VI – Climate change and Water, 2008.*

REFERENCE BOOKS:

1 *IPCC fourth assessment report - The AR4 synthesis report, 2007*
2 *IPCC fourth assessment report –Working Group I Report, " The physical Science Basis",2007*
3 *IPCC fourth assessment report - Working Group II Report,* ***"Impacts, Adaptation and Vulnerability"****, 2007*
4 *Climate change 2014: Impacts, Adaptation and Vulnerability, IPCC*
5 *Climate change 2013: The Physical Science basis, IPCC.*
6 *www.environment.gov.au/climate-change/adaptation.*
7 *www.environment.org/explore-topics/climate-change/what.we.do/climate-adaptation.*

COURSE OUTCOMES:

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

CO1: Understand the climatic system and the factors influencing the climatic changes
CO2: Assess the uncertainty and impact of climatic changes
CO3: Understand the impacts of climate change in various sectors.
CO4: Develop strategies for adaptation and mitigation of climatic changes
CO5: Identify clean technologies for sustainable growth

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO4
CO1			M			L	L					L	L	L	L	
CO2	L					L	L					L	M	M	M	
CO3						L	L					L		H	H	
CO4	M	M	L	M		L	M					L	L	M	M	
CO5	L	M	M	M		L	H					L	L	M	L	
18COE $01	L	M	M	M		L	M					L	L	M	M	

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

18COE$02	DISASTER MANAGEMENT AND MITIGATION *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

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	**(9 Periods)**
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	**(9 Periods)**
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 Influncing Vulnerability, risk Perception.	
UNIT - III : MITIGATION AND PREPAREDNESS	**(9 Periods)**
Mitigation - types of mitigation ,Ostacles 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	**(9 Periods)**
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	**(9 Periods)**
Governmental Disaster management agencies- Fire, law, emergency management, Emergency medical service, Millitary 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 GovernmentalOrganaisations – operations, NGO/ Millitary coordination, standard of conduct. The role of Private sector and academia. Multilateral organaisations - UN agencies and progammes, Regional &Inernationalorganaisations. 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:

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

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:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS01	PS02	PSO3	PS04
CO1		L			L	L		L								
CO2	L	H		M	L	M						L	L			
CO3	L	L			H	M						L	L			
CO4	L	M		L	L	M	M									
CO5		M		L	L	M										
18COE $02	L	M		L	L	M	M					L	L			

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

18COE$03	ENERGY EFFICIENT BUILDINGS *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To understand the Concepts of Sustainable Environment, basics of energy analysis, simulation and management.
- To understand the concept of managing air quality.
- To understand the Green building concepts.

UNIT – I : INTRODUCTION	**(9 Periods)**
Life cycle impacts of materials and products – sustainable design concepts – strategies of design for the environment -the sun-earth relationship and the energy balance on the earth's surface, climate, wind – solar radiation and solar temperature – sun shading and solar radiation on surfaces – energy impact on the shape and orientation of buildings – thermal properties of building materials.	
UNIT – II : ENERGY EFFICIENT TECHNIQUES	**(9 Periods)**
Passive Cooling And Day Lighting – Active Solar And Photovoltaic- Building Energy Analysis Methods- Building Energy Simulation- Building Energy Efficiency Standards- Lighting System Design- Lighting Economics and Aesthetics- Impacts of Lighting Efficiency – Energy Audit and Energy Targeting- Technological Options For Energy Management.	
UNIT – III : INDOOR ENVIRONMENTAL QUALITY MANAGEMENT	**(9 Periods)**
Psychrometry- Comfort Conditions- Thermal Comfort- Ventilation And Air Quality Air Conditioning Requirement- Visual Perception- Illumination Requirement- Auditory Requirement-Energy Management Options- Air Conditioning Systems- Energy Conservation In Pumps- Fans And Blowers-Refrigerating Machines- Heat Rejection Equipment- Energy Efficient Motors- Insulation.	
UNIT – IV : GREEN BUILDING CONCEPTS	**(9 Periods)**
Green Building Concept- Green Building Rating Tools- Leeds And IGBC Codes. – Material Selection Embodied Energy- Operating Energy- Façade Systems- Ventilation Systems- Transportation- Water Treatment Systems- Water Efficiency- Building Economics.	
UNIT – V : GREEN BUILDING DESIGN CASE STUDY	**(9 Periods)**
Students To Work Through A Controlled Process of Analysis And Design To Produce Drawings and Models Of Their Own Personal Green Building Project. Topics Include Building Form, Orientation and Site Considerations; Conservation Measures; Energy Modeling; Heating System And Fuel Choices; Renewable Energy Systems; Material Choices; and Construction Budget-Students Will Research Green Construction and Design in A Particular -Construction Context and Report Their Results to the Class.	

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

TEXT BOOKS:

1 *Kibert, C.* ***"Sustainable Construction: Green Building Design and Delivery"****, John Wiley & Sons, 4th Edition, 2016.*

2 *Edward G Pita,* ***"An Energy Approach- Air-Conditioning Principles and Systems"****, Pearson Education, 2003.*

3 *Satyajit Ghosh, Abhinav Dhaka,* ***"Green structures: Energy efficient buildings"****, 2015.*

REFERENCE BOOKS:

1 *Colin Porteous,* ***"The New Eco-Architecture"****, Spon Press, 2002.*

2 *Ganesan T P,* ***"Energy Conservation in Buildings"****, ISTE Professional Center, Chennai, 1999.*

3 *NPTEL* ***"Energy Efficiency and Simulation"****, Prof.E.Rajsekar., IIT Roorkee.*

4 *Energy Conservation Building Codes: www.bee-india.nic.in*

5 *Lever More G J,* ***"Building Energy Management Systems"****, E And FN Spon, London, 2000.*

6 *NPTEL* ***"Energy efficiency acoustics and day lighting in building"****, Prof.B.Bhattacharjee., IIT Delhi.*

COURSE OUTCOMES:

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

CO1: Understand the Concepts of Sustainable Environment.

CO2: Understand the basics of energy analysis, simulation and management.

CO3: Understand the concept of managing air quality.

CO4: Understand the Green building concepts.

CO5: Create drawings and models of their own personal green building project

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO4
CO1	L	M	L			M	M	L	L	L		L	L	M	L	
CO2			L	L		L	L					L		L		
CO3		L				L	M	L				L		L		
CO4	L	M					H					M		M		
CO5	M	M	H	L			H	L	M		M	M		H	L	
18COE $03	L	M	H	L		M	H	L	L	L	M	M	L	H	L	

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

18MOE$04	NANOTECHNOLOGY AND SURFACE ENGINEERING *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To Understand and analyze the concepts of Quantum confinement, Dimensional structures and Properties of Nanosystems.
- To be familiar with various methods of synthesis of Nanomaterials.
- To analyze and understand the mechanical and electrical properties of Nanomaterial and its applications.

UNIT – I: PROPERTIES OF NANOMATERIALS	**(9 Periods)**
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	**(9 Periods)**
Sol-Gel Process - Self-assembly – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis – Metal nano-crystals by Reduction – Solvo-thermal 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 – Applications.	
UNIT – III : MECHANICAL AND ELECTRICAL PROPERTIES	**(9 Periods)**
Nanoscale Mechanics - Introduction – Mechanical properties – The Elasticity of Nanomaterials – Elasticity of Bulk Nanomaterials –Plastic Deformation of Nanomaterials – Crystals and Crystal Plasticity – From Crystal Plasticity to Polycrystal Plasticity. Introduction - Energy Storage Basics - Electrical Energy Storage Devices and Impact of Nanomaterials - Electrochemical Properties of Nanoscale Materials - Aerogels and Structure-Directed Mesoporous and Macroporous Solids - Nanoparticles - Nanotubes, Nanowires, and Nanorolls.	
UNIT – IV : FUNDAMENTALS OF SURFACE ENGINEERING	**(9 Periods)**
Surface engineering - classification, definition, scope and general principles, Conventional surface engineering - Surface engineering by material removal: Cleaning, pickling, etching, grinding, polishing, buffing / puffing, Surface engineering by material addition - From liquid bath, hot dipping, Electro-deposition / plating.	
UNIT – V : SURFACE MODIFICATION	**(9 Periods)**
Surface modification of steel and ferrous components - Pack carburizing, Aluminizing, calorizing, diffusional coatings (principle and scope of application), Surface modification using liquid/molten bath: Cyaniding, liquid carburizing (diffusion from liquid state), Surface modification using gaseous medium: Nitriding, Carbo-nitriding (diffusion from gaseous state).	

