Sri Krishna College of Engineering and Technology

An Autonomous Institution, Affiliated to Anna University

Coimbatore – 641 008

CURRICULUM AND SYLLABI

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Regulation 2020

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To provide the students with high quality technical education in the field of Electrical and Electronics Engineering enabling them to become competent and responsible engineers with employability and entrepreneurial skills.

MISSION

M1: Equip the students with adequate knowledge in the field of Electrical and Electronics Engineering and professional skills necessary to face the future challenges with confidence and courage.

M2: Engineer them to engage in research activities leading to innovative applications of technology.

M3: Enable them to become responsible citizens of the country with a willingness to serve the society.

Programme Outcomes (POs)

At the time of their graduation students of Electrical and Electronics Engineering Programme should be in possession of the following Programme Outcomes

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

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

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

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

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

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

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

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

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

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

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

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

Program Educational Objectives (PEOs)

PEO1: Graduates will have successful career in industry that meets the needs of Indian and multinational companies.

PEO2: Graduates will have the ability to synthesize data and develop technical concepts for application to product design and to solve contemporary problems

PEO3: Graduates will work as part of teams on multidisciplinary projects with good technical, communication and interpersonal skills.

PEO4: Graduates will fulfill the roles and responsibilities of professional electrical engineers in their chosen career with an attitude to serve the industry and society.

PEO5: Graduates will undertake research, pursuing higher studies, thereby adopting extended learning, keeping pace with the technological developments and codes of professional practice.

Mapping of PO's to PEO's

Programme Educational Objectives	Programme Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
PEO 1	3	3	3	2	3	2	3	2	2	3	2	3
PEO 2	3	3	3	2	3	2	3	2	2	3	3	3
PEO 3	2	2	2	3	2	2	3	2	2	3	2	3
PEO 4	3	3	3	2	3	2	2	2	2	3	3	2
PEO 5	2	2	2	1	1	3	2	3	3	2	2	2

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

Program Specific Outcome (PSOs)

After the successful completion of the B.E. Electrical and Electronics Engineering programme,the graduates will be able to:

PSO1: Analyze basic scientific concepts and provide solutions to Electrical and Electronics Engineering problems with a specific focus on emerging energy challenges.

PSO2: Use relevant software apply current techniques for data processing problems in the field of modern electronic systems for sustainable development.

PSO3: Develop products/software to cater to the societal & Industrial needs and adapt ethical values so as to become successful electrical engineering professionals.

Year	Sem	Course Code - CourseTitle	Program Outcomes												Program Specific Outcomes		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I Year	Semester I	20SB101 - Engineering Biology	2	2	2	2	0	3	2	0	0	0	0	3	2	0	0
		20MA101 - Engineering Mathematics I	3	2	3	2	2	0	0	0	2	0	0	0	3	0	0
		20PH102 - Physics for Electrical Science	2	2	2	2	2	0	0	0	2	0	0	1	2	1	0
		20EE101 - Analog Electronics	3	2	1	1	2	0	0	0	0	0	0	2	3	3	0
		20CS111 - Problem Solving using C Programming	3	2	3	2	2	0	0	0	2	0	0	0	3	0	0
		20ME103 - Engineering Practices Laboratory	3	2	3	1	2	0	2	1	1	1	0	1	2	0	0
		20MC101 - Mandatory Course I (Induction Programme)	0	0	0	0	0	3	3	3	2	3	0	3	0	0	3
	Semester II	20GE201 - Universal Human Values	0	0	0	0	0	3	3	3	2	2	0	3	0	0	3
		20MA201 - Engineering Mathematics II	3	2	3	2	2	0	0	0	2	0	0	0	3	1	0
		20EN101 - Technical Communication Skills	0	0	0	0	2	3	0	3	2	3	0	3	0	0	3
		20CH101 - Engineering Chemistry	2	1	2	1	0	0	1	0	0	0	0	0	2	0	0
		20EE201 - Basics of Electrical Circuits	3	3	3	3	0	0	0	0	1	0	0	0	3	0	0
		20ME111 - Engineering Graphics	2	2	1	0	0	0	0	2	2	0	2	0	2	0	0
		20MC102 - Mandatory Course II (Environmental Sciences)	0	0	0	0	0	3	3	3	2	0	0	3	0	0	3

Year	Sem	Course Code - CourseTitle	Program Outcomes												Program Specific Outcomes		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
II Year	Semester III	20EE301 - Electrical Machines - I	3	2	2	1	0	0	0	0	0	0	0	1	0	2	0
		20EE302 - Digital Circuits	3	2	2	1	0	0	0	0	0	0	0	1	0	2	0
		20EE303 - Electric PowerGeneration	3	2	2	1	0	0	0	0	0	0	0	1	2	1	0
		20EE304 - Measuring Instruments and Smart Sensors	3	2	2	1	1	0	0	0	0	0	0	1	1	2	0
		20MA301 - Engineering Mathematics III	3	3	0	3	0	0	0	0	0	0	0	0	1	0	0
		20CS311 - Data Structuresusing C++	2	3	2	0	2	0	0	0	0	0	2	3	0	3	2
		20EE305 - Electrical Machines - I Laboratory	3	3	2	2	1	0	1	2	2	2	0	0	3	0	3
		20EE306 - Digital Circuits Laboratory	3	3	2	1	1	1	1	2	2	2	1	0	0	3	0
		20MC1XX - Mandatory Course III	0	0	0	0	0	3	3	3	2	0	0	3	0	0	3
	Semester IV	20EE401 - Electrical Machines - II	2	2	1	1	0	0	0	0	2	0	0	1	3	0	3
		20EE402 - Transmission and Distribution	3	3	2	2	2	0	0	0	0	0	0	0	3	2	0
		20EE403 - Control Systems	3	3	2	2	1	0	0	0	0	1	0	2	3	0	0
		20EE404 - Linear Integrated Circuits	3	2	1	1	3	0	2	0	0	0	2	2	3	1	0
		20MA403 - Applied Mathematics	3	3	0	0	3	0	0	0	0	0	0	0	1	0	0
		20IT101 - Python Programming	2	3	2	0	2	0	0	0	0	0	2	3	0	3	2
		20EE405 - Electrical Machines - II Laboratory	2	2	1	1	1	0	0	0	2	0	0	1	3	0	3
		20EE406 - Control Systems Laboratory	3	2	1	1	1	0	0	1	0	1	0	1	2	1	0
		20EE407- Linear Integrated Circuits Laboratory	3	2	1	1	1	0	0	1	0	1	0	1	2	1	0
		20MC1XX - Mandatory Course IV	0	0	0	0	0	3	3	3	2	0	0	3	0	0	3
		20EE408 - Mini Project-I	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3

Year	Sem	Course Code - CourseTitle	Program Outcomes												Program Specific Outcomes		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
III Year	Semester V	20EE501 - Power Electronics	3	2	2	2	2	0	2	0	2	0	1	2	3	3	0
		20EE502 - Microcontrollers	3	2	2	2	2	0	2	0	0	0	1	2	3	2	0
		20EE503 - Power System Analysis	3	2	2	2	2	1	0	0	1	1	0	0	3	0	0
		20EEXX - Professional Elective I	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3
		20EEXX - Professional Elective II	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3
		20EE0XX - Open Elective-I	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3
		20EE504 - Power Electronics Laboratory	3	2	1	1	1	0	0	1	0	1	0	1	2	1	0
		20EE505 - Microcontrollers Laboratory	3	2	1	1	1	0	0	1	0	1	0	1	2	1	0
		20EE506 - Power System Simulation Laboratory	3	2	1	1	1	0	0	1	0	1	0	1	2	1	0
		20MC1XX - Mandatory Course V	0	0	0	0	0	3	3	3	2	0	0	3	0	0	3
	Semester VI	20EC611 - Communication Engineering	3	2	1	1	0	0	0	0	0	0	1	0	1	3	0
		20EEXX - Professional Elective III	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3
		20EEXX - Professional Elective IV	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3
		20EE0XX-Emerging Elective I	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3
		20EC612 - Principles of Digital Signal Processing	3	2	1	1	3	0	0	0	0	0	1	1	1	2	0
		20EN602 - Business Communication and Value Science	0	0	0	0	0	0	0	1	2	3	0	1	0	0	1
		20EC163 - Principles of Digital Signal Processing Laboratory	3	3	2	2	3	0	0	0	2	0	0	0	2	3	0
		20EE601 - Mini Project-II	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3
		20EES01 - Employability Enhancement Skills	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3

Year	Sem	Course Code - CourseTitle	Program Outcomes												Program Specific Outcomes		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
IV year	Semester VII	20EE701 - Power System Protection and Switchgear	2	1	0	0	0	0	1	0	0	1	0	0	3	0	0
		20MG701 - Engineering Economics	0	0	0	0	0	2	0	2	0	2	2	1	0	0	0
		20EEXX-Professional Elective V	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3
		20EEXX-Professional Elective VI	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3
		20EE0XX-Emerging Elective II	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3
		20EE0XX - Open Elective-I	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3
		20EE702 - Digital Simulation for Electrical Systems Laboratory	3	2	1	1	3	2	2	0	2	0	2	2	3	3	0
	Semester VIII	20EE801 - Project	3	3	3	3	3	2	2	3	2	3	3	2	3	3	3

B.E. ELECTRICAL AND ELECTRONICS ENGINEERINGREGULATION 2020

CHOICE BASED CREDIT SYSTEM

I – VIII SEMESTER CURRICULUM AND SYLLABI

SEMESTER I							
S.No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**C**	**Ext/Int**	**Cat.**
Theory							
1	20SB101	Engineering Biology	3/0/0	3	3	50/50	BSC
Theory Cum Laboratory							
2	20MA101	Engineering Mathematics-I	2/1/2	5	4	40/60	BSC
3	20PH102	Physics for Electrical Science	3/0/3	6	4.5	40/60	BSC
4	20EE101	Analog Electronics	3/0/2	5	4	40/60	PCC
5	20CS111	Problem Solving using C Programming	3/0/2	5	4	40/60	ESC
Practical							
6	20ME103	Engineering Practices Laboratory	0/0/3	3	1.5	40/60	ESC
Mandatory Course							
7	20MC101	Mandatory Course I: Induction Programme	3 Weeks		0	0/100	MC
		Total	**14/1/12**	**27**	**21**	**700**	

SEMESTER II							
S.No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**C**	**Ext/Int**	**Cat.**
Theory							
1	20GE201	Universal Human Values	3/0/0	3	3	50/50	HSMC
Theory Cum Laboratory							
2	20MA201	Engineering Mathematics-II	2/1/2	5	4	40/60	BSC
3	20EN101	Technical Communication Skills	2/0/2	4	3	40/60	HSMC
4	20CH101	Engineering Chemistry	3/0/3	6	4.5	40/60	BSC
5	20EE201	Basics of Electrical Circuits	3/1/2	6	5	40/60	ESC
Practical							
6	20ME111	Engineering Graphics	1/0/3	4	2.5	40/60	ESC
Mandatory Course							
7	20MC102	Mandatory Course II	2/0/0	2	0	0/100	MC
		Total	**16/2/12**	**30**	**22**	**600**	

SEMESTER III							
S.No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**C**	**Ext/Int**	**Cat.**
Theory							
1	20EE301	Electrical Machines-I	3/0/0	3	3	50/50	PCC
2	20EE302	Digital Circuits	2/1/0	3	3	50/50	PCC
3	20EE303	Electric Power Generation	3/0/0	3	3	50/50	PCC
4	20EE304	Measuring Instruments and Smart sensors	3/0/0	3	3	50/50	PCC
Theory Cum Laboratory							
5	20MA301	Engineering Mathematics III	2/1/2	5	4	40/60	BSC
6	20CS311	Data Structures using C++	3/0/2	5	4	40/60	ESC
Practical							
7	20EE305	Electrical Machines-I Laboratory	0/0/2	2	1	40/60	PCC
8	20EE306	Digital Circuits Laboratory	0/0/2	2	1	40/60	PCC
Mandatory Course							
9	20MC1XX	Mandatory Course III	2/0/0	2	0	0/100	MC
		Total	**18/2/8**	**28**	**22**	**900**	