Contact Periods:

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

TEXT BOOKS:

*1. Kelsall Robert W, Ian Hamley and Mark Geoghegan, —**"Nanoscale Science and Technology"**,Wiley Eastern, 2004.*
*2. N John Dinardo, **"Nanoscale Charecterisation of Surfaces & Interfaces**", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.*
*3. ASM Metals Hand Book –Vol. 5, **"Surface Engineering"**, 1996.*

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. GuozhongGao,**"Nanostructures & Nanomaterials: Synthesis, Properties & Applications**", Imperial College Press (2004).*
*4. K.G. Budinski, **"Surface Engineering for Wear Resistances",** Prentice Hall, Englewood Cliffs, 1988.*

COURSE OUTCOMES:

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

CO1: Analyze the particle size, particle shape, particle density, Size effect and properties of Nanostructures.

CO2: Acquire knowledge in various methods of synthesis of Nanomaterials.

CO3: Analyze the Elasticity of Nanomaterials, Electrical Energy Storage Devices and Aerogels.

CO4: Apply various Nanomaterials to the LED, Transistor Applications.

CO5: Apply various surface engineering techniques

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	M	M	L	L	M	L	M	M	M	L	M	M	M	M	M
CO2	H	H	M	H	H	L	L	M	M	M	L	H	M	H	M
CO3	H	H	L	H	M	M	L	L	M	M	M	M	M	H	M
CO4	L	H	M	H	M	M	L	L	M	M	M	M	M	H	M
CO5	M	M	L	M	M	L	M	M	M	L	M	M	M	H	M
18MOE$04	H	H	L	M	H	M	H	H	M	H	M	M	M	M	M

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

18MOE$05	**MECHATRONICS** *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To study the mechatronics system and understanding the concepts of integration and design of mechatronics system.

UNIT – I : SYSTEM MODELS	**(9 Periods)**
Introduction - Definition of Mechanical Systems, Philosophy and approach. Systems and Design - Mechatronic approach, Integrated Product Design - Modeling- Analysis and Simulation, Man-Machine Interface.	
UNIT – II : SENSORS AND TRANSDUCERS	**(9 Periods)**
Sensors and transducers - classification, Development in Transducer technology, Optoelectronics - Shaft encoders, CD Sensors, Vision System.	
UNIT – III : DRIVES AND ACTUATORS	**(9 Periods)**
Drives and Actuators - Hydraulic and Pneumatic drives - Electrical Actuators - servo motor and Stepper motor, Drive circuits, open and closed loop control - Embedded Systems - Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems.	
UNIT – IV : SMART MATERIALS	**(9 Periods)**
Smart materials - Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators - Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation.	
UNIT – V : MICROMECHATRONIC SYSTEMS	**(9 Periods)**
Micromechatronic systems - Microsensors, Microactuators - Micro-fabrication techniques - LIGA Process- Lithography, etching, Micro-joining. Application examples - Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.	

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

TEXT BOOKS:

*1. W.Bolton, **"Mechatronics"**, Longman,2nd Edition,1999*

REFERENCE BOOKS:

1. *Michael B. Histand and David G.Alciatore,* ***"Introduction to Mechatronics and Measurement Systems"****, Tata McGraw Hill, 2nd Edition,2003*
2. *D.A.Bradley, D.Dawson, N.C.Buru and A.J.Loader,* ***"Mechatronics"*** *Chapman and Hall,1993*
3. *Dan S Necsulescu,* ***"Mechatronics"****, Pearson Education Asia,2005*
4. *Devdas Shetty, Richard A. Kolk,* ***"Mechatronics System Design"****, Thomson, PWS publishing, 2007.*
5. *Smaili.A and Mrad.F,* ***"Mechatronics: Integrated Technologies for Intelligent Machines"****, Oxford university press, 2008*

COURSE OUTCOMES:

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

CO1: Identify the key elements of mechatronics system and models.

CO2: Select appropriate sensors and transducers for industrial application.

CO 3: Integrate mechanical, electrical, electronics, control systems in the mechatronics system design

CO 4. Select the proper smart material for mechatronics system.

CO 5: Apply the principles of mechatronics in industrial needs.

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	H	H	H	M	L	H	L	L	H	L	M	L	M	H	L
CO2	H	H	H	L	L	H	L	L	M	L	M	L	M	H	L
CO3	H	H	H	L	L	H	L	L	M	L	M	L	M	H	L
CO4	H	H	H	M	H	H	L	L	M	M	L	L	H	H	L
CO5	H	H	H	M	L	H	L	L	H	M	M	M	H	H	L
18MOE$05	H	H	H	H	L	H	L	L	M	L	M	L	M	H	L

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

18EOE$07	RENEWABLE POWER GENERATION SYSTEMS *(Common to All Branches)*

Category : OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To elucidate the technologies used for generation and utilization of power from renewable energy resources.

UNIT-I : SOLAR ENERGY	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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. 2016*
2. *Rai , G.D., "**Non-Conventional sources of Energy**", Khanna Publishers , V Ed.,2016*

REFERENCE BOOKS:

1. *Khan. B.H, "Non-Conventional Energy Resources", The McGraw Hills, Second edition, 2016.*
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 OUTCOMES:

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

CO1: Understand the concept of various Non-Conventional energy resources

CO2: Familiarize the principles of operation of renewable energy technologies

CO3: Realize the need for utilizing the energy from clean and Sustainable energy resources.

CO4: Interpret advantages and disadvantages of different renewable sources of energy

CO5: Comprehend the environmental aspects and the correlation between different operational parameters

CO6: Evaluate the options and estimate the energy generation through renewable sources

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	M	M
CO2	H	H	M	L	M	M	M	L	-	-	-	-	H	H	H
CO3	H	M	M	M	M	M	M	-	-	-	-	-	M	H	H
CO4	M	H	M	L	M	H	M	-	-	-	-	-	H	H	H
CO5	M	H	L	H	M	M	M	-	-	-	L	-	M	H	M
CO6	H	M	M	L	M	M	M	-	L	-	L	-	M	H	M
18EOE $07	H	H	M	M	-	M	M	L	L	-	L	-	H	H	H

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

18EOE$08	ELECTRIC VEHICLES *(Common to All Branches)*

Category : OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the technology of Electric and Hybrid Electric Vehicles and their business perspective

UNIT-I : INTRODUCTION	**(9 Periods)**
Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	
UNIT-II : ELECTRIC TRAINS	**(9 Periods)**
Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, Switch Reluctance Motor drives- drive system efficiency.	
UNIT-III : ANALYSIS OF ENERGY STORAGE	**(9 Periods)**
Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.	
UNIT-IV : ENERGY MANAGEMENT STRATEGIES	**(9 Periods)**
Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.	
UNIT-V : BUSINESS PERSPECTIVE OF ELECTRIC VEHICLE	**(9 Periods)**
Design of a Hybrid Electric Vehicle (HEV) - Design of a Battery Electric Vehicle (BEV) Hybrid Electric Heavy Duty Vehicles, Fuel Cell Heavy Duty Vehicles. Business: E-mobility business, electrification challenges, Connected mobility and Autonomous mobility- case study: E-mobility Indian Roadmap Perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs.	