SEMESTER IV							
S.No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**C**	**Ext./Int.**	**Cat.**
Theory							
1	20EE401	Electrical Machines-II	3/0/0	3	3	50/50	PCC
2	20EE402	Transmission and Distribution	3/0/0	3	3	50/50	PCC
3	20EE403	Control Systems	3/1/0	4	4	50/50	PCC
4	20EE404	Linear Integrated Circuits	3/0/0	3	3	50/50	PCC
Theory Cum Laboratory							
5	20MA403	Applied Mathematics	2/1/2	5	4	40/60	BSC
6	20IT101	Python Programming	3/0/2	5	4	40/60	ESC
Practical							
7	20EE405	Electrical Machines-II Laboratory	0/0/2	2	1	40/60	PCC
8	20EE406	Control Systems Laboratory	0/0/2	2	1	40/60	PCC
9	20EE407	Linear Integrated Circuits Laboratory	0/0/2	2	1	40/60	PCC
Mandatory Course							
10	20MC1XX	Mandatory Course IV	2/0/0	2	0	0/100	MC
Mini Project							
11	20EE408	Mini Project-I	0/0/2	2	1	40/60	PROJ
		Total	**19/2/12**	**33**	**25**	**1100**	

SEMESTER V							
S.No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**C**	**Ext/Int**	**Cat.**
Theory							
1	20EE501	Power Electronics	3/0/0	3	3	50/50	PCC
2	20EE502	Microcontrollers	3/0/0	3	3	50/50	PCC
3	20EE503	Power System Analysis	3/1/0	4	4	50/50	PCC
4	20EE9XX	Professional Elective-I	3/0/0 (or) 2/0/2	3 (or) 4	3	60/40 (or) 50/50	PEC
5	20EE9XX	Professional Elective-II	3/0/0 (or) 2/0/2	3 (or) 4	3	60/40 (or) 50/50	PEC
6	20EE0XX	Open Elective-I	3/0/0	3	3	50/50	OEC
Practical							
7	20EE504	Power Electronics Laboratory	0/0/2	2	1	40/60	PCC
8	20EE505	Microcontrollers Laboratory	0/0/2	3	1	40/60	PCC
9	20EE506	Power System Simulation Laboratory	0/0/2	2	1	40/60	PCC
Mandatory Course							
10	20MC1XX	Mandatory Course V	2/0/0	2	0	0/100	MC
		Total	**18/1/6 (or) 16/1/10**	**28 (or) 30**	**22**	**900**	

SEMESTER VI							
S.No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**C**	**Ext/Int**	**Cat.**
Theory							
1	20EC611	Communication Engineering	3/0/0	3	3	50/50	PCC
2	20EE9XX	Professional Elective-III	3/0/0 (or) 2/0/2	3(or)4	3	60/40 (or) 50/50	PEC
3	20EE9XX	Professional Elective-IV	3/0/0 (or) 2/0/2	3(or)4	3	60/40 (or) 50/50	PEC
4	20EE0XX	Emerging Elective-I	3/0/0	3	3	50/50	EEC
5	20EC612	Principles of Digital Signal Processing	2/1/0	3	3	50/50	PCC
Theory Cum Laboratory							
6	20EN602	Business Communicationand Value Science	2/0/2	4	3	40/60	HSMC
Practical							
7	20EC613	Principles of Digital Signal Processing Laboratory	0/0/2	2	1	40/60	PCC
Mini Project							
8	20EE601	Mini Project-II	0/0/2	2	1	40/60	PROJ

Employability Enhancement Skills							
9	20EES01	Employability Enhancement Skills			2	-	EES
		Total	**16/1/6 (or) 14/1/10**	**23 (or) 25**	**22**	**900**	

SEMESTER VII							
S.No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**C**	**Ext/Int**	**Cat.**
Theory							
1	20EE701	Power System Protection and Switchgear	3/0/0	3	3	50/50	PCC
2	20MG701	Engineering Economics	3/0/0	3	3	50/50	HSMC
3	20EE9XX	Professional Elective-V	3/0/0 (or) 2/0/2	3(or)4	3	60/40 (or) 50/50	PEC
4	20EE9XX	Professional Elective-VI	3/0/0 (or) 2/0/2	3(or)4	3	60/40 (or) 50/50	PEC
5	20EE0XX	Emerging Elective-II	3/0/0	3	3	50/50	EEC
6	20EE0XX	Open Elective-II	3/0/0	3	3	50/50	OEC
Practical							
7	20EE702	Digital Simulation for Electrical Systems Laboratory	0/0/2	2	1	40/60	PCC
		Total	**18/0/2 (or) 16/0/2**	**20 (or) 22**	**19**	**800**	

SEMESTER VIII							
S.No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**C**	**Ext/Int**	**Cat.**
Project							
1	20EE801	Project	0/0/24	24	12	40/60	PROJ
		Total	**0/0/24**	**24**	**12**	**100**	

SCHEME OF CREDIT DISTRIBUTION - SUMMARY

S.No	Stream	Credits/Semester								Credits	Courses			%
		I	II	III	IV	V	VI	VII	VIII		Theory	Theory Cum Lab	Lab	
1.	Humanities and Social Sciences Including Management (HSMC)		6				3	3		**12**	2	2		7.27
2.	Basic Science Courses (BSC)	11.5	8.5	4	4					**28**	1	6		16.97
3.	Engineering Science Courses (ESC)	5.5	7.5	4	4					**21**		4	2	12.72
4.	Professional Core Courses (PCC)	4		14	16	13	7	4		**58**	14	1	10	35.15
5.	Professional Elective Courses (PEC)					6	6	6		**18**	6			10.90
6.	Open Elective Course (OEC) / Emerging Elective Course (EEC)				3	3	6			**12**	4			7.27
7.	Project Work (PROJ) / Employability Enhancement Skills (EES)				1		3		12	**16**			3	9.70
8.	Mandatory Courses (MC)	-	-	-	-					**-**	5			-
	Total	**21**	**22**	**22**	**25**	**22**	**22**	**19**	**12**	**165**	**32**	**13**	**15**	**100**

CURRICULUM STRUCTURE FOR UG DEGREE PROGRAMME

S.No	Course Work - Subject Area	AICTE Suggested Breakdown of Credits	SKCET Credits
1.	Humanities and Social Sciences (HS), including Management Courses	12*	12
2.	Basic Sciences (BS) including Mathematics, Physics, Chemistry, Biology	26*	28
3.	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation	20*	21
4.	Professional Subjects-Core (PC), relevant to the chosen specialization/branch	53*	58
5.	Professional Subjects - Electives (PE), relevant to the chosen specialization/ branch;	18*	18
6.	Open Subjects- Electives (OE), from other technical and/or emerging subject areas	18*	12
7.	Project Work, Seminar and/or Internship in Industry or elsewhere	11*	14
8.	Employability Enhancement Skills	-	2
9.	Mandatory Courses (MC)	Non-credit	Non-credit
	Total	**158***	**165**

**Minor Variations is allowed as per need of the respective disciplines*

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT (12 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
1.	20GE201	Universal Human Values	3/0/0	3	3	HSMC
2.	20EN101	Technical Communication Skills	2/0/2	4	3	HSMC
3.	20EN602	Business Communication and Value Science	2/0/2	4	3	HSMC
4.	20MG701	Engineering Economics	3/0/0	3	3	HSMC

BASIC SCIENCE COURSES (28 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
1.	20SB101	Engineering Biology	3/0/0	3	3	BSC
2.	20MA101	Engineering Mathematics I	2/1/2	5	4	BSC
3.	20PH102	Physics for Electrical Science	3/0/3	6	4.5	BSC
4.	20MA201	Engineering Mathematics II	2/1/2	5	4	BSC
5.	20CH101	Engineering Chemistry	3/0/3	6	4.5	BSC
6.	20MA301	Engineering Mathematics III	2/1/2	4	4	BSC
7.	20MA403	Applied Mathematics	2/1/2	4	4	BSC

ENGINEERING SCIENCE COURSES (21 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
1.	20CS111	Problem Solving using C Programming	3/0/2	5	4	ESC
2.	20ME103	Engineering Practices Laboratory	0/0/3	4	1.5	ESC
3.	20EE201	Basics of Electrical Circuits	3/1/2	6	5	ESC
4.	20ME111	Engineering Graphics	1/0/3	3	2.5	ESC
5.	20CS311	Data Structures using C++	3/0/2	5	4	ESC
6.	20IT101	Python Programming	3/0/2	5	4	ESC

PROFESSIONAL CORE COURSES (58 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
1.	20EE101	Analog Electronics	3/0/2	5	4	PCC
2.	20EE301	Electrical Machines – I	3/0/0	3	3	PCC
3.	20EE302	Digital Circuits	3/0/0	3	3	PCC
4.	20EE303	Electric Power Generation	3/0/0	3	3	PCC
5.	20EE304	Measuring Instruments and Smart Sensors	3/0/0	3	3	PCC
6.	20EE305	Electrical Machines – I Laboratory	0/0/2	2	1	PCC
7.	20EE306	Digital Circuits Laboratory	0/0/2	2	1	PCC
8.	20EE401	Electrical Machines – II	3/0/0	3	3	PCC
9.	20EE402	Transmission and Distribution	3/0/0	3	3	PCC

10.	20EE403	Control Systems	3/1/0	4	4	PCC
11.	20EE404	Linear Integrated Circuits	3/0/0	3	3	PCC
12.	20EE405	Electrical Machines - II Laboratory	0/0/2	2	1	PCC
13.	20EE406	Control Systems Laboratory	0/0/2	2	1	PCC
14.	20EE407	Linear Integrated Circuits Laboratory	0/0/2	2	1	PCC
15.	20EE501	Power Electronics	3/0/0	3	3	PCC
16.	20EE502	Microcontrollers	3/0/0	3	3	PCC
17.	20EE503	Power System Analysis	3/1/0	4	4	PCC
18.	20EE504	Power Electronics Laboratory	0/0/2	2	1	PCC
19.	20EE505	Microcontrollers Laboratory	0/0/2	3	1	PCC
20.	20EE506	Power System Simulation Laboratory	0/0/2	2	1	PCC
21.	20EC611	Communication Engineering	3/0/0	3	3	PCC
22.	20EC612	Principles of Digital Signal Processing	2/1/0	3	3	PCC
23.	20EC613	Principles of Digital Signal Processing Laboratory	0/0/2	2	1	PCC
24.	20EE701	Power System Protection and Switchgear	3/0/0	3	3	PCC
25.	20EE702	Digital Simulation for Electrical Systems Laboratory	0/0/2	2	1	PCC

PROFESSIONAL ELECTIVE COURSES (18 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
Elective Stream I - Power System						
1.	20EE901	Smart Grid Technology	3/0/0	3	3	PEC
2.	20EE902	Power System Restructuring	3/0/0	3	3	PEC
3.	20EE903	Energy Auditing, Conservation and Management	3/0/0	3	3	PEC
4.	20EE904	Power System Operation and Control	3/0/0	3	3	PEC
5.	20EE905	Power Quality	3/0/0	3	3	PEC
6.	20EE906	High Voltage Engineering	3/0/0	3	3	PEC
7.	20EE907	Renewable Energy and Storage Systems	3/0/0	3	3	PEC
8.	20EE908	Distribution Automation Systems	3/0/0	3	3	PEC
9.	20EE909	HVDC Transmission Systems	3/0/0	3	3	PEC
Elective Stream II - Applied Electronics						
1.	20EC940	Data Communications and Networks	3/0/0	3	3	PEC
2.	20EE910	Introduction to Soft Computing	3/0/0	3	3	PEC
3.	20EC941	VLSI Design Technology	3/0/0	3	3	PEC
4.	20EC921	Wireless Sensor Networks	3/0/0	3	3	PEC

5.	20EC942	Digital Control Systems	3/0/0	3	3	PEC
6.	20EE911	Automotive Electronics	3/0/0	3	3	PEC
7.	20EE912	Virtual Instrumentation	2/0/2	3	3	PEC
8.	20EC943	Embedded System Design	2/0/2	3	3	PEC
9.	20EC944	Nano Electronics	3/0/0	3	3	PEC
Elective Stream III - Power Electronics						
1.	20EE913	Design of Electrical Machines	3/0/0	3	3	PEC
2.	20EE914	Special Electrical Machines	3/0/0	3	3	PEC
3.	20EE915	PLC and Automation	3/0/0	3	3	PEC
4.	20EE916	Servo Drives in Robotics	3/0/0	3	3	PEC
5.	20EE917	Flexible AC Transmission Systems	3/0/0	3	3	PEC
6.	20EE918	Digital Simulation of Power Electronic Circuits	2/0/2	3	3	PEC
7.	20EE919	Electric Drives and Control	2/0/2	3	3	PEC
8.	20EE920	Line-Commutated and Active PWM Rectifiers	3/0/0	3	3	PEC
9.	20EE921	Electric and Hybrid Vehicles	3/0/0	3	3	PEC

OPEN ELECTIVE COURSES (6 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
Stream - I						
1.	20EE001	Power Generation Systems	3/0/0	3	3	OEC
2.	20EE002	Autonomous Vehicles	3/0/0	3	3	OEC
3.	20EE003	Industrial Safety Management	3/0/0	3	3	OEC
Stream - II						
4.	20EE004	Renewable Energy Sources	3/0/0	3	3	OEC
5.	20EE005	Servo and Robot Drives	3/0/0	3	3	OEC
6.	20EE006	Special Purpose Machines	3/0/0	3	3	OEC

EMERGING ELECTIVE COURSES (6 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
Stream - I						
1.	20EE007	Machine Learning Applications in Energy Systems	3/0/0	3	3	EEC
2.	20EE008	Big Data Analytics for Smart Grid	3/0/0	3	3	EEC
3.	20EE009	Advanced Processors	3/0/0	3	3	EEC

Stream - II						
4.	20EE010	Internet of Things and its Applications	3/0/0	3	3	EEC
5.	20EE011	Real Time Systems	3/0/0	3	3	EEC
6.	20EE012	Modern Power Converters	3/0/0	3	3	EEC

MANDATORY COURSES (0 credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
1.	20MC101	Induction Program	3 weeks		0	MC
2.	20MC102	Environmental Sciences	2/0/0	2	0	MC
3.	20MC103	Soft Skills	2/0/0	2	0	MC
4.	20MC104	Management Organizational Behavior	2/0/0	2	0	MC
5.	20MC105	General Aptitude	2/0/0	2	0	MC
6.	20MC106	Life Skills and Ethics	2/0/0	2	0	MC
7.	20MC107	Stress Management	2/0/0	2	0	MC
8.	20MC108	Constitution of India	2/0/0	2	0	MC
9.	20MC109	Essence of Indian Traditional Knowledge	2/0/0	2	0	MC

ONE CREDIT COURSES

S.No	Course Code	Course Title	Credits
1.	20EEA01	MOOC Courses	1
2.	20EEA02	Electrical Testing and Safety Procedures	1
2.	20EEA03	PLC and SCADA	1
3.	20EEA04	Embedded Structure Design	1
4.	20EEA05	Robotics	1
5.	20EEA06	PCB Design and Fabrication	1
6.	20EEA07	MATLAB Programming for Electrical Engineering	1
7.	20EEA08	Solar Panel Installation	1
8.	20EEA09	Embedded Raspberry Pi	1
9.	20EEA10	Wind Turbine Design	1
10.	20EEA11	Industrial Electronics Design	1
11.	20EEA12	Foreign Language / Spoken Hindi	1
12.	20EEA13	Certification Courses	1
13.	20EEA14	NSS	1
14.	20EEA15	Sports	1
15.	20EEA16	Swachh Bharat Summer Internship	1
16.	20EEA17	Yoga	1

EMPLOYABILITY ENHANCEMENT SKILLS (2 Credits)

S.No	Name of the Course	L/T/P	Duration	C
1.	Employability Enhancement Skills (Internship / Journal Publication)	-	4 Weeks	**2**

SEMESTER WISE CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	**21**	**22**	**22**	**25**	**22**	**22**	**19**	**12**	**165**

Total Credits: 165

L: Lecture **T:** Tutorial **P:** Practical **C:** Credit **Cat.:** Category **Hrs.:** Hours **Wk.:** Week

HSMC : Humanities and Social Sciences (including Management Courses)

BSC : Basic Science Courses

ESC : Engineering Science Courses

PCC : Professional Core Courses

PEC : Professional Elective Courses

OEC : Open Elective Courses

PROJ : Project Work

EEC : Emerging Elective Courses

MC : Mandatory Course

EES : Employability Enhancement Skills

20SB101	Engineering Biology	3/0/0/3
Nature of Course	C (Theory Concept)	
Course Pre-requisites	Nil	

Course Objectives:

1	To grasp and apply biological engineering principles, procedures needed tosolve real-world problems.
2	To give a basic knowledge of the applications of biological systems in relevant Industries
3	To understand the mutual dependence of modern biology and engineering
4	To give a basic knowledge of artificial organs and physiological assist devices.
5	To understand about the use of various nanomaterials towards biologicalapplications

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Explain the structure of human physiology.	[U]
C101.2	Compare biological and artificial neural networks.	[A]
C101.3	Realize the basic concepts of brain computer interface	[U]
C101.4	Apply the concept of Brain computer interface in different applications	[AP]
C101.5	Recognize the compatibility and functioning of artificial organs inside the human being.	[U]
C101.6	Integrate the knowledge core of modern physiological assist deviceand its functionalities.	[AP]
C101.7	Comprehend the concepts of Nanomaterials for biotechnology	[U]

Course Contents:

Module 1: Human Physiology and Artificial Organ **15 Hrs**

Cell and their structure -Transport of ions through cell, Different systems of human body. Biological neural networks - Artificial neural networks, applications of neural networks - Artificial Kidney, Artificial Pancreas, Artificial liver, Artificial heart valves.

Module 2: Brain Computer Interface (BCI) **15 Hrs**

Fundamentals of BCI - Working of BCI, Classification of BCI, measuring of surgical and non - surgical BCI, Neuro feedback Training for BCI Control, signal processing and application.

Module 3: Nano biology **15 Hrs**

Introduction to Nano biology, Bioremediation - removal of bacteria and microbes. Nanomaterials for antimicrobial coatings- medical implants - medical and defense textiles. Biosensors - bio devices and implantable devices. Nanomaterials for diagnosis and therapy - Implications of Drug delivery- various forms of Nano carriers - Polymeric Nanoparticles as drug carriers - Drug release mechanism- Targeted drug delivery. Point-of-care and Personalized medicine.

Total Hours	**45**

Text Books:

1	Leslie Cromwell. Bomedical Instrumentation and measurements-PrenticeHall,2011
2	Bernhard Graimann, Brenden Allison, GertPfurtscheller, Computer Interfaces: Revolutionizing Human-Computer Interaction, Springer 2010
3	M Arumugam , Bio medical instrumentation, Anuradha Publications,2002
4	B. Bhushan, Springer Handbook of Nanotechnology, Springer-Verlag, 2004

Reference Books:	
1	Malcom Carpenter, Textbook of Neuroanatomyll, Mc. Graw hill Edition, 1996.
2	Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis,2011
3	Matews G.G, Neurobiology, Second Edition, Blackwell Science,UK,2000
Web References:	
1	https://ocw.mit.edu/courses/biological-engineering/20-010j-introduction-to- bioengineering-be-010j-spring-2006/videos/Lecture-1-bioengineering/
2	https://www.technicalsymposium.com/alllecturenotes_biomed.html
3	https://ocw.mit.edu/courses/biology/7-28-molecular-biology-spring-2005/

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C101.1	Understand	Quiz Assignment Class Presentation Group Assignment	**20**
C101.2	Analyze		
C101.3	Understand		
C101.4	Apply		
C101.5	Understand		
C101.6	Apply		
C101.7	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	10	10	10
Understand	80	30	40	40
Apply	-	30	30	30
Analyze	-	30	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C101.1	2	1	2	1		3	2					3	2		
C101.2	3	3	3	3		3	2					3	3		
C101.3	2	1	2	1		3	2					3	2		
C101.4	3	2	3	3		3	2					3	3		
C101.5	2	1	2	1		3	2					3	2		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20MA101	Engineering Mathematics I (Common to MECH, MCT, CIVIL, ECE, EEE, CSE, IT, AIDS)	2/1/2/4
Nature of Course	J (Problem analytical)	
Course Pre-requisites	Concept of Differentiation and Matrices	

Course Objectives:

1	To develop the skill to use matrix algebra techniques that is needed byengineers for practical applications.
2	To know about system of linear equations and its solution set and how to write down the coefficient matrix and augmented matrix of a linear system
3	To familiarize with functions of several variables applicable in many branches of engineering.
4	To find the solution of ordinary differential equations as most of theengineering problems are characterized in this form.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recall the concepts of matrices, ordinary and partial derivatives.	[R]
C101.2	Express square matrix in the diagonal form.	[U]
C101.3	Solve systems of linear equations numerically and to find inverse matrices.	[AP]
C101.4	Apply numerical techniques effectively to analyse and visualize data to solve basic engineering-related problems.	[AP]
C101.5	Find the extreme values of the given functions to solve engineering problems.	[AP]
C101.6	Find the solution of second and higher order differential equations connected with electric circuits and simple harmonic motion.	[AP]

Course Contents:

Module 1: Matrices **14 Hrs**

Definition - Types of matrices - Characteristic equation - Eigenvalues and eigenvectors ofa real matrices and their properties (statement only) - Cayley-Hamilton theorem (statement only) - Verification and application to find inverse and powers of real matrices - Orthogonal transformation of a real symmetric matrix to diagonal form - Reduction of quadratic form to canonical form by Orthogonal transformation.

Module 2: Solution of Equations and Eigenvalue Problems **16 Hrs**

Newton-Raphson method - Fixed point iteration method - Gauss-Elimination method -Gauss-Jordan method - Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalue of a matrix by Power method and Jacobimethod.

Module 3: Calculus **15 Hrs**

Concepts of limits and continuity - Functions of several variables - Total derivatives - Differentiation of implicit functions - Jacobians - Taylor series expansion - Maxima and Minima - Method of Lagrangian multipliers - Ordinary differential equations - Higher orderlinear differential equations with constant coefficients - Euler Cauchy's equations - Applications of ODE: Solving electrical circuits and simple harmonic motion.

List of Experiments:

S.No	List of Experiments	CO Mapping	BT
1	Entering row vector, column vector, accessing blocks of elements in MATLAB.	C101.1	[AP]
2	Entering matrices, to locate matrix elements and correcting any entrythrough indexing in MATLAB	C101.2	[AP]
3	Sum, product, transpose, inverse, determinant and rank of a matrices using MATLAB.	C101.3	[AP]

4	Eigenvalues and eigenvectors of a matrix using MATLAB.	C101.4	[AP]
5	System of linear equations in MATLAB using Gaussian elimination.	C101.4	[AP]
6	System of linear equations in MATLAB using matrix inverse method.	C101.4	[AP]
7	System of linear equations in MATLAB using linsolve	C101.5	[AP]
8	First and second derivative of single variable functions using MATLAB.	C101.5	[AP]
9	Maxima and Minima of a function using MATLAB	C101.6	[AP]
10	Higher Order Equations of constant coefficients using MATLAB	C101.6	[AP]
		Total Hours	**75**

Text Books:

1	G. B. Thomas and R.L. Finney, Calculus and Analytic Geometry, 14th Edition,Pearson, Reprint, 2018
2	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2018.
3	Grewal. B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, Delhi, 2018.

Reference Books:

1	Veerarajan. T, "Engineering Mathematics I", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.
2	Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, 4th edition, 2012.
3	N.P.Bali and Dr.ManishGoyal,"A Text book of Engineering Mathematics" 9th edition, Laxmi publications ltd, 2014.

Web References:

1	http://www.nptel.ac.in/courses/111105035
2	http://www.nptel.ac.in/courses/122104017
3	http://nptel.ac.in/courses/122102009
4	http://nptel.ac.in/courses/111107063

Online Resources:

1	https://www.coursera.org/learn/linearalgebra2
2	https://www.coursera.org/learn/differentiation-calculus
3	https://www.coursera.org/learn/single-variable-calculus

Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubrics Based Practical Assessment [30 Marks]	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50
Analyze	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
0	60	40	100

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C201.1	1	1	1	1	2				2				1		
C201.2	3	2	3	2	2				2				3		
C201.3	3	3	3	3	2				2				3		
C201.4	3	2	3	2	2				2				3		
C201.5	3	3	3	3	2				2				3		
C201.6	3	3	3	3	2				2				3	3	
1	Reasonably Agreed				2	Moderately Agreed					3	Strongly Agreed			

20PH102	Physics for Electrical Science (EEE)	3/0/3/4.5
Nature of Course	E (Theory Skill Based)	
Course Pre-requisites	Nil	

Course Objectives:

1	To gain knowledge of the basics of conducting materials, semiconducting materials, magnetic materials, superconducting materials and nanomaterials.
2	To familiarize the principles of electrostatics and electrodynamics.