Contact Periods:

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

TEXT BOOKS:

1. *Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, "**Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design**", CRC press, 2004.*
2. *C. Mi, M. A. Masrur and D. W. Gao, "**Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives**", John Wiley & Sons, 2011.*
3. *S. Onori, L. Serrao and G. Rizzoni, "**Hybrid Electric Vehicles: Energy Management Strategies**", Springer, 2015.*

REFERENCE BOOKS:

1. *James Larminie and John Loury, "**Electric Vehicle Technology – Explained**", John Wiley & Sons Ltd, 2003.*
2. *Sandeep Dhameja, "**Electric Vehicle Battery Systems**", Butterworth – Heinemann, 2002.*
3. *Ronald K Jurgen, "**Electric and Hybrid – Electric Vehicles**", SAE, 2002.*
4. *Ron Hodkinson and John Fenton, "**Light Weight Electric/ Hybrid Vehicle Design**", Butterworth – Heinemann, 2001.*
5. *T. Denton, **"Electric and Hybrid Vehicles"**, Routledge, 2016.*

COURSE OUTCOMES:

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

CO1: Understand the basics of electric vehicle components and configuration.
CO2: Analyze suitable drive scheme for developing an electric vehicle.
CO3: Able to opt a proper energy management system.
CO4: Analyze the performance of practical HEV and EV.
CO5: Understand the infrastructure for Electric Vehicles and business potential.

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	-	-	-	-	L	M	M	-
CO2	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
CO3	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
CO4	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
CO5	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
18EOE $08	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-

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

18EOE$09	SMART GRID SYSTEMS *(Common to All Branches)*

Category : OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

***** To comprehend the underlying techniques applied to Smart Grid

UNIT-I : BASICS OF POWER SYSTEMS	**(9 Periods)**
Basics of Power Systems: Load and Generation - Power Flow Analysis- Economic Dispatch and Unit Commitment Problems. Smart Grid: Definition – Applications- Government and Industry-Standardization	
UNIT-II : SMART GRID COMMUNICATIONS	**(9 Periods)**
Two-way Digital Communications Paradigm - Network Architectures - IP-based Systems - Power Line Communications - Advanced Metering Infrastructure	
UNIT-III : WIDE AREA MEASUREMENT	**(9 Periods)**
Sensor Networks - Phasor Measurement Units- Communications Infrastructure- Fault Detection and Self-Healing Systems -Applications and Challenges	
UNIT-IV : SECURITY AND PRIVACY	**(9 Periods)**
Cyber Security Challenges in Smart Grid - Load Altering Attacks- False Data Injection Attacks- Defense Mechanisms - Privacy Challenges- Cyber Security Standards	
UNIT-V : ECONOMICS AND MARKET OPERATIONS	**(9 Periods)**
Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process - Entities involved. The market place mechanisms-Energy and Reserve Markets- Market Power - Generation Firms- Locational Marginal Prices= Financial Transmission Rights	

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. 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. Lars T. Berger, Krzysztof Iniewski "**Smart Grid applications, Communications and Security**" John Wiley Publishers Ltd., 2012.*

*2.Yang Xiao, **"Communication and Networking in Smart Grids",** CRC Press Taylor and Francis Group, 2012.*

*3. Caitlin G. Elsworth, **"The Smart Grid and Electric Power Transmission"**, Nova Science Publishers Inc, August 2010.*

COURSE OUTCOMES:

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

CO1: Demonstrate the various aspects of the smart grid, including Technologies, Components, Architectures and applications

CO2: Creating a framework to operate the grid more effectively.

CO3: Evaluate the existing grid with respect to smart grid

CO4: Upgrade the existing grid to smart grid 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	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
18EOE $09	L	L	M	M	M	M	H	L	M	M	M	H	M	H	H

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

18LOE$10	**MOBILE COMMUNICATION** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the concept of Mobile radio propagation, cellular system design
- To understand mobile technologies like GSM and CDMA.
- To know the mobile communication evolution of 2G, 3G and 3 GPP in detail.
- To have overview of immerging technologies application.

UNIT I WIRELESS COMMUNICATION	**(9 Periods)**
Cellular systems- Frequency Management and Channel Assignment- types of handoff and their characteristics, dropped call rates & their evaluation -MAC – SDMA – FDMA – TDMA – CDMA – Cellular Wireless Networks.	
UNIT II WIRELESS NETWORKS	**(9 Periods)**
Wireless LAN – IEEE 802.11 Standards – Architecture – Services – Mobile Ad hoc Networks- WiFi and WiMAX - Wireless Local Loop.	
UNIT III MOBILE COMMUNICATION SYSTEMS	**(9 Periods)**
GSM-architecture-Location tracking and call setup- Mobility management- Handover-Security-GSM SMS – International roaming for GSM- call recording functions-subscriber and service data mgt – Mobile Number portability -VoIP service for Mobile Networks – GPRS – Architecture-GPRS procedures-attach and detach procedures-PDP context procedure-combined RA/LA update procedures-Billing	
UNIT IV MOBILE NETWORK AND TRANSPORT LAYERS	**(9 Periods)**
Mobile IP – Dynamic Host Configuration Protocol-Mobile Ad Hoc Routing Protocols– Multicast routing-TCP over Wireless Networks – Indirect TCP – Snooping TCP – Mobile TCP – Fast Retransmit / Fast Recovery – Transmission/Timeout Freezing-Selective Retransmission – Transaction Oriented TCP- TCP over 2.5 / 3G wireless Networks.	
UNIT V APPLICATION LAYER	**(9 Periods)**
WAP Model- Mobile Location based services -WAP Gateway –WAP protocols – WAP user agent profile- caching model-wireless bearers for WAP - WML – WMLScripts - WTA - iMode - SyncML.	

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

TEXT BOOKS:

*1. John Schiller, "**Mobile Communications**", Second Edition, Pearson Education, 2003.*
*2. William Stallings, "**Wireless Communications and Networks**", Pearson Education, 2002.*

REFERENCES BOOKS:

*1. Kaveh Pahlavan, Prasanth Krishnamoorthy, "**Principles of Wireless Networks**", First Edition, Pearson Education, 2003.*

*2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "**Principles of Mobile Computing**", Springer, 2003.*

*3. C.K.Toh, "**AdHoc Mobile Wireless Networks**", First Edition, Pearson Education, 2002.*

COURSE OUTCOMES:

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

CO1: Understand GSM, CDMA concepts and architecture, frame structure, system capacity, services provided.

CO2: Study of evolution of mobile communication generations 2G, 2.5G, 3G with their characteristics and limitations.