Course Outcomes:

Upon completion of the course, students shall have ability to

C102.1	Describe the knowledge of conducting materials.	[U]
C102.2	Outline the semiconductor physics and functioning of semiconductor devices.	[U]
C102.3	Interrelate electric and magnetic fields behaviour of electrostatics and electrodynamics.	[AP]
C102.4	Infer changes in the properties of superconducting materials and their applications.	[AP]
C102.5	Recall the basic concepts of magnetic materials, smart materials and nano materials in different Engineering applications.	[R]
C102.6	Apply the gained knowledge to solve the problems related to their field of study.	[AP]

Course Contents:

Module 1: Conducting Materials and Semiconducting Materials **15 Hrs**

Conducting Materials: Classical free electron theory: Drude - Lorentz theory, electrical conductivity and thermal conductivity, Wiedemann - Franz law – Origin of band theory - Classification of solid materials based on band theorem - Fermi distribution function. **Semiconducting materials:** direct and indirect band gap semiconductors -Intrinsic semiconductors: density of electrons, density of holes, Fermi Energy - Doping - Extrinsic semiconductor: n-type and p-type carrier semiconductor, carrier concentration derivation, Fermi energy - Conductivity of semiconductors - Law of mass action - Hall effect: Hall coefficient measurement, applications - Application of semiconductors: solar cell.

Module 2: Electrostatics and Magnetism **15 Hrs**

Electrostatics: Coulomb's law – Gauss's law and applications of Gauss's law: Electric field around a plane, sheet of conductor and charged sphere - Electric field in matter: dielectric, polarization, susceptibility, types of polarization - Internal field - Claussius-Mosotti equation - Capacitors. **Magnetism:** Definitions of fundamental terms - Magnetic field around a current carrying conductor – Direction of magnetic field and current – Biot - Savart law and its applications: magnetic field due to circular current loop - Ampere's law and its applications: magnetic field due to a solenoid and a toroid - Magnetic Lorentz force: force experienced by a current carrying conductor in a magnetic field - Force between two long parallel current carrying conductors - Electromagnetic induction Faraday's law of induction - Lenz law - Expression for induced emf in a conductor - Time varying magnetic fields. Maxwell's equations (equations only) - Propagation of electromagnetic waves in dielectric medium.

Module 3: Materials **15 Hrs**

Magnetic materials: definition of terms permeability (absolute and relative), magnetic permeability, magnetic field intensity, magnetic moment of a bar magnet, intensity of magnetization, magnetic lines of force, magnetic flux – classification of magnetic materials: dia, para, ferro and anti-ferro magnetic materials and its properties – Domain theory of ferromagnetism, hysteresis, hard and soft magnetic materials - Applications. **Superconductors:**

properties of superconductor: resistivity, Meissner effect, persistent current, heat capacity, entropy, isotope effect, effect of heavy current, effect of temperature and effect of magnetic field - Type I and II superconductors - BCS theory (qualitative) - High temperature superconductors - Josephson effect – Quantum interference (qualitative), SQUID - Applications of super conductors**. Metallic Glasses:** Properties, Preparation and applications - Shape memory alloys, Characteristics and properties of Ni-Ti alloy and applications. **Nanomaterials:** Introduction and properties, Moore's law Quantum confinement, Quantum well, wire and dot. (Definitions) - Synthesis: chemical vapor deposition and ball milling - Applications. Carbon nanotubes: structure, properties and applications.

List of Experiments:

S.No	List of Experiments	CO Mapping	BT
1	Determination of thermal conductivity of a bad conductor – Lee's disc.	C101.1	[U]
2	Determination of a bandgap of semiconductor.	C101.2	[U]
3	Determination of Hall co-efficient – Hall Effect.	C101.3	[U]
4	Characteristics curves of solar cell.	C101.4	[U]
5	Time constant of RC circuits.	C101.4	[U]
6	Magnetic field along the axis of current carrying coil- Stewart and Gee method.	C101.4	[U]
7	LCR circuits.	C101.5	[U]
8	Faraday's electromagnetic induction law – simulation lab.	C101.5	[U]
9	Hysteresis loss.	C101.6	[U]
10	Determine the mass susceptibility of a diamagnetic material – Quincke'smethod.	C101.6	[U]
Life Skills Experiments			
1	How does a fuel (gas/liquid) pump nozzle shut off?	[U]	1
2	How does a circuit breaker work?	[U]	2
3	How to Check Earthing at Home?	[U]	3
		Total Hours	**90**

Text Books:

1	Rajendran, V "Engineering Physics" Mc Graw Hill Publications ltd, New Delhi, 2016.
2	David Halliday, Robert Resnick, Jearl Walker "Fundamentals of Physics" Wileyplus.2018.

Reference Books:

1	Avadhanulu M.N., Kshirshagar P.G., Arun Murthy TVS "A Text Book of Engineering Physics"S.Chand& Co Ltd, 2018.
2	Richard P. Feynman. Robert B. Leighton, Matthew Sands "The Feynman Lectures on Physics Vol. II": The New Millennium Edition.2015
3	David Griffiths 'Introduction to Electrodynamics' 4th Edition, Cambridge UniversityPress 2017.
4	David Jiles "Introduction to Magnetism and Magnetic Materials", 3rd Edition, Taylor & Francis Group, 2015

Web References:

1	https://www.electronics-tutorials.ws/diode/diode_1.html
2	https://nptel.ac.in/courses/115/104/115104109/
3	https://nptel.ac.in/courses/115/102/115102025/
4	http://www.phys.ufl.edu/~korytov/phy2049/old_notes/all_chapters.pdf

Online Resources:	
1	http://www.eas.uccs.edu/~mwickert/ece3110/lecture_notes/N3110_4.pdf
2	https://www.tcd.ie/Physics/research/groups/magnetism/files/lectures/5006/5006- 2.pdf
3	https://www.askiitians.com/iit-jee-magnetism/magnetic-properties-of-materials/
4	https://nptel.ac.in/courses/115/101/115101012/
5	https://nptel.ac.in/courses/118/104/118104008/

Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubrics Based Practical Assessment [30 Marks]	
Remember	30	20	30	20	30
Understand	60	60	60	40	60
Apply	10	20	10	30	10
Analyze	-	-	-	10	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
0	60	40	100

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C102.1	2	1	2	1	2				2			1	2		
C102.2	2	1	2	1	2				2			1	2	2	
C102.3	3	3	3	3	2				2			1	3		
C102.4	3	3	3	3	2				2			1	3		
C102.5	1	1	1	1	2				2			1	1	2	
C102.6	3	2	3	2								1	3		

1	Reasonably Agreed	2	Moderately Agreed	3	Strongly Agreed

20EE101	Analog Electronics	3/0/2/4
Nature of Course	D (Theory Application)	
Course Pre-requisites	Nil	

Course Objectives:

1	To remember the basic PN junction diode and its applications.
2	To understand the basic structure, operation and characteristics of Electronic Devices.To apply BJT to act as amplifier.
3	To gain knowledge about differential amplifiers.
4	To analyze the small signal characteristics of transistor amplifiers and oscillators.
5	To remember the basic PN junction diode and its applications.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Describe the basic PN junction diode and its applications	[U]
C101.2	Analyse the basic structure, operation and characteristics of Electronic Devices.	[A]
C101.3	Apply the characteristics of transistors for amplifier operations	[AP]
C101.4	Analyse the characteristics of feedback amplifiers	[A]
C101.5	Infer the operation of phase shift and Wien bridge oscillator	[U]

Course Contents:

Module 1: Diodes **20 Hrs**

Theory of PN junction - PN Junction Diode –Structure, Operation and V-I Characteristics - Rectifiers - Half Wave and Full Wave Rectifiers, Diode clampers and clippers - Operation and V- I Characteristics of Zener diode - Structure, Operation of LED and LCD - Structure, Operation of Charge Coupled Display (CCD).

Module 2: Electronic Devices and their Characteristics **20 Hrs**

Bipolar Junction Transistors (BJT) - Types - Structure and Operation - Input and Output Characteristics - Transistor as a switch - Biasing of BJT. Junction Field Effect Transistors (JFET) - Types - Structure and Operation - Drain and Transfer Characteristics - FET as Variable Resistor - Metal Oxide Semiconductor Field Effect Transistor (MOSFET) - Types - Structure, Operation and V-I Characteristics of n-channel MOSFET-Biasing of MOSFET. Uni Junction Transistor (UJT) - Structure, Operation and V-I Characteristics.

Module 3: Amplifier Circuits and Oscillators **20 Hrs**

BJT small signal model - Analysis of CE amplifier, Gain and Frequency response - Differential Amplifier - Multi-stage amplifier - Common mode and Differential mode analysis - Current mirror circuits**.** Basic concepts of Feedback amplifier- types - positive feedback - Stability of Feedback Amplifier. Condition for oscillations - Phase shift Oscillator - Wien bridge Oscillator.

Lab Component

S.No	List of Experiments	CO Mapping	BT
1	Characteristics of PN diode	C101.1	[U]
2	Line and load regulation of Zener regulator	C101.1	[AP]
3	Design of half wave, full wave and bridge rectifier circuits	C101.2	[AP]
4	Diode as clipper and clamper	C101.2	[AP]
5	Characteristics of BJT in CE configuration	C101.2	[AP]
6	Characteristics of JFET	C101.2	[U]

7	UJT triggering circuit for Power Switch.	C101.3	[AP]
8	Frequency Response of Common Emitter BJT Amplifier for a public addressingsystem.	C101.3	[AP]
9	Transistorized Differential amplifier	C101.4	[AP]
10	Analyze the basic electronic circuits by simulation	C101.4	[A]
11	Wien bridge oscillator	C101.5	[U]
		Total Hours	**75**

Text Books:	
1	David A. Bell, 'Electronic Devices and Circuits', Oxford University Press, 5th Edition, reprint 2015.
2	Floyd, Thomas.L 'Electronic Devices',Prentice Hall,9th Edition, 2012
3	S. Salivahanan, N.Suresh Kumar, 'Electronic Devices and Circuits' Tata McGraw Hill , 6th edition, 2015
Reference Books:	
1	Robert Diffenderfer, 'Electronic Devices: Systems and Applications', Cengage Learning, 2010.
2	Robert L.Boylestad, 'Electronic Devices and Circuit theory', Pearson Education, 2013,
3	Jacob Millman, Christos.C.Halkias and SatyabrataJit, 'Electronic Devices and Circuits', Tata McGraw Hill, 2010.
4	Theodore F. Bogart, Jeffery S. Beasley and Guilermo Rico, 'Electronic Devices and Circuits', Pearson Education , 6th edition, 2019.
Web References:	
1	https://nptel.iitg.ernet.in/Elec_Comm_Engg/.../Video-ECE.pdf
2	https://nptel.ac.in/video.php?subjectId=117103063

Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**				**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	**Rubrics Based Practical Assessment [30 Marks]**	
Remember	10	10	10	10	10
Understand	30	30	30	30	40
Apply	20	20	20	20	20
Analyze	40	40	40	40	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**60**	**40**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C101.1	2	1			2							2	3	3	
C101.2	3	3	2	2	2							2	3	3	
C101.3	3	2	1	1	2							2	3	3	
C101.4	3	3	2	2	2							2	3	3	
C101.5	2	1			2							2	3	3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20CS111	Problem Solving Using C Programming	3/0/2/4
Nature of Course	F (Theory Programming)	
Course Pre-requisites	Nil	

Course Objectives:

1	To understand problem solving using structured programming languageto gain knowledge about the control structures in C.
2	To develop logics and write C programs using arrays
3	To gain familiarity in inbuilt functions, structures and unions in C.
4	Apply concept and techniques for implementation in respective domain
5	To understand problem solving using structured programming languageTo gain knowledge about the control structures in C.

Course Outcomes:

Upon completion of the course, students shall have ability to

C111.1	Apply problem solving techniques to solve real world problems	[AP]
C111.2	Understand C fundamental constructs and control structures	[U]
C111.3	Use the concept of pointers and arrays in designing programs	[AP]
C111.4	Design C programs using the concepts of strings and functions	[C]
C111.5	Develop programs using structures and Unions in C	[AP]
C111.6	Apply the suitable programming concept for the given computational problem	[AP]

Course Contents:

Module 1: Problem Solving Techniques and C Fundamentals **15 Hrs**

Problem Solving Techniques: Algorithm, Pseudo-code and Flowchart. Creative Thinking and Problem-solving skills in everyday life. Understanding Compiler and interpreter. Program Development Life Cycle. C Fundamentals: Structure of C program, Character Set – identifiers and Keywords - Data Types - Constants - Variables and Arrays - Declarations - Operators and Expressions - Precedence of operators and associativity. Data input andoutput - Preparing and running a Complete C Program.

Module 2: Control Structures, Arrays, Strings **15 Hrs**

Control Structures: Branching: if-else- Looping – while - do while – for - Nested control structures - switch – break – continue – comma - goto. Arrays - Defining an array - Processing an array - Multi dimensional arrays - Strings: Defining a string - Null character - initialization of strings - reading and writing a string - processing the string.

Module 3: Pointers, Functions, Structures and Unions: **15 Hrs**

Pointers: fundamentals – Pointer Declaration and Usage – Dynamic Memory Allocation. Functions: Defining a Function – Accessing a function – Function Prototype Functions -Pointer to Function - Functions Returning Pointers. - Pointers and Strings - Passingarguments to a function - Recursion. Structures and Unions: The Type Definition (type def) - Enumerated types - Structure - Type Definition - Initialization - Accessing Structures - Unions.

Lab Component

S.No	List of Experiments	CO Mapping	BT
1	Formulate simple algorithm and flowchart using Raptor Tool for simple andcomplex problem	C111.1	[U]
2	Program to process data types, format input and output and to evaluate an expression	C111.1	[AP]
3	Program using decision making statements	C111.2	[AP]
4	Program using looping statements	C111.2	[AP]
5	Program using single and two dimensional arrays	C111.2	[AP]

6	Program with Strings	C111.2	[AP]
7	Program using Pointers.	C111.3	[AP]
8	Program using Recursion	C111.3	[AP]
9	Program using structures	C111.4	[AP]
10	Branch specific application program	C111.5	[A]
		Total Hours	**75**

Text Books:	
1	Sprankle M,"Problem Solving and Programming Concepts", 9th Edition, Pearson Education, New Delhi, 2013
2	Yashavant Kanetkar, "Let Us C", 16th Edition, BPB Publication, 2017.
3	Byron, S. Gottfreid, "Programming with C", McGraw Hill, Schaum's outlines, 4th Edition, 2018.
4	Reema Thareja Computer Fundamentals and Programming in C, 2nd edition, OXFORD publications, 2016
5	Brian W. Kernighan, Dennis Ritchie, " The C Programming Language", 2nd Edition Pearson Publicaitons, 2015
Reference Books:	
1	Yashavant Kanetkar, "101 Challenges in C Programming" Edition, BPB Publication,2017
2	Herbert Schildt, "The Complete Reference C", 4th Edition, McGraw Hill, 2015
3	Venugopal K R and Sudeep R.Prasad , "Mastering C", 2nd Edition, McGraw Hill,2017
4	Jeri.R Hanly, and Elliot B Koffman, "Problem solving and programming Design in C",8th Edition, Pearson 2016
Web References:	
1	http://raptor.martincarlisle.com/
2	https://nptel.ac.in/courses/106/104/106104128/
3	https://nptel.ac.in/courses/106/105/106105171/
4	https://www.coursera.org/specializations/c-programming

Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**				**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	**Rubrics Based Practical Assessment [30 Marks]**	
Remember	30	30	20	20	20
Understand	70	50	30	20	40
Apply	-	20	50	60	40
Analyze	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**60**	**40**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C101.1	3	2	3	2	2				2				3		
C101.2	2	1	2	1	2				2				2		
C101.3	3	2	3	2	2				2				3		
C101.4	3	2	3	2	2				2				3		
C101.5	3	2	3	2	2				2				3		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20ME103	Engineering Practices Laboratory	0/0/3/1.5
Nature of Course	Practical application	
Course Pre-requisites	Nil	

Course Objectives:

1	To learn the use of basic hand tools and to know the need for safety in work place and to gain hands on experience in Carpentry, Sheet metal, Plumbing, Welding and Foundry.
2	To learn about basic electrical devices, meters and electronics devices and to gain knowledge about the fundamentals of various electrical and electronic gadgets their working and trouble shooting.

Course Outcomes:

Upon completion of the course, students shall have ability to

C103.1	Identify and solve the basic engineering problems at home and in workplace.	[AP]
C103.2	Develop the surfaces and make simple components like tray and funnel.	[C]
C103.3	Make simple metal joints using welding equipment and wooden joints using carpentry tools.	[AP]
C103.4	Prepare pipe connections and sand moulds.	[AP]
C103.5	Understand the fundamentals of hot forging and injection moulding	[U]
C103.6	Examine and troubleshoot electrical and electronic circuits	[A]

Course Contents:

GROUP A (CIVIL & MECHANICAL)

Manufacturing Methods - Sheet metal operations - Welding - arc welding, gas welding, Study of TIG & MIG welding. Study of foundry, Demonstration of Smithy and Injection moulding - Carpentry work using power tools - Plumbing components and pipelines.

S.No	List of Experiments	CO Mapping	BT
1	Preparation of butt joints and lap joints using arc welding	C103.3	[AP]
2	Sheet metal Forming and Bending, Model making – Trays and funnels.	C103.2	[AP]
3	Preparation of wooden joints by sawing, planning and cutting.	C103.3	[AP]
4	Making basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings.	C103.4	[AP]
5	Demonstration of foundry operations like mould preparation for solid and split piece pattern.	C103.4	[U]
6	Demonstration of Smithy operations	C103.5	[AP]
7	Demonstration of assembly of pump / Demonstration of Injection moulding	C103.5	[AP]

GROUP B (ELECTRICAL AND ELECTRONICS ENGINEERING)

List of Experiments:

Basic Circuit Elements: Resistor, inductor, capacitor. Introduction to measuring equipment: Moving iron meter, moving coil meter, Wattmeter, Energy meter, CRO, Multi-meter. Digital logic circuits, PCB design, fuse, relay, circuit breaker, wire, Earthling, fan, fluorescent lamp,iron box, mixer grinder, study of FM radio and mobile phone.

S.No	List of Experiments	CO Mapping	BT
1	Study and identification of electronic components with specification.	C103.6	[A]
2	Testing of CRO and Electronic components using Multimeter.	C103.6	[A]
3	Generation and measurement of signals using CRO.	C103.6	[A]
4	Familiarization of digital basic gate IC‟s.	C103.6	[A]
5	Soldering practice-components devices and circuits-using general purpose PCB.	C103.6	[A]

6	Demonstration of meters and electrical components.	C103.6	[A]
7	Safety precautions with electrical components.	C103.6	[A]
8	Residential house wiring.	C103.6	[A]
9	Measurement of power and energy.	C103.6	[A]
10	Trouble shooting of electrical equipment.	C103.6	[A]
		Total Hours	**45**

Reference Books:	
1	Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Pearson Education, Inc. 2009 (Second Indian Reprint).
2	Hajra Choudhury, "Elements of Workshop Technology", Vol. I & II, Media PromotorsPvt Ltd., 2014.
3	Suyambazhagan S, „Engineering practices" PHI Learning private limited, NewDelhi,2012.
4	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill,2010.
5	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
Web References:	
1	www.nptel.ac.in
2	www.sme.org
3	http://www.allaboutcircuits.com/education/

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**	**End Semester Examination [50 marks]**
	Rubrics Based Practical Assessment [60 Marks]	
Remember	10	10
Understand	10	10
Apply	40	40
Analyze	20	20
Evaluate	10	10
Create	10	10

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**60**	**40**	**100**

No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C103.1	3	3	3		3		3		3	2		1	3		
C103.2	3	3	3		3		3		3	2		1	3		
C103.3	2	1	3	2	3			3	2		1	1	2		
C103.4	3	2	3	2			3					1	2		
C103.5	2	1	2	1								1	2		
C103.6	2	1	2	1	3		2					1	2	2	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20GE201	Universal Human Values (All Branches)	3/0/0/3
Nature of Course	C (Theory Concept)	
Course Pre-requisites	Interpersonal Communication and Value Sciences	

Course Objectives:

1	Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2	Understanding (or developing clarity) of the harmony in the human being, family, society and nature / existence.
3	Strengthening of self-reflection.
4	Development of commitment and courage to act.
5	Helping the students to appreciate the essential complementarily between VALUES and SKILLS to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.
6	Highlighting plausible implications of such a Holistic understanding interms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Understand about themselves and their surroundings (family, society, nature).	[U]
C201.2	Understand and take responsibilities in life and handle problems to attain sustainable solutions while keeping human relationships and human Nature in mind.	[U]
C201.3	Apply responsibilities towards their commitments (human values, human relationship and human society).	[AP]
C201.4	Apply what they have learnt to their own self in different day-to-day settings in real life, atleast a beginning would be made in this direction.	[AP]
C201.5	Analyse ethical and unethical practices, and formulate strategies to actualize a harmonious environment wherever they work.	[AN]
C201.6	Understand the harmony in nature and existence, and work out mutually on fulfilling participation in the nature.	[U]

Course Contents:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education, Understanding Harmony in the Human Being - Harmony in Myself! 15 Hrs

Purpose and motivation for the course. Self – Exploration - Its content and process; "Natural Acceptance" and Experiential Validation - as the process for self-exploration. Continuous Happiness and Prosperity - A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Understanding human being as a co-existence of the sentient „I" and the „Material Body". Understanding the needs of Self ("I") and Body - happiness and physical Facility. Understanding the Body as an instrument of "I" (I being the doer, seer and enjoyer). Understanding the characteristics and activities of "I" and harmony in "I". Understanding the harmony of "I" with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail-Programs to ensure Sanyam and Health.

Module 2: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship, Understanding Harmony in the Nature and Existence - Whole existence as Coexistence 15 Hrs

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference

between intention and Competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all- pervasive space. Holistic perception of harmony at all levels of existence.

Module 3: Implications of the above Holistic Understanding of Harmony on Professional Ethics **15 Hrs**

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for the above production systems. Case studies of typical holistic technologies, management models and eco-friendly production systems. Strategy for transition from the present state to Universal Human Order: a. Individual level: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations. Sum up.

	Total Hours	**45**

Text Books:

1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books,New Delhi, 2010.
2	Rajni Setia, Priyanka Sharma, " Human Values", Genius Publication", Jaipur,2019.

Reference Books:

1	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
2	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
3	India Wins Freedom - Maulana Abdul Kalam Azad.

Web References:

1	https://examupdates.in/professional-ethics-and-human-values/
2	http://hvpe1.blogspot.com/2016/06/notes-human-values-and-professional.html
3	https://www.yourmorals.org/schwartz.2006.basic%20human%20values.pdf

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C201.1	Understand	Group Discussion Book Review Role Play Formal Presentation	**20**
C201.2	Understand		
C201.3	Apply		
C201.4	Apply		
C201.5	Apply		
C201.6	Apply		

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	40	40
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-
Formative Assessment	**Summative Assessment**			**Total**
	Continuous Assessment		**End Semester Examination**	
20	**30**		**50**	**100**

No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C201.1						3	3	3	2	2		3			3
C201.2						3	3	3	2	2		3			3
C201.3						3	3	3	2	2		3			3
C201.4						3	3	3	2	2		3			3
C201.5						3	3	3	2	2		3			3
C201.6						3	3	3	2	2		3			3
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20MA201	Engineering Mathematics II (COMMON TO MECH, MCT, CIVIL, ECE, EEE, CSE, IT, AIDS)	2/1/2/4
Nature of Course	J (Problem analytical)	
Course Pre-requisites	Concepts of Differentiation and Integration.	

Course Objectives:

1	To gain knowledge in integrals, which are needed in engineering applications.
2	To develop logical thinking and analytical skills in evaluating multiple integrals.
3	To acquaint with the concepts of vector calculus needed for problems in all engineering disciplines.
4	To impart the knowledge of Laplace transform, to find solutions of initial value problems for linear ordinary differential equations.

Course Outcomes:
Upon completion of the course, students shall have ability to

C201.1	Determine the area and volume by applying the techniques of double and triple integrals.	[R]
C201.2	Finding the values of integrals through different numerical methods.	[U]
C201.3	Differentiate and integrate a vector-valued function to solve real world applications.	[AP]
C201.4	Calculate grad, div, curl and use Gauss, Stokes and Greens theorem to simplify the calculations of integrals.	[AP]
C201.5	Apply Laplace transform techniques in system modelling, digital signal processing, process control, solving boundary value problems.	[AP]
C201.6	Apply Laplace transform methods for solving linear differential equations.	[AP]

Course Contents:

Module 1: Integral calculus **18 Hrs**

Definite integrals: Evaluation of definite integrals using Bernoulli's formula - Multiple Integrals: Double integration in Cartesian coordinates - Area as double integral - Change of order of Integration - Triple integration in Cartesian co-ordinates - Volume as triple integral - Beta and Gamma functions - Relation between Beta and Gamma Functions - Evaluation of Integrals using Beta and Gamma Functions - Numerical integration: Trapezoidal rule and Simpson's rule for single and double integrals.