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	-
18LOE $10	M	M	M	-	-	-	-	-	-	-	-	L	M	L	-

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

18LOE$11	INTRODUCTION TO VLSI SYSTEM DESIGN *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce various aspects of CMOS logic design in combinational and sequential circuit to design CMOS VLSI system components

UNIT I: CMOS LOGIC DESIGN	**(9 Periods)**
Inverter- CMOS Logic Gates: Compound Gates – Pass Transistors and Transmission Gates – Tristated – Multiplexers –CMOS Fabrication and Layout: Fabrication Process – Layout Design rule – Gate Layouts – Stick Diagrams – Design Partitioning	
UNIT II: MOS TRANSISTOR THEORY	**(9 Periods)**
Introduction – Long Channel I-V Characteristics – C-V Characteristics – Non-ideal I-V Effects – DC Transfer Characteristics – CMOS Technologies – Sources of Power Dissipation - Dynamic Power – Static Power.	
UNIT III: COMBINATIONAL CIRCUIT DESIGN	**(9 Periods)**
Circuit Families: Static CMOS – Ratioed Circuits – Cascode Voltage Switch Logic – Dynamic Circuits – Pass Transistor Circuits. Silicon-on-Insulator Circuit Design – Subthreshold Cirucit Design	
UNIT IV: SEQUENTIAL CIRCUIT DESIGN	**(9 Periods)**
Sequential static circuits – Circuit design of latched and flip-flops – Sequencing dynamic circuits – Synchronizers – Wave pipelining - VLSI clocking: CMOS clocking styles - Pipelined systems - Clock generation and distribution.	
UNIT V: DESIGN OF VLSI SYSTEMS	**(9 Periods)**
System Specifications – Structural Gate Level Modeling – Switch Level Modeling – Behavioral and RTL Modeling - Addition/subtraction – Comparators –counters —Multiplexers - Binary Decoders – Comparators – Priority Encoders – Latches - Flip-Flops and Registers – SRAM – DRAM – ROM.	

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

TEXT BOOKS:

1. *N. Weste and David Money Harris, "**CMOS VLSI Design**", Fourth Edition, Pearson Education,2011.*
2. *Uyemura, John P, "**Introduction to VLSI Circuits and Systems**", Wiley & Sons, 8th Reprint 2009*

REFERENCE BOOKS:

1. *Jan M. Rabaey, "**Digital Integrated Circuits: A Design Perspective**", PHI, Second Edition, 2012.*
2. *R. Jacob Baker, "**CMOS: Circuit Design, Layout, and Simulation**", Wiley-IEEE, Revised Second Edition, 2008.*
3. *Pucknell, "**Basic VLSI Design**", Prentice Hall, 2006.*

COURSE OUTCOMES:

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

CO1: Realize the CMOS logic design

CO2: Acquire knowledge on combinational and sequential circuit design of CMOS logic

CO3: Use VLSI clocking styles and realize CMOS VLSI system components

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	L	L
CO2	M	M	M	-	-	-	-	-	-	-	-	L	M	L	L
CO3	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
18LOE $11	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L

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

18LOE$12	MICROCONTROLLER AND APPLICATIONS *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Describe the architecture of 8051 microcontroller.
- Develop assembly program for 8051.
- Apply the instruction set of 8051 to get effective programs.
- Design system in block level using microcontroller, memory devices, buses and other peripheral devices.
- Solve real life problem using microcontroller based systems.

UNIT I: MICROCONTROLLER	**(9 Periods)**
Microcontroller Features – On chip oscillator, List of Special Function Registers (SFRs), On chip program memory, on chip data memory, I/O Ports, Watch Dog Timer, Architecture of 8051, Instruction set - Addressing modes.	
UNIT II: ASSEMBLY LANGUAGE PROGRAMMING	**(9 Periods)**
8051 Assembly Language Programming, Branch Instruction Programming -I/O Port Programming – Arithmetic and Logic Instruction Programming-code conversion programming	
UNIT III: PROGRAMMING IN C AND INTERFACING-I	**(9 Periods)**
Timers & Counters programming - Serial Port Programming - Interrupts Programming .8255 Interfacing and Programming- External Memory Interfacing - LCD interfacing, LED Interfacing	
UNIT IV: INTERFACING-II	**(9 Periods)**
Keyboard Interfacing - ADC, DAC interfacing –Temperature Transducer-Pressure and Displacement Transducer-Light Sensor - Optocoupler - Relays.	
UNIT V: APPLICATIONS OF MICROCONTROLLERS	**(9 Periods)**
Stepper Motor interface-Temperature Monitoring and Control System-Speed Control of a DC Motor - Digital Thermometer-Digital Frequency Meter.	

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

TEXT BOOKS:

*1.Mohammad Ali Mazidi, Janice Gillispie Mazidi, **"The 8051 Microcontroller and Embedded Systems (Using assembly and C)"**, Pearson education / Prentice Hall of India Pvt. Ltd., 2007.*
*2. Ajit Pal, **"Microcontrollers : Principles and Applications"**, Prentice-Hall of India Pvt. Ltd;1 edition (August 2011).*

REFERENCE BOOKS:

1. *Krishna Kanth, **"Microprocessor and Microcontroller Archotecture, Programming and System Design using 8085, 8086, 8051"**, Prentice Hall of India, 2011.*
2. *Kenneth J.Ayala, **"The 8051 Microcontroller"** 3rd edition, Thompson Delmar Learning,2007, New Delhi.*
3. *Jacob Fraden, **"Handbook of Modern Sensors: Physics, Design and Applications"**, 3rd ed, Springer, 2010.*
4. *Michael J. Pont, **"Embedded C"**, Pearson Education India, 1st edition (*2007*);*

COURSE OUTCOMES:

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

CO1: Describe the architectures of controller

CO2: Develop Assembly program applying Digital logic and mathematics using 8051 instruction set

CO3: Design microcontroller based system within realistic constraint like user specification, availability of components etc

CO4: Interface real world sensors

CO5: Solve real life problem and construct a complete system as a solution

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	L	L
CO2	M	M	M	-	-	-	-	-	-	-	-	L	M	L	L
CO3	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
CO4	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
CO5	M	M	M	-	-	-	-	-	-	-	-	L	M	L	L
18LOE $12	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L

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

18POE$13	RAPID PROTOTYPING *(Common to All Branches)*

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To educate students with fundamental and advanced knowledge in the field of Rapid Prototyping technology and the associated Aerospace, Architecture, Art, Medical and Industrial applications.

UNIT- I	INTRODUCTION	(9 Periods)
Need - Development of RP systems – Applications in Product Development - Virtual Prototyping- Rapid Tooling – Rapid Manufacturing - Classification of RP processes – Benefits - Applications		
UNIT- II	**REVERSE ENGINEERING AND CAD MODELING**	**(9 Periods)**
Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wireframe, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for RP- Case studies.		
UNIT- III	**LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS**	**(9 Periods)**
Classification – Liquid based systems - Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and application. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.		
UNIT- IV	**POWDER BASED RAPID PROTOTYPING SYSTEMS**	**(9 Periods)**
Selective Laser Sintering (SLS): Principle, process, indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications – case Studies, Selective Laser Melting and Electron Beam Melting		
UNIT- V	**OTHER RAPID PROTOTYPING SYSTEMS**	**(9 Periods)**
Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, Demerits, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Bio Additive Manufacturing.		

Contact Periods:

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

TEXT BOOKS:

1. *Chua Chee Kai and Leong Kah Fai* ***"Rapid Prototyping: Principles and Applications in Manufacturing",*** *John Wiley AND Sons, 1997.*
2. *Paul F. Jacobs* ***"Stereo-lithography and other RP & M Technologies",*** *from Rapid Prototyping to Rapid Tooling, SME/ASME,1996.*

REFERENCE BOOKS:

1. *Gibson, I., Rosen, D.W. and Stucker, B* ***"Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing",*** *Springer, 2010.*
2. *Chua, C.K., Leong K.F. and Lim C.S* ***"Rapid prototyping: Principles and applications",*** *second edition, World Scientific Publishers, 2010.*
3. *Gebhardt, A* ***"Rapid prototyping",*** *Hanser Gardener Publications, 2003.*
4. *Liou, L.W. and Liou, F.W* ***"Rapid Prototyping and Engineering applications: A tool box for prototype development",*** *CRC Press, 2011.*
5. *Hilton, P.D. and Jacobs, P.F* ***"Rapid Tooling: Technologies and Industrial Applications",*** *CRC press, 2005*

COURSE OUTCOMES:

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

CO1: Appreciate the importance of computers and modern tools in manufacturing to reduce cost and matching the societal needs.