Module 2: Vector Calculus **14 Hrs**

Vector differential operator - Gradient of a scalar point function - Directional derivatives -Divergence and Curl of a vector point function - Irrotational and solenoidal vector fields - Simple problems - Vector integration - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (theorems statements only) - Simple applications involving cubes and rectangular parallelepipeds.

Module 3: Laplace Transform **16 Hrs**

Convergence of Laplace transform - Transform of some standard functions - Unit step function - Unit Impulse function - Properties - Initial and final value theorem - Inverse Laplace transform - Partial fraction method - Convolution theorem - Application of Laplace transform for solving second order ordinary differential equation.

List of Experiments:

S.No	List of Experiments	CO Mapping	BT
1	Double integrals evaluation in cartesian coordinates using MATLAB.	C201.1	[AP]
2	Triple integral calculations using MATLAB in cartesian and cylindrical coordinates	C201.2	[AP]
3	Double integral evaluation in MATLAB by Trapezoidal rule.	C201.3	[AP]

4	Evaluation of gradient, curl and divergence in MATLAB.	C201.4	[AP]
5	Line integral over a vector field using MATLAB	C201.4	[AP]
6	Applying Green's theorem to solve integrals in MATLAB.	C201.4	[AP]
7	Relation between Laplace transform of function and its derivative using MATLAB.	C201.5	[AP]
8	Laplace transform of Dirac delta and Heaviside functions in MATLAB.	C201.5	[AP]
9	Solving Differential Equations in MATLAB using Laplace Transform.	C201.6	[AP]
10	Inverse Laplace Transform of symbolic expressions using MATLAB.	C201.6	[AP]
		Total Hours	**75**

Text Books:	
1	G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry, 14 th Edition, Pearson, Reprint,2018.
2	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2018.
3	Grewal. B.S, "Higher Engineering Mathematics", 43 rd edition, Khanna Publications, Delhi, 2014.
Reference Books:	
1	Veerarajan. T, "Engineering Mathematics II", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.
2	Glyn James, —Advanced Modern Engineering Mathematics, Education, 4th edition, 2012.
3	N.P.Bali and Dr. Manish Goyal,"A Text book of Engineering Mathematics" 9th edition, Laxmi publications ltd, 2014.
Web References:	
1	http://nptel.ac.in/video.php?subjectId=122107037
2	http://nptel.ac.in/courses/122107036/
3	http://nptel.ac.in/video.php?subjectId=117102060
Online Resources:	
1	https://www.coursera.org/learn/pre-calculus
2	https://www.coursera.org/learn/linearalgebra1
3	https://alison.com/courses/Advanced-Mathematics-1
4	https://www.edx.org/course/algebra-lineal-mexicox-acf-0903-1x.

Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**				**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	**Rubrics Based Practical Assessment [30 Marks]**	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50
Analyze	-	-	-	-	-
Evaluate	-	-	-		-
Create	-	-	-		-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
0	60	40	100

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C201.1	1	1	1	1	2				2				1		
C201.2	2	1	2	1	2				2				2		
C201.3	3	2	3	2	2				2				3		
C201.4	3	2	3	2	2				2				3		
C201.5	3	2	3	2	2				2				3	3	
C201.6	3	2	3	2	2				2				3		
1	Reasonably Agreed				2	Moderately Agreed					3	Strongly Agreed			

20EN101	Technical Communication Skills (MECH/MCT/IT/CIVIL/CSE)	2/0/2/3
Nature of Course	E (Theory Skill Based)	
Course Pre-requisites	Basics of English Language	

Course Objectives:

1	To enhance learners' LSRW skills.
2	To develop effective communication skills.
3	To facilitate learners to acquire effective technical writing skills.
4	To prepare learners for placement and competitive exams.
5	To facilitate effective language skills for academic purposes and real-life

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Remember language skills for technical communication.	[R]
C101.2	Apply communication skills in corporate environment.	[AP]
C101.3	Understand and communicate effectively in personal and professional situation.	[AP]
C101.4	Understand and analyse a variety of reading strategies to foster comprehension and to construct meaningful and relevant connections to the text.	[U]
C101.5	Apply technical writing skills to write letters, emails and prepare technical documents.	[AP]
C101.6	Apply language skills with ease in academic and real-life situations.	[AP]

Course Contents:

Module 1: Listening and Speaking **17 Hrs**

Introduction to Effective Communication- Basics of English Language - Importance of LSRW Skills - Self Introduction - Introducing Others - Listening to Short Conversations or Monologues - Listening to Speeches / Talks - Listening and Responding -- Longer Listening Tasks -Recognise Functions Speaking- Speaking about Giving Directions / Instruction – Talk about Preferences-Agree and Disagree - Giving Opinions - Speaking Practices by Giving Examples, Reasons and Additional Information- Short Talk on Business Topics- Non Verbal Communication- Presentation using Digital Tools- Effectiveness of Narration- Leadership, Conflict and Persuasion.

Module 2: Reading **13 Hrs**

Reading Short Texts - Skimming and Scanning - Comparing Facts and Figures - Reading and Understanding Specific Information in a Text - Cloze Reading - Identifying Reasons and Consequences Through Reading Practices - Comprehension - Collocations.

Module 3: Grammar and Writing **15 Hrs**

Parts of Speech- Tenses - Subject Verb Agreement - Sentence Structures - Connectives - Modal Verbs - Question Formation - If Conditionals- Active and Passive - Impersonal Passive Voice - Vocabulary Building - Business Vocabulary - Synonyms, Antonyms - British and American Words - One Word Substitution - Identifying Common Errors. Writing Formal Letters (Accepting and Declining Invitations) - Writing Business Letters (Calling for Quotation, Seeking Clarification, Placing an Order and Complaint Letter) - Email Writing - Memo - Circular - Agenda and Minutes of the Meeting - Job Application Letter - Resume Writing - Paragraph Writing - Proof Reading and Editing - Technical Instructions and Recommendations- Jumbled Sentences - Technical Definitions - Report Phrases - Report Writing - Technical Proposal - Transcoding (Bar Chart, Flow Chart).

List of Experiments:

S.No	List of Experiments	CO Mapping	BT
1	Listening Comprehension	C101.1	[E]
2	Pronunciation, Intonation, Stress and Rhythm	C101.3	[E]

3	Situational Dialogues	C101.4	[E]
4	Formal Presentation	C101.2	[E]
5	Group Discussion	C101.6	[E]
6	Interview Skills- Online and Offline	C101.5	[E]
		Total Hours	**60**

Text Books:	
1	Practical English Usage. Michael Swan. OUP. 1995.
2	Remedial English Grammar. F.T. Wood. Macmillan.2007
3	On Writing Well. William Zinsser. Harper Resource Book. 2001
4	Dr Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited 2015.
Reference Books:	
1	Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
2	Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
3	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
Web References:	
1	http://www.academiccourses.com/Courses/English/Business-English
2	https://steptest.in
3	https://www.coursera.org/specializations/business-english
4	http://www.academiccourses.com/Courses/English/Business-English
5	https://scoop.eduncle.com/one-word-substitution-list

Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	40	40
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**60**	**40**	**100**

No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
C101.1					2	3		3	2	3		3			3
C101.2					2	3		3	2	3		3			3
C101.3					2	3		3	2	3		3			3
C101.4					2	3		3	2	3		3			3
C101.5					2	3		3	2	3		3			3
C101.6					2	3		3	2	3		3			3
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C101.1	1	1	1	1			1						1		
C101.2	3	2	3	2			1						3		
C101.3	2	1	2	1			1						2		
C101.4	2	1	2	1			1						2		
C101.5	3	2	3	2			1						3		
C101.6	2	1	2	1			1						2		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20CH101	Engineering Chemistry (Common to all I Year B.E./B.Tech)	3 /0/3/4.5
Nature of Course	E (Theory Skill Based)	
Course Pre-requisites	NIL	

Course Objectives:

1	To make the students conversant with water treatment, boiler feed water techniques.
2	To learn the effect of corrosion in materials and the methods for prevention of corrosion.
3	To understand the principles and applications of electrochemistry and to learn electro analytical methods.
4	To understand the basic concepts, synthesis, and applications of nano materials.
5	To explore the synthesis and properties of important engineering plastics, energy sources and drug molecules.
6	To understand the concepts of photo physical and photochemical processes in spectroscopy.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recall the requirements of water treatment procedures and boiler feed water for industries.	[R]
C101.2	Apply the various corrosion control techniques in real time industrial environments.	[AP]
C101.3	Understand the principle and working of reference electrodes and conductivity meters as an analyzer.	[U]
C101.4	Understand the basic concepts and applications of Nanochemistry.	[U]
C101.5	Use the knowledge of polymers, various energy sources and storage devices in engineering field.	[AP]
C101.6	Understand the principle and working of certain analytical techniques, and synthesis of some common drug molecules.	[U]

Course Contents:

Module 1: Water chemistry and Corrosion **25 Hrs**

Water treatment - characteristics of water - hardness - types and estimation of hardness by EDTA method with numerical problems. Boiler feed water - requirements - disadvantages of hard water. Domestic water treatment - disinfection methods (chlorination, Ozonation, UV treatment) - demineralization process - desalination - reverses osmosis. Corrosion - types - mechanism of dry and wet corrosion - galvanic corrosion - differential aeration corrosion - protective coatings - electroplating of gold - electrolysis plating of nickel.

Module 2: Electrochemistry and Energy sources **25 Hrs**

Electrochemical cells - electrolytic cell - reversible and irreversible cells - Free energy and emf, cell potentials, Nernst equation and applications. Oxidation and reduction potentials - standard hydrogen electrode, saturated calomel electrode, glass electrode - pH measurement. Nanochemistry - Basics - Comparison of molecules, nanomaterials and bulk materials; Types - nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: Electrochemical deposition and electro spinning. Applications of nanomaterials in medicine. Energy Sources - Fuel cells (H 2 -O 2). Storage Devices –Batteries - Alkaline - Lead acid, Nickel cadmium and Lithium - ion batteries.

Module 3: Polymer chemistry, Spectroscopic techniques and Synthesis of drug molecules **25 Hrs**

Introduction - monomers and polymers - classification of polymers – Polymerization -types. Mechanism of addition polymerization (free radical mechanism). Plastics – classification - preparation, properties and uses of Nylon 6,6, Nylon 6, PVC, Bakelite and PET. Moulding methods - moulding of plastics for Car parts, bottle caps (Injection moulding), Pipes, Hoses (Extrusion moulding), Mobile Phone Cases, Battery Trays (Compression moulding) and PET bottles (Blow

moulding). Spectroscopy - Beer Lambert's law, principle, instrumentation, and applications of Electronic spectroscopy (UV-visible), Vibrational and rotational spectroscopy (IR) and Flame emission spectroscopy (FES). Synthesis of a commonly used drug molecule-Asprin,p-nitroaniline from acetanilide.

Field work:

Industrial visit- Water treatment plant / Sewage treatment plant / Reverse osmosis plant

List of Experiments:

S.No	List of Experiments	CO Mapping	BT
1	Estimation of hardness of water by EDTA method	C101.1	[E]
2	Estimation of alkalinity of water sample	C101.1	[E]
3	Determination of chloride content in bleaching powder	C101.2	[E]
4	Estimation of dissolved oxygen in water	C101.2	[E]
5	Potentiometry- determination of redox potentials and emf's	C101.3	[E]
6	Conductometric titration-mixture of acids vs NaOH	C101.3	[E]
7	Determination of strength of strong acid by pH metry	C101.4	[E]
8	Corrosion rate of mild steel in acid medium	C101.4	[E]
9	Electroplating of nickel over copper	C101.5	[E]
10	Spectrophotometry-Estimation of iron in water	C101.5	[E]
11	Separation of mixture of amino acids by thin layer chromatography	C101.6	[E]
12	Synthesis of Nylon 66	C101.6	[E]
		Total Hours	**60**

Text Books:

1	Dara S.S, Umare S.S, "Engineering Chemistry", First revised Edition by S. Chand &Company Ltd., New Delhi 2015.
2	Jain P. C. & Monica Jain., "Engineering Chemistry", 16 th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
3	Fundamentals of Molecular Spectroscopy, 4 th Edition by C. N. Banwell Publishing McGraw-Hill Book Company (P) Ltd, England, 1994.
4	Physical Chemistry, 11 th Edition by P. W. Atkins Publishing Oxford University Press (P) Ltd, United Kingdom, 2018.
5	Nanochemistry, 2 nd Edition by K. Klabunde, G. Sergeev Springer Publisher, 2013.
6	N.Krishna Murthy, Vallinayagam D.,"Engineering Chemistry" 3 rd Edition by PHI Learning Pvt Ltd.,2014
7	Sunita Rattan, A Text Book of Engineering Chemistry, Student Edition by SK Kataria Publishers, 2013.
8	R.V.Gadag, A.Nithyananda Shetty "Engineering Chemistry" 3 rd Edition PHI Learning Pvt Ltd., 2014.