CO2: Create and analyze 2D and 3D models using CAD modeling software and integrating with manufacturing systems.

CO3: Understand the variety of Additive Manufacturing (AM) technologies apply to their potential to support design and manufacturing, case studies relevant to mass customized manufacturing.

CO4: Apply knowledge on latest techniques of manufacturing in their field of career

CO5: To monitor and control shop floor with the aid of computers

COURSE ARTICULATION MATRIX

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			L				M						L	L	
CO2			M											M	L
CO3			L										M	L	
CO4			M		H	M	L						M	H	L
CO5		M				L					M		L	H	
18POE$13		M	M		M	L	L				L		M	M	L

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

18POE$14	MANAGERIAL ECONOMICS *(Common to All Branches)*

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To introduce the fundamental economic principles necessary for production managers.

UNIT- I	FUNDAMENTALS OF MANAGERIAL ECONOMICS	(9 Periods)
Goals and Constraints - The Nature and Importance of Profits - Understanding Incentives - Economic rationality, Scarcity and opportunity cost -Marginal and Incremental Analysis.		
UNIT- II	**DEMAND ANALYSIS**	**(9 Periods)**
Demand and Supply -Market Equilibrium - Price Elasticity of Demand - Price Elasticity, Total Revenue, and Marginal Revenue - Factors Affecting Price Elasticity - Cross Price Elasticity - Income Elasticity of Demand - Other Elasticities, Elasticities for Nonlinear Demand Functions - Elasticity of Supply.		
UNIT- III	**DEMAND THEORIES**	**(9 Periods)**
Choice and Utility Theory - Law of Diminishing marginal utility - Consumer Equilibrium - Consumer Surplus - Price effect, Substitution Effect and Income Effect.		
UNIT- IV	**THEORY OF PRODUCTION AND COST**	**(9 Periods)**
The Production Function - Profit-Maximizing Input Usage - Isoquants and Isocosts - Cost Minimization and Optimal Input Substitution - The Cost Function - Breakeven analysis, Contribution analysis - Long-run Costs and Economies of Scale - Multiple Cost Functions and Economies of Scope - Learning curve.		
UNIT- V	**THEORY OF MARKET AND PRICING**	**(9 Periods)**
The Nature of Industry - Perfect Competition – Monopoly - Monopolistic Competition – Oligopoly - Product pricing.		

Contact Periods:

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

TEXT BOOKS:

1. *Thomas and Maurice **"Managerial Economics: Concept and Applications",** McGraw-Hill, 2005*
2. *Maheshwari.Y **"Managerial Economics",** Prentice Hall of India, 2012*

REFERENCE BOOKS:

1. *D.N. Dwivedi, **"Managerial Economics",** Vikas Publishing house, 2015*
2. *Christopher R Thomas, S Charles Maurice, **"Managerial economics",** Mcgraw Hill, 2014*

COURSE OUTCOMES:

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

CO1: Explain fundamentals of managerial economics.

CO2: Discuss the dynamics of market forces.

CO3: Explain about various theories of demand.

CO4: Discuss about the cost concepts related to production.

CO5: Describe about the theory of market and pricing method.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	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	M	M	L			L
CO2	L	L	L							M	M	L			L
CO3	L									L	M	L			L
CO4	L									L	L	L			L
CO5	L	M	M	L						L	M	L			L
18POE$14	L	L	L	L						L	M	L			L

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

18POE$15	HYDRAULICS AND PNEUMATICS *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To make the students to design the hydraulic and pneumatic circuits for different applications.

UNIT- I	**BASIC PRINCIPLES**	**(9 Periods)**
Hydraulic Principles; Hydraulic Fluids; Hydraulic pumps – Classification, Characteristics, Pump Selection; Hydraulic actuators; Hydraulic valves – Pressure, Flow, Direction Controls, Applications, Symbols.		
UNIT- II	**HYDRAULIC CIRCUITS**	**(9 Periods)**
Hydraulic circuits – Reciprocating, Quick Return, Sequencing, Synchronizing, Regenerative circuit, Double pump hydraulic system; Safety Circuits.		
UNIT- III	**POWER GADGETS IN HYDRAULICS**	**(9 Periods)**
Accumulators – Classification, Circuits; Pressure Intensifier and Circuit; Mechanical-hydraulic servo system; Selection of components. Installation and Maintenance of Hydraulic power pack; Troubleshooting of fluid power circuits.		
UNIT- IV	**PNEUMATIC SYSTEMS**	**(9 Periods)**
Pneumatic Fundamentals; Control Elements; Logic Circuits; Position sensing, Pressure sensing; Electrical controls: Various switches; Electro Pneumatic and Electro Hydraulic Circuits.		
UNIT- V	**DESIGN AND SELECTION OF PNEUMATIC CIRCUITS**	**(9 Periods)**
Design of Pneumatic circuits – Classic, Cascade, Step counter; PLC and Microprocessors – Uses; Selection criteria for Pneumatic components; Installation and Maintenance of Pneumatic power pack; Fault finding; Case studies.		

Contact Periods:

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

TEXT BOOKS:

1. *Anthony Esposito,* ***"Fluid Power with Applications",*** *Pearson Education India, 7th edition, 2013.*
2. *Andrew Parr,* ***"Hydraulics and Pneumatics:A Technician's and Engineer's Guide",*** *Butterworth-Heinemann, 3rd edition, 2011.*

REFERENCE BOOKS:

1. *DudleyA Pease and John J Pippenger* ***"Basic Fluid Power",*** *Prentice Hall PTR, 2nd edition 1987.*
2. *John J Pippenger and Tyler G Hicks* ***"Industrial Hydraulics",*** *McGraw Hill,2nd edition, 1970.*
3. *J. Michael, Pinches and HohnG.Ashby* ***"Power Hydraulics",*** *Prentice Hall, 1989.*

COURSE OUTCOMES:

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

CO1: Describe the principle of fluid power
CO2: Describe the components of hydraulics
CO3: Design the hydraulic circuits for automation
CO4: Describe the components of pneumatics
CO5: Design the pneumatic circuits for automation

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	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		
CO2	M											M	L		
CO3	M	H										M	L		
CO4	M											M	L		
CO5	M											M	L		
18POE$15	M	H										M	L		

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

18NOE$16	MEASUREMENT AND CONTROL *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE

- To learn about the working of different analog and digital instruments.

UNIT I – INTRODUCTION TO MEASUREMENTS	**(9 Periods)**
Significance of measurements – Methods of measurements – Classification of Instruments – Functions of Instruments and Measurement System – Elements of measurement system – Errors in measurement — Calibration of instruments: Methods & analysis – Introduction to Transducer & types.	
UNIT II – STRAIN AND DISPLACEMENT MEASUREMENT	**(9 Periods)**
Factors affecting strain measurements – Types of strain gauges – theory of operation – strain gauge materials – strain gauge circuits and applications of strain gauges. Resistive potentiometer (Linear, circular and helical) – L.V.D.T., R.V.D.T. and their characteristics – variable inductance and capacitance transducers – Piezo electrical transducers – Hall Effect devices and Proximity sensors.	
UNIT III – PRESSURE AND TEMPERATURE MEASUREMENT	**(9 Periods)**
Mechanical devices like Diaphragm, Bellows, and Bourdon tube for pressure measurement – Variable inductance and capacitance transducers – Piezo electric transducers – L.V.D.T. for measurement of pressure. Resistance type temperature sensors – RTD & Thermistor – Thermocouples & Thermopiles, Laws of thermocouple – Radiation methods of temperature measurement.	
UNIT IV – FLOW AND LEVEL MEASUREMENT	**(9 Periods)**
Differential pressure meters like Orifice plate, Venturi tube, flow nozzle, Pitot tube, Rotameter, Turbine flow meter, Electromagnetic flow meter and Ultrasonic flow meter. Resistive, inductive and capacitive techniques for level measurement – Ultrasonic methods – Air purge system (Bubbler method).	
UNIT V – AUTOMATIC CONTROL SYSTEM	**(9 Periods)**
Elements of control systems – concept of open loop and closed loop systems – Controllers – Brief idea of proportional, derivative and integral – Pneumatic Controller – Hydraulic Controller.	

Contact Periods:

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

TEXT BOOKS

1. *A.K. Sawhney, Puneet Sawhney **"A Course in Electronic and Electrical Measurements and Instrumentation"** S.K.Kataria & Sons, Delhi, 2014.*
2. *E. D. Doeblin, **"Measurement Systems: Application and Design",** McGraw – Hill Publication, 6th Edition 2017.*

REFERENCE BOOKS

1. *S. K. Singh,* ***"Industrial Instrumentation & Control"****, 3rd Edition, McGraw Hill, 2016.*
2. *A.K. Sawhney, Puneet Sawhney* ***"A Course in mechanical measurements and Instrumentation & Control"****, Dhanapat Rai & Co, 2012.*

COURSE OUTCOMES:

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

CO 1: Explain the construction and working of instruments used for various measurements.
CO 2: Describe the methods of measurement, classification of transducers and to analyze error.
CO 3: Elaborate the basic concept of control system.
CO 4: Analyze the characteristics of various measuring instruments
CO 5: Suggest suitable instruments for a particular application

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	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
18NOE$16	H	H	M	H	M	H	M	L	H	M	H	H	M	H	M

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

18NOE$17	**INDUSTRIAL AUTOMATION** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE

- To elaborate the basic concept of automation and the components required for automation

UNIT I – INTRODUCTION TO AUTOMATION	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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)	**(9 Periods)**
Overview of DCS – DCS hardware – DCS software configuration – DCS communication – DCS supervisory computer tasks – DCS integration with PLC and Computers	
UNIT V – SCADA	**(9 Periods)**
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. *Romily Bowden,* ***"HART application guide and the OSI communication foundation",*** *1999*
3. *Frank D. Petruzella,* ***"Programmable Logic Controllers",*** *5th Edition, McGraw Hill, 2016.*

COURSE OUTCOMES:

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

CO 1: Elaborate the basic architecture of automation systems

CO 2 : Describe the various sensors and actuators involved in industrial automation

CO 3: Construct ladder logic diagram using PLC basic functions, timer and counter functions for simple applications

CO 4: Illustrate the functionary components and supervisory control of DCS with relevant diagrams

CO 5: Describe the basics of SCADA technology

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	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
18NOE$17	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L

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

18NOE$18	VIRTUAL INSTRUMENTATION *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE

- To confer applications of virtual instrumentation in various fields.

UNIT I – INTRODUCTION	**(9 Periods)**
Virtual Instrumentation and LabVIEW - Evolution of LabVIEW - Difference between LabView and conventional languages - Sequencing and data flow - Graphical programming.	
UNIT II – LabVIEW ENVIRONMENT	**(9 Periods)**
Front panel - Block diagram - Icon and Connector - Control Palette - Function Palette-Tools Palette - Creating, editing, wiring, debugging and saving VIs - sub-VIs - creating sub-VIs - simple examples-Looping: For loop, while loop-Shift registers - case and sequence; structures, formula nodes.	
UNIT III – PROGRAMMING TECHNIQUES	**(9 Periods)**
Arrays - clusters, charts and graphs, - local and global variables - property node, string and file I/O.	
UNIT IV – DATA ACQUISITION AND INSTRUMENT CONTROL	**(9 Periods)**
DAQ – Components - Buffers: Buffered and non buffered I/O - Triggering - Analog I/O-Digital I/O - Counters and timers-Instrument control: VISA, GPIB, VXI and PXI	
UNIT V – ADVANCED Lab VIEW AND APPLICATIONS	**(9 Periods)**
Connectivity in LabVIEW: an introduction - IVI - Labwindows/CVI. Applications of Lab VIEW: process control, physical, biomedical, Image acquisition and processing.	

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 edition 2010*
2. *Gary Johnson, Richard Jennings **"Lab view graphical programming",** Tata McGraw Hill, 2011.*

REFERENCE BOOKS

1. *Lisa K Wells and Jeffrey Travels, **"Labview for everyone",** Prentice Hall, 3rd Edition 2009.*
2. *S. Gupta, J.P. Gupta, **"PC interfacing for data acquisition and process control",** 2nd Ed., Instrument Society of America, 2011*
3. *Jovitha Jerome, **"Virtual Instrumentation Using LabVIEW"** PHI Learning Pvt. Ltd 1st Edition, 2010*

COURSE OUTCOMES:

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

CO 1 Recognize the importance and applications of virtual instrumentation.

CO 2 Develop ability for programming in LabVIEW using various data structures, program structures, plotting the graphs and charts for system monitoring, processing and controlling.

CO 3 Realize the basics of interfacing and programming using related hardware.

CO 4 condition the acquired signal from the transducer to standard data formats

CO 5 Develop real time applications using LabVIEW

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	M	H	M	M	L	L	L	H	L	M	M	M	H	M	M
CO2		H	H	H	L	L	L	H	L	M	M	M	H	M	M
CO3		H	M	M	L	L	M	H	L	M	M	M	H	M	M
CO4		H	H	H	L	L	L	H	L	M	M	M	H	M	M
CO5		H	M	M	M	L	L	H	L	M	M	M	H	M	M
18NOE$18	M	H	M	M	L	L	L	H	L	M	M	M	H	M	M

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

18SOE$19	**PROGRAMMING IN JAVA** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

- Basic programming constructs in java to develop simple object oriented programs.
- Exception handling, multi-threading and I/O programming
- Development of GUI applications
- Manipulation of images.
- Network Programming

UNIT – I : FUNDAMENTALS OF JAVA PROGRAMMING	**(9 Periods)**
History and Evolution of Java- Overview of java– Operators- Control Structures– Methods- Classes and Objects– Inheritance- Packages and Interfaces- Exception Handling.	
UNIT – II : THREADS , I/O AND STRING HANDLING	**(9 Periods)**
Multi threaded Programming– Enumeration- Auto boxing– Annotations- String Handling-Input/Output: Exploring java.io.	
UNIT – III : APPLETS AND EVENT HANDLING	**(9 Periods)**
Applet class- Event Handling. Introducing the AWT: working with windows- graphics and text- Using AWT controls- Layout Manager - menus.	
UNIT – IV : IMAGING AND DATABASE CONNECTIVITY	**(9 Periods)**
Imaging: Creating- loading and displaying- Image observer- Double buffering- Media tracker- Image producer– consumer– filters– animation- Java Database Connectivity.	
UNIT – V : NETWORKING	**(9 Periods)**
Networking – Remote Method Invocation – Java Beans –Java servlets	

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

TEXT BOOKS:

1. *Herbert Schildt, **"Java, The Complete Reference** ", Tata McGrawHill, Eighth Edition, 2011.*

REFERENCE BOOKS:

1. *Deitel .H.M and Deitel.P.J, **"Java: How to Program",** Pearson Education Asia, Eighth Edition 2010.*
2. *Lay.S&Horstmann Gary Cornell, **"Core Java Vol I",** Seventh Edition, The Sun Microsystems & press Java Series, 2005.*
3. *Lay.S&Horstmann Gary Cornell, **"Core Java Vol II",** Eighth Edition, The Sun Microsystems & press Java Series, 2008.*

COURSE OUTCOMES:

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

CO1: Write simple java programs using fundamental concepts of java like control structures, inheritance, packages, interfaces and exception handling. [**Usage]**