Reference Books:

1	Shikha Agarwal., "Engineering Chemistry and Applications", Cambridge University press, 2016.
2	Liliya., Bazylak.I., Gennady.E.,Zaikov.,Haghvi.A.K.,"Polymers Composites" CR Press,2014.
3	Lefrou., Christine., Fabry., Pierre.,Poignet.,Jean-claude., "Electrochemistry – The Basics, with examples" 2012 ., Springer.
4	Zaki Ahmad, Digby Macdonald, "Principles of Corrosion Engineering and Corrosion Control", Elsevier Science, 2nd Edition 2012.
5	Perez, Nestor,"Electrochemistry and Corrosion Science", Springer, 2016.
6	Introduction to Nano: basics to Nanoscience and Nanotechnology, by Sengupta, Amretashis, Sarkar, Chandan Kumar, Springer Publisher, 2015.
7	Ghazi A.Karim. "Fuels, Energy and the Environment", CRC Press, Taylor and Francis group, 2012.

Web References:	
1	http://www.analyticalinstruments.in/home/index.html
2	www.springer.com›Home›Chemistry›Electrochemistry
3	https://www.kth.se/.../electrochem/welcome-to-the-division-of-applied-electro chemistry
4	www.edx.org/
5	https://www.ntnu.edu/studies/courses
6	www.corrosionsource.com/
Online Resources	
1	nptel.ac.in/courses/105104102/hardness.htm
2	https://ocw.mit.edu/courses/chemistry
3	nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdfhttps://alison.com-
4	Spectroscopictechnique, Colorimetry
5	https://ocw.mit.edu/courses/chemistry
6	nptel.ac.in/courses/113108051

Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubrics Based Practical Assessment [30 Marks]	
Remember	30	30	30	10	20
Understand	60	50	40	20	50
Apply	10	20	30	40	30
Analyze	-	-	-	30	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
0	60	40	100

20EE201	Basics of Electrical Circuits	3/1/2/5
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	NIL	

Course Objectives:

1	To understand DC and AC circuits
2	To learn network theorems and two port networks for circuit analysis.
3	To explore the transient and resonance response of different electrical circuit

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Analyse basic DC and AC electric circuits	[A]
C201.2	Derive the sinusoidal steady-state (single-phase and three-phase) response of AC Circuits	[AP]
C201.3	Analyse two port circuit behaviour	[A]
C201.4	Apply network theorems for the analysis of electrical circuits.	[AP]
C201.5	Analyse the transient and resonance response of electrical circuits	[A]

Course Contents:

Module 1: DC Circuits and AC Circuits **25 Hrs**

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, Resistor in series and parallel, voltage division, Current division, Star-delta transformation, Mesh and Nodal analysis. Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), Three phase balanced circuits – voltage, current, power relations in star and delta connections.

Module 2: Network Theorems and Two Port Networks **20 Hrs**

Superposition theorem, Thevenin‟s theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Concept of duality and dual networks. Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters, hybrid parameters. Two-terminal network synthesis. Properties of Hurwitz polynomial and Positive real function.

Module 3: Transients and Resonance Analysis **15 Hrs**

Steady State and Transient response - DC response of RL, RC and RLC Circuits using Laplace transforms.AC Transients response of RL and RC Circuits. Resonance: Series Resonance - Bandwidth of an RLC circuit, Q factor, Magnification in Resonance. Parallel Resonance - Resonant frequency for a tank circuit factor of parallel resonance, magnification. Self and mutually induced emf, coefficient of coupling, dot convention in coupled circuits.

List of Experiments

S.No	List of Experiments	CO Mapping	BT
1	Estimation of voltage and current by KVL and KCL in Electric Circuits	C201.1	[U]
2	Determination of mesh current and node voltage by Mesh and Nodal Analysis	C201.1	[U]
3	Apply Superposition Theorem in Electrical Circuits	C201.4	[AP]
4	Apply Reciprocity Theorem in Electrical Circuits	C201.4	[AP]
5	Application of thevenin‟s theorem for Maximum Power Transfer	C201.4	[AP]
6	Apply Norton and Compensation Theorem in Electrical Circuits	C201.4	[AP]
7	Determination of series and parallel resonance frequency response of circuits.	C201.5	[U]

8	Determination of transient current in RL, RC and RLC circuits	C201.5	[U]
9	Verification of circuit analysis by simulation	C201.5	[A]
10	Measurement of three phase power	C201.5	[U]
		Total Hours	**90**

Text Books:	
1	William H.Hayt,JackE.Kemmerly and Steven M.Durbin," Engineering Circuits Analysis",TMHpublishers,8thedition, NewDelhi,2017
2	Joseph A.Edminister, Mahmood Nahvi,"Electric circuits",Schaum"s series, Mc Graw-Hill, New Delhi, 5thedition,2013
3	M. E. Van Valkenburg, "Network Analysis", Phi Learning, 3/ E,3rd Edition, 2014.
Reference Books:	
1	Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", 3rd Edition, McGraw Hill, reprint 2011.
2	Robins & Miller, „Circuit analysis theory and practice", Delmar Publishers, 5th Edition, 2012.
3	Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis",Tata McGraw Hill, 2017.
Web References:	
1	http://www.electrical4u.com/circuit-analysis.htm
2	http://www.technologystudent.com
3	http://www.allaboutcircuits.com
4	http://www.nptel.ac.in

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**				**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	**Rubrics Based Practical Assessment [30 Marks]**	
Remember	50	-	20	20	20
Understand	50	70	40	40	40
Apply		-	20	20	20
Analyze	-	30	20	20	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**60**	**40**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C201.1	3	3	3	3					1				3		
C201.2	3	3	3	3					1				3		
C201.3	3	3	3	3					1				3		
C201.4	3	3	3	3					1				3		
C201.5	3	3	3	3					1				3		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20ME111	Engineering Graphics	1/0/3/2.5
Nature of Course	M (Practical application)	
Course Pre-requisites	Basic Drawing and Computer Knowledge	

Course Objectives:

1	To know the method to construct the conic curves used in engineering applications.
2	To develop an understanding of Isometric to orthographic views and vice versa.
3	To learn the basic projection of straight lines and plane surfaces.
4	To develop the imagination of solids inclined to one reference plane.
5	To know the development of surfaces used in various fields.

Course Outcomes:

Upon completion of the course, students shall have ability to

C111.1	Understand the basic concepts of Engineering Graphics.	[U]
C111.2	Sketch isometric, orthographic projections and projection of lines and planes	[AP]
C111.3	Develop lateral surfaces of solids including prisms and pyramids.	[AP]
C111.4	Construct projections of lines, planes, solids and isometric views using modelling software.	[A]

Course Contents:

Conic curves and special curves – Isometric projections, Isometric to orthographic projection-Orthographic to Isometric projection-Projection of lines and plane surfaces-Projection of solids-Development of surfaces-Introduction to perspective projection.

S.No	List of Experiments	CO Mapping	BT
1	Introduction to drafting software.	C111.1	[U]
2	Construction of conic curves (Ellipse, Parabola and Hyperbola)	C111.1	[U]
3	Construction of special curves (Cycloid and Involutes)	C111.1	[U]
4	Isometric to orthographic projections – manual sketches	C111.2	[AP]
5	Isometric to orthographic projections – software sketches	C111.4	[A]
6	Projection of lines - inclined to HP, VP and Both HP & VP	C111.4	[A]
7	Projection of plane surface (Hexagon, Pentagon and circle) – inclined to any one of the principle	C111.4	[AP]
8	Projection of solids (Prism and Pyramid) – inclined to HP	C111.3	[AP]
9	Projection of solids (Cone and Cylinder) – inclined to VP	C111.3	[A]
10	Development of surfaces (Prism, Pyramid, Cone and Cylinder)	C111.4	[A]
11	Introduction to perspective projection	C111.2	[U]
		Total Hours	**60**

Reference Books:

1	Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2014
2	K. V. Natarajan, “A Text Book of Engineering Graphics", Dhanalakshmi Publishers, 2018.
3	Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2011.
4	Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2013.

Web References:

1	http://nptel.ac.in/courses/112102101/
2	www.solidworks.com

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model(Max.Marks:20)			
Summative assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment**		**End Semester Examination [50 marks]**
	Rubrics Based Practical Assessment [60 Marks]		
Remember	30		30
Understand	30		30
Apply	20		20
Analyze	20		20
Evaluate	-		-
Create	-		-
Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**60**	**40**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C111.1	2	2	1					2	3		2		3		
C111.2	2	2	1					2	3		2		3		
C111.3	2	2	1					2	3		2		3		
C111.4	2	2	1					2	3		2		3		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE301	Electrical Machines-I	3/0/0/3
Nature of Course	G (Theory Analytical)	
Pre-requisites	Basics of Electrical Circuits	

Course Objectives:

1	To study the basic concepts of magnetic field.
2	To understand the construction, working principle of DC machines and analyse their performance.
3	To familiarize with the construction details of different types of transformers, working

Course Outcomes:
Upon completion of the course, students shall have ability to

C301.1	Examine the basic concepts of magnetic circuits.	[U]
C301.2	Analyse the operation of various DC machine configurations.	[A]
C301.3	Interpret the constructional details of different type of transformers, working principle and their performance	[U]
C301.4	Analyse the performance of single-phase transformer by various testing methods.	[A]
C301.5	Choose an appropriate DC motor for any industrial application and appraise its significance.	[AP]

Course Contents:

Module 1: Magnetic Fields and Magnetic Circuits **15Hrs**

Nature of magnetic field — electromagnetism - Different laws for calculating magnetic Field - Leakage flux and fringing effect - Reluctance and Permeance - BH Characteristics - Analysis of series and parallel magnetic circuit - Force due to electromagnet - Properties of magnetic material - Faraday's law of electromagnetic induction - Induced voltage and Induction - Eddy current and hysteresis losses - Singly and Double excited magnetic system.

Module 2: DC Machines **15 Hrs**

DC Generator - Construction, Principle of Operation - emf equation - types, Characteristics, commutation - Interpoles - armature reaction - Armature circuit equation for motoring and generation - Open circuit and load characteristics of separately excited DC generator. **DC Motor** - principle of operation - torque equation - types - electrical and mechanical characteristics - Need for starters - Types of starters - soft starters - Braking - Speed control methods - Testing of DC motors - Case study: selection of DC motors for various industrial application.

Module 3: Single Phase and Three Phase Transformers **15 Hrs**

Single Phase Transformers - principle of operation - types - basic construction - equivalent circuit – Phasor diagram - regulation and efficiency - separation of Hysteresis and Eddy current losses - Testing of Transformers - open circuit and short circuit tests, polarity test, back-to-back test. Three - phase Transformers - construction - types of connection and their comparative features - Summation Transformers - Auto transformer - all day efficiency - parallel operation of transformers - Phase conversion -Concept of tap changing, on - load and off - load tap changers - Cooling methods of transformers - Case study: procedure for Transformer erection in Power Stations.

Total Hours	**45**

Text Books:

1	Stephen J. Chapman, "Electric Machinery Fundamentals", Tata McGraw Hill International Edition, New Delhi, 5th Edition 2011.
2	Robert L. Boylestad, "Introductory Circuit Analysis", Pearson Education India, 13th Edition, 2016.
3	D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2017.