CO2: Write java program using multithreading and string handling. [**Usage]**

CO3: Develop GUI based applications using Applets. [**Usage]**

CO4: Write java programs to display and manipulation of graphical images. [**Usage]**

CO5: Establish database connectivity.[**Familiarity]**

CO6: Develop client server programs using RMI and servlets. [**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	PSO4
CO1	M	M	H		H	M	M				H	M	M	H	H	
CO2	M	M	H		H	M	M				H	M	M	H	H	
CO3	M	M	H		H	M	M				H	M	M	H	H	
CO4	M	M	H		H	M	M				H	M	M	H	H	
CO5	M	M	H		H	M	M				H	M	M	H	H	
CO6	M	M	H		H	M	M				H	M	M	H	H	
18SOE$19	M	M	H		H	M	M				H	M	M	H	H	

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

18SOE$20	CYBER SECURITY *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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, Compute 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 OUTCOMES:

Upon completion of the course, the student 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	PSO4
CO1	M	M	M	M	L	H	L	M				H	H	L	M	
CO2	M	M	M	M	M	H	M	M				M	H	H	M	
CO3	H	L	L	L	L	H	H	L				H	H	H	L	
CO4	H	M	M	M	M	H	H	H				M	H	H	L	
CO5	H	M	M	M	M	L	H	L				H	H	H	M	
18SOE$20	H	M	M	M	M	H	H	M				H	H	H	M	

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

18SOE$21	NETWORK ESSENTIALS *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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"** 5th edition, Morgan Kaufmann Publishers Inc, 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.*

COURSE OUTCOMES:

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

CO1: Identify topologies and types of Computer Networks and enumerate the layers of the OSI model and TCP/IP and Explain the functions of each layer **[Familiarity]**

CO2: Explain the significance of wireless networks and configure a Wireless LAN **[Assessment]**

CO3: Describe basic routing algorithms and network services. **[Familiarity]**

CO4: Troubleshoot the router and switch interface **[Usage]**

CO5: Analyze Campus Network data traffic **[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	PSO4
CO1	M	M	H	H	H	L	L	H	H	H	H	H	M	H	H	
CO2	L	L	L	L	H	L	L	H	L	L	L	H	M	H	H	
CO3	L	H	M	M	H	L	L	H	H	M	L	H	L	H	H	
CO4	H	H	H	M	H	L	L	H	H	H	M	H	M	H	H	
CO5	H	H	H	M	H	L	L	H	H	M	L	H	M	H	H	
18SOE$21	M	H	H	M	H	L	L	H	H	L	M	H	M	H	H	

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

18IOE$22	PROGRAMMING IN PYTHON *(Common to All Branches)*

PRE-REQUISITES: **Category: OE**

NIL

L	T	P	C
3	0	0	3

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 operations used in python.
- File and Exception handling.
- Object oriented programming and GUI development.

UNIT – I : INTRODUCTION	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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. *David I.Schneider,* ***"Introduction to programming using python",*** *person, 2015.*

REFERENCE BOOKS:

1. *Michael Dawson,* ***"Python Programming for the Absolute Beginner",*** *Premier Press, 2003.*
2. *Charles Dierbach,* ***"Introduction to Computer Science Using Python: A Computational Problem-Solving Focus",*** *Wiley Publications, 2012.*

COURSE OUTCOMES:

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

CO1: Use various data types. **[Understand]**

CO2: Use control statements and functions. **[Understand]**

CO3: Analyze the arrangement of data elements in Lists and Dictionary structures. **[Analyze]**

CO4: Handle exceptions and perform file operations**. [Understand]**

CO5: Develop application using object oriented programming and GUI. **[Analyze]**

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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	
18IOE $22	**M**	**M**	**L**	**M**	**L**		**M**	**M**			**L**	**L**	**M**	**L**	

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

18IOE$23	**BIG DATA SCIENCE** *(Common to All Branches)*

PRE-REQUISITES: **Category: OE**

NIL

L	T	P	C
3	0	0	3

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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
Link analysis – Page rank – Efficient computation of a page rank – topic sensitive page rank – link spam –Frequent datasets – the market basket model – Apriori 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, Paul Zikopoulos,* ***"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.*
3. *Bill Franks,* ***"Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics",*** *Wiley and SAS Business Series, 2012.*
4. *Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch , James Giles, David Corrigan,* ***"Harness the Power of Big data – The big data platform",*** *McGraw Hill, 2012.*
5. *Colleen Mccue,* ***"Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis",*** *Elsevier, 2007*

COURSE OUTCOMES:

Upon the completion of the course, 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. **[Analyze]**

CO4: Mine larger data streams using suitable algorithms. **[Understand]**

CO5: Rank pages and handle large data sets efficiently. **[Analyze]**

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L	M	L	H	L							M	L	
CO2	M				H			L				L	M	L	
CO3		H			H							L	M	L	
CO4	M	H	M		M							L	M	L	
CO5	L	M	H									L	M	L	
18IOE $23	**M**	**H**	**M**	**L**	**H**	**L**		**L**				**L**	**M**	**L**	

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

18IOE$24	OBJECT ORIENTED PROGRAMMING USING C++ *(Common to All Branches)*

PRE-REQUISITES: **Category: OE**

NIL

L	T	P	C
3	0	0	3

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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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. *Lafort Robert,* ***"Object oriented proframming in C++",*** *4th Edition.*
2. *E.Balagurusamy,* ***"Object oriented Programming with C++",*** *McGraw Hill Education Ltd, 7th Edition 2017.*

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 OUTCOMES:

Upon the completion of the course, 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	H	H	M			M						M	L	
CO2	M	H	H	H			M						H	L	
CO3	M	H	H	H			M						H	L	
CO4	M	H	H	H			M						H	L	
CO5	M	H	H	H			M						H	L	
18IOE $24	M	H	H	H			M						H	L	

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

18BOE$25	COMPUTATIONAL BIOLOGY *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

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	**(9 Periods)**
Biomolecules of life: Structure and Composition of DNA, RNA & Protein. Protein Structure basics-Primary, Secondary and tertiary Structure of protein.	
UNIT – II : BIOLOGICAL DATABASES	**(9 Periods)**
Concept of Relational database, Data archiving, Data mining, Primary databases-NCBI, EMBL, DDBJ; Structure databases-PDB	
UNIT – III : SEQUENCE ANALYSIS	**(9 Periods)**
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	**(9 Periods)**
Protein secondary prediction-Chou fasman method, GOR method; Tertiary structure prediction-Homology modelling, Introduction to Computer aided drug design.	
UNIT – V : MACHINE LEARNING	**(9 Periods)**
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. Andreas D. Baxevanis, **"Bioinformatics, A Practical Guide to the Analysis of Genes and Proteins"**, Third edition; Wiley-Interscience, 2004.*

*2. Baxevanis A.D. and Oullette, B.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 OUTCOMES:

Upon completion of the course the students will be able to

CO1: Understand the basic structure of Biological macromolecules

CO2: Acquire the knowledge of biological databases and its importance.

CO3: Perform pair wise and multiple sequence alignment

CO4: Predict the secondary and tertiary structure of proteins.

CO5: Understand the machine learning approaches in computational biology

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	L		L			M				L		
CO2	M	L	L	L					L			L	L	L	
CO3	L		L			M			L			L	L		
CO4	M	M	L	M	M								M		
CO5		M		H	H	M	L		M				H	H	
18BOE $25	M	M	L	M	M	M	L		M			L	M	H	

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

18BOE$26	FUNDAMENTAL CONCEPTS OF BIOLOGY FOR ENGINEERS *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To understand the basic functions of the cell and their mechanisms in transport process.
2. To get familiarize human anatomy and physiology.
3. To learn about microbes, immune system and biomolecules.
4. To know the concepts of applied biology.

UNIT – I : BASICS OF CELL BIOLOGY	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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	**(9 Periods)**
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 Krein NR, **"Microbiology"**, Tata McGraw Hill, 5thEdition, New Delhi.2001.*

*3. Wulf Cruger and Anneliese Cruger, **"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),1st edition, 1998*
4. *Kuby J, **"Immunology"**, WH Freeman & Co., 7th edition, 2013.*

COURSE OUTCOMES:

Upon the completion of the course, 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L	-	-	-	-	-	-	-	-	-	H	M	
CO2	L	M	-	L	-	-	L	M	-	-	-	-	M	M	
CO3	L	M	L	L	-	-	-	L	M	-	-	L	H	H	
CO4	L	L	L	L	M	-	-	-	L	-	-	-	M	H	
CO5	-	-	-	-	-	-	-	-	-	-	-	-	H	H	
18BOE $26	L	M	L	L	M	-	L	M	M	-	-	L	H	H	

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

18BOE$27	FUNDAMENTALS OF BIOENGINEERING *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

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 Periods)**
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 Periods)**
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 Periods)**
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 Periods)**
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 Periods)**
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. Stanbur., Stephen J. Hall., A. Whitake., **"Principles of Fermentation Technology"**, Science & Technology Books. 2007.*
2. *Presscott, S.C., Cecil G., Dun, **"Industrial Microbiology"**, Agrobios (India), 2005.*
3. *Casida, L.E., **"Industrial Microbiology"**, New Age International (P) Ltd, 1968.*

REFERENCE BOOK

1. *Crueger, W., Anneliese Cruege.,**"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., Kristiansen B., **"Basic Biotechnology"**, Cambridge University Press, second Edition, 2001.*
4. *Michael J. Waites., **"Industrial Microbiology: An Introduction"**, Blackwell Publishing,2001.*

COURSE OUTCOMES:

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

CO1: 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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	
18BOE $27	H	M	H	M	M	M	-	L	H	-	-	-	M	H	

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

18EVA$01	YOGA FOR YOUTH EMPOWERMENT *(Common to CIVIL, MECH, EEE & PRODN)*

Category: VA

PRE-REQUISITES: NIL

L	T	P	C
1	0	0	1

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	**(5 Periods)**
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 : YOGASANAS	**(5 Periods)**
Rules & Regulations – asana, pranayama, mudra, bandha.	
UNIT-III : MIND	**(5 Periods)**
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 BOOKS:

*1. "**Mind**" – Vethathiri Maharashi*

COURSE OUTCOMES:

Upon the completion of the course, Students 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
CO 4	-	-	-	-	-	-	-	L	H	-	M	-	-	-	L
18EVA $01	-	-	-	-	-	H	L	-	M	-	L	-	L	L	L

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

18EVA$02	ELECTRICAL WIRING, WINDING AND EARTHING, REPAIRING OF HOUSEHOLD APPLIANCES

Category :VA

PRE-REQUISITES: NIL

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

- 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 & 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: 15 Periods 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:

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

CO1: Explain the hazards of electricity and effects.
CO2: Select appropriate personal equipment for a variety of applications.
CO3: Able to make effective wiring.
CO4: Employ Safe Work Practices when working with and around electricity.
CO5: Able to make good earthing.

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
18EVA $02	M	M	M	M	-	M	M	M	-	L	L	L	H	H	H

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

18EVA$03	SIMULATION OF ELECTRICAL SYSTEMS AND CONTROL USING DIgSILENT

Category :VA

L	T	P	C
1	0	0	1

PRE-REQUISITES:

1. 18EPC502- Power Generation, Transmission and Distribution

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: 15 Periods **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:

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

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
18EVA $03	M	M	M	M	M	M	H	M	M	H	H	M	M	M	H

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

18EVA$04	SOLAR POWER PLANT - DESIGN

Category :VA

PRE-REQUISITES: NIL

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

* To gain knowledge on basics of designing and installing solar power plant and 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	**(5 Periods)**
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	**(5 Periods)**
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 PV Array to the Inverter's Power Rating - Summary of Calculations for Matching Array and Inverter	
UNIT-III : SOLAR POWER PLANT SYSTEM PROTECTION, PLANT INSTALLATION	**(5 Periods)**
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 system**" Earth scan Publication II edition 2006.*

REFERENCE BOOKS:

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 OUTCOMES:

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

CO1: Provide a general overview on solar energy resources and on technologies to utilise solar energy in power production.
CO2: Understand the solar photovoltaic (PV) power production technologies
CO3: Explore solar PV power systems operating in various environmental conditions.
CO4: Understand the solar PV power plants as electrical systems and their electrical safety and protection
CO5: 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
18EVA $04	L	M	M	L	M	M	M	L	M	M	H	M	M	M	M

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

18EVA$05	PCB DESIGN AND FABRICATION *(Common to EEE & EIE Branches)*

Category :VA

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

1. 18EPC304-Electronic Devices and Circuits

COURSE OBJECTIVES:

* To acquire knowledge on Circuit board designing in assembling and testing of PCB 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:

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

CO1: Apply knowledge of mathematics, science and engineering
CO2: 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: Understand the 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
18EVA $05	H	H	H	H	M	M	M	M	L	L	M	H	H	H	H

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

18EVA$06	HOME AUTOMATION

Category :VA

L	T	P	C
1	0	0	1

PRE-REQUISITES:

1. 18EPC304-Electronic Devices and Circuits
2. 18EPC503-Microprocessors, Microcontrollers and Applications

COURSE OBJECTIVES:

* 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:

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

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
18EVA $06	M	M	M	M	M	M	H	M	M	M	M	M	M	M	M

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

18EVA$07	ELECTRICAL SAFETY

Category :VA

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 minimize risks and develop skills in investigative techniques for determining the cause of electrical accidents, fires and explosions.

UNIT-I : ELECTRICAL HAZARDS	**(5 Periods)**
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 arc ignition energy	
UNIT-II : PROTECTION SYSTEMS	**(5 Periods)**
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 –Earthing - Emergency Switching - Protective devices -Installation of lightning arrestor	
UNIT-III : ELECTRICAL SAFETY STANDARDS	**(5 Periods)**
National electrical safety code ANSI. - Indian electricity act and rules - Statutory requirements from electrical inspectorate- 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 OUTCOMES:

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

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 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
18EVA $07	H	M	M	M	-	M	M	M	H	M	L	L	H	H	H

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

18EVA$08	PLUG-IN ELECTRIC VEHICLE

Category :VA

PRE-REQUISITES: NIL

L	T	P	C
1	0	0	1

COURSE OBJECTIVES:

* To learn the basics and understand the concepts of plug-in Electric Vehicle.

UNIT-I : MOTORS FOR ELECTRIC VEHICLE	**(5 Periods)**
Concept and testing of different types of motors for Electric Vehicle.	
UNIT-II : BATTERIES FOR ELECTRIC VEHICLE	**(5 Periods)**
Study of different types of batteries for Electric Vehicle -Study of different charging methods.	
UNIT-III : APPLICATION OF PLUG-IN ELECTRIC VEHICLE	**(5 Periods)**
Selection of motor ratings - Case study of Plug-in Electric Vehicle.	

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 OUTCOMES:

Upon the completion of the 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	-
18EVA $08	H	L	M	H	L	-	L	L	L	L	-	M	M	M	-

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

18EVA$09	STUDY OF WEATHER MONITORING SYSTEM

Category :VA

L	T	P	C
1	0	0	1

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- 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, 2014.*

COURSE OUTCOMES:

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

CO1: Understand the role of weather monitoring station in analysis and design
CO2: Know the usage of software and data logger
CO3: 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
18EVA$09	H	H	H	H	M	M	L	L	L	L	L

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