Reference Books:	
1	P. S. Bimbhra, “Electrical Machines”, Khanna Publishers,2nd edition 2017
2	J B Gupta, “Theory &Performance of Electrical machines”, SK Kataria &sons, 2015.
3	Allan H. Robbins and Wilhelm C, Miller, "Circuit Analysis Theory and Practice”, Cengage Learning, 2013.
Web References:	
1	https://courses.lumenlearning.com/boundless-physics/chapter/magnetism-and-magnetic-fields/
2	https://library.automationdirect.com/selecting-motors-industrial-applications/
3	https://electrical-engineering-portal.com/erection-procedure-for-power-transformer

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C301.1	Analyse	Class Presentation Group Assignment Online Quiz Simulation exercises	**20**
C301.2	Understand		
C301.3	Apply		
C301.4	Analyse		
C301.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember		-	20	20
Understand	50	50	40	40
Apply		50	20	20
Analyze	50	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C301.1	3	1	1	1										2	
C301.2	3	2	2	1										2	
C301.3	3	2	1									3		2	
C301.4	3	3	3	2		1	1					2		3	
C301.5	3	3	3	2		1	1					2		3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE302	Digital Circuits	2/1/0/3
Nature of Course	J (Problem Analytical)	
Pre-requisites	Analog Electronics	

Course Objectives:

1	To understand the working of logic families and logic gates.
2	To design and implement Combinational and Sequential logic circuits.
3	To use Programmable Logic Devices to implement the given logical problem.

Course Outcomes:

Upon completion of the course, students shall have ability to

C302.1	Interpret, convert and represent different number systems.	[U]
C302.2	Manipulate and examine Boolean algebra, logic operations, Boolean functions and their simplification	[A]
C302.3	Explain the different types of memories and Programmable Logic Devices to implement the given logical problem	[U]
C302.4	Design various combinational logic circuits	[A]
C302.5	Design various sequential logic circuits.	[A]

Course Contents:

Module 1: Fundamentals of Digital Systems and logic families 18 Hrs

Digital Signals - Digital Circuits - Logic Gates - Boolean algebra - Theorems, Number Systems, one's and two's Complements - Codes - Arithmetic Codes, Error Detecting and Correcting Codes Characteristicsof digital lCs - Standard representation for logic functions - K-map representation, simplification of logic functions using K-map and Quine McCluskey method. Digital logic families - TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Module 2: Combinational Digital Circuits, memories and Programmable Logic Devices 12 Hrs

Design of Adders, Subtractors, Carry look ahead adder, serial adder - Multiplexer, De-Multiplexer Encoder, Decoders, priority encoders, decoders/drivers for display devices. ALU - Elementary ALU design - Digital comparator - Parity checker and generator - code converters - Memories - RAM, ROM, PROM, EPROM, EEPROM, PLDs, FPGA. Introduction to Verilog HDL.

Module 3: Sequential circuits and systems 15 Hrs

Types of Flip-Flops - Shift Registers - Analysis of Synchronous Sequential Logic circuits - Design of Synchronous Sequential Logic circuits - state table and excitation tables, state diagrams, Moore and Mealy models - Design of counters using flip-flops - synchronous counters, Modulo Counters, Ring Counters, ripple (Asynchronous) counters - Sequence Generator. Analysis of Asynchronous sequential logic circuits - Design of Asynchronous sequential logic circuits - Transition table, flow table, race conditions, circuits with latches, implication table, hazards. Case study: ATM Machine.

Total Hours	**45**

Text Books:

1	M. Morris R. Mano, Michael D. Ciletti, "Digital Logic Design", Prentice Hall,5th Edition,2013.
2	Floyd, "Digital Fundamentals", Pearson education, 11th edition, 2015.
3	A.Anand kumar, "Fundamental of Digital Circuits", PHI Learning Private Ltd, 4th edition, 2016.

Reference Books:

1	R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 4th Edition, 2009.
2	Tocci R.J., Neal S. Widmer, "Digital Systems: Principles and Applications", Pearson Education Asia, 2014.
3	Donald P Leach, Albert Paul Malvino, Goutam Sha, "Digital Principles and Applications", TataMcGraw Hill, 7th Edition, 2010.

Web References:	
1	https://onlinecourses.nptel.ac.in/noc18_ee33
2	http://www.ni.com/example/14493/en/
3	http://electronics-course.com/

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C302.1	Understand	Assignments Technical Online Quiz Class Presentation Group Assignment Tutorial	**20**
C302.2	Analyse		
C302.3	Understand		
C302.4	Apply		
C302.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	-	-	-	20
Understand	50	50	20	30
Apply	-	-	-	20
Analyze	50	50	80	40
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C302.1	3	1	1	1										2	
C302.2	3	2	2	1										2	
C302.3	3	2	1									3		2	
C302.4	3	3	3	2		1	1					2		3	
C302.5	3	3	3	2		1	1					2		3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE303	Electric Power Generation	3/0/0/3
Nature of Course	D (Theory Application)	
Pre-requisites	Nil	

Course Objectives:

1	To understand the concepts of thermal power plants and their associated components.
2	To enable students to understand in detail about nuclear and gas turbine power plants which play an important role in power generations.
3	To understand different non-conventional energy sources and their economic aspects to meet desired social requirements.

Course Outcomes:

Upon completion of the course, students shall have ability to

C303.1	Analyze the concepts of Rankine cycle and various components of Thermal, Nuclear and hydro power plant.	[A]
C303.2	Illustrate the safety measures of power plants, operation of binary cycles and cogeneration systems.	[U]
C303.3	Illustrate the operation of gas turbine and combined cycle power plants.	[U]
C303.4	Enumerate the concepts of renewable energy systems and their energy scenarios.	[AP]
C303.5	Apply the different types of Tariff, Consumers and different types of Power Generation Plants.	[AP]

Course Contents:

Module 1: Thermal and Hydro power plants **15 Hrs**

Basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, steam and heating rates, binary cycles and cogeneration systems. Hydro Electric Power Plants - classification, typical layout and components. case studies on thermal and hydro power plants

Module 2: Nuclear and Gas Turbine Power Plants **15 Hrs**

Introduction, Layout and subsystems of nuclear power plants, Types of reactors, safety waste disposal for nuclear power plants, case study on nuclear power plant, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems, pollution control technologies.

Module 3: Renewable Energy Sources **15 Hrs**

Construction and working of Wind, Tidal, Solar PV and Solar Thermal, Geothermal, Biogas and Fuel Cell Power Systems, Comparison of site selection criteria, relative merits and demerits, capital and operating cost of different power plants. DC systems in power plants, station control - switch yard and control room. Economic considerations – Types of Costs, Tariff and Consumers.

Total Hours	**45**

Text Books:

1	Rai, G.D, “Non-Conventional Energy Sources”, Khanna Publishers, 2010.
2	El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3	R.K.Hegde., "Power Plant Engineering", Pearson Publisher Limited Ltd., 2015.

Reference Books:

1	P C Sharma, “Power plant engineering‘’, S.K. Kataria & Sons, New Delhi, 2010.
2	Deshpande.M.V, “Elements of Electrical Power Station Design”, PHI Learning PVT LTD,2010.
3	Wadhwa.C.L, “Generation, Distribution and Utilization of Electrical Energy”, Wiley Eastern Limited, 3rd Edition, 2011.

Web References:	
1	https://nptel.ac.in/courses/108105058/8
2	http://indianpowersector.com/home/power-station/thermal-power-plant/
3	www.altenergy.org/renewables/renewables.html
4	https://www.energy.gov/fe/how-gas-turbine-power-plants-work

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C303.1	Analyse	Case Study Assignments Simulation Technical Quiz	**20**
C303.2	Analyse		
C303.3	Understand		
C303.4	Apply		
C303.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	-	-	-	-
Understand	50	50	2	20
Apply	-	-	8	50
Analyze	50	50	-	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C303.1	3	1	2	1									2	2	
C303.2	3	2	1	1									2	1	
C303.3	3	2	2	1		1	1							2	
C303.4	3	3	3	2								2	2	1	
C303.5	3	2	2	1								2	2	1	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE304	Measuring Instruments and Smart Sensors	3/0/0/3
Nature of Course	D (Theory Application)	
Pre-requisites	Nil	

Course Objectives:

1	To state the fundamental concepts of measurements and instruments.
2	To explore the operation of different bridges and transducers in real time.
3	To design aspects and performance criterion of optical and advanced sensors and instruments employed in industry.

Course Outcomes:

Upon completion of the course, students shall have ability to

C304.1	Summarise the general measurement instruments techniques.	[U]
C304.2	Identify the instruments for measuring various electrical parameters.	[U]
C304.3	Analyse the operating principle of different bridges and transducers.	[A]
C304.4	Analyse the functioning of various optical sensors in real time.	[A]
C304.5	Apply suitable advanced sensors in industry based applications.	[AP]

Course Contents:

Module 1: Introduction to Measurements and Instruments **15 Hrs**

Introduction to measurements and Instruments - classifications, applications, Elements of a generalized measurement system, Static and dynamic characteristics, Analog and Digital Instruments - PMMC, Attraction and Repulsion type Moving Iron Instruments, Induction type-dynamometer type Wattmeters, Single and Three Phase Energy Meter **-** Instrumentation Transformers - Megger **-** Tachometer - Torque meter - Flow meter**.**

Module 2: Bridges and Transducers **10 Hrs**

DC and AC Bridges - Wheatstone bridge, Kelvin's double bridge, Maxwell L/C and Wien bridges. Transducers - Characteristics, Requirements, Classifications, Selection Criteria, Displacement Transducers - LVDT, Potentiometers, Pressure Transducers - Bourdon tube, Strain Gauge, Temperature Transducers - RTD, Thermistors, Thermocouples.

Module 3: Optical devices and Advanced Sensors in Real Time **20 Hrs**

Oscilloscopes - Basic principle, Block diagram of oscilloscope, Types, Digital storage oscilloscope, Introduction to MSO, UV and IR spectrometry, Photo Plethysmo Graphy (PPG), RFID sensors, Introduction to MEMS, Introduction to Metal Oxide (MOS) gas sensors, VR headset and controller, Moisture Sensors, Collision Detection Sensor, Object Detection Sensors. Case Studies - Inertial Sensors (Accelerometer and gyroscope).

Total Hours	**45**

Text Books:

1	A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation",Dhanpatrai & Co., 19th Edition, 2016.
2	A.D.Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2016.
3	D.V.S. Murthy, "Transducers and Instrumentation", PHI Learning, 2nd Edition,2013.

Reference Books:

1	H.S Kalsi, "Electronics Instrumentation", Tata McGraw Hill, Higher education,3rd edition,2010.
2	E. O. Doebelin and D. N. Manik, "Measurement Systems – Application and Design", Tata McGraw-Hill, New Delhi, 2011.
3	M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009.

4	J.J. Carr, "Elements of Electronic Instrumentation and Measurement", Pearson Education India, New Delhi, 2011.
Web References:	
1	https://nptel.ac.in/courses/108/105/108105153/
2	https://www.bosch-sensortec.com/
3	http://www.shortcoursesportal.com
4	https://learn.ni.com/teach/resources/1014/measurements-and-instrumentation
5	https://the-eye.eu/public/Books/Electronic%20Archive/OliverCageElectronic Measurements and Instrumentation-text.pdf
6	https://lecturenotes.in/subject/265/electrical-measurement-and-instrumentation-emi

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C304.1	Understand	Quiz Class Presentation Assignment Case Study	**20**
C304.2	Remember		
C304.3	Analyse		
C304.4	Analyse		
C304.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	50	-	20	20
Understand	50	-	20	20
Apply	-	10	20	20
Analyze	-	80	40	40
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C304.1	3	2	1	1									2	2	
C304.2	2	1	1	1	2							2	2		
C304.3	3	3	2	2	2							2		2	
C304.4	2	1	1	1	2							1		2	
C304.5	3	3	3	2	1							1		2	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20MA301	Engineering Mathematics III MECH/ MCT/ CIVIL/ ECE/ EEE	2/1/2/4
Nature of Course	J (Problem analytical)	
Pre-requisites	Concepts of basic differentiation and Integration	

Course Objectives:

1	To understand the different possible forms of Fourier series and the frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
2	To acquaint the student with transform techniques which are used in variety of engineering fields.
3	To study the concept of mathematical formulation of certain practical problems in terms of partial differential equations and solving for physical interpretation.
4	To find the numerical solution for partial differential equations.

Course Outcomes:
Upon completion of the course, students shall have ability to

C301.1	Recall the basic integration concepts and partial derivatives.	[R]
C301.2	Interpret Fourier series solutions to the engineering problems.	[U]
C301.3	Apply continuous transforms techniques to evaluate definite integrals.	[AP]
C301.4	Apply the Z transform techniques in discrete sequences.	[AP]
C301.5	Apply analytical methods to solve the partial differential equations.	[AP]
C301.6	Apply numerical methods to solve wave and heat equation with boundary Conditions.	[AP]

Course Contents:

Module 1: Fourier Series **15 Hrs**

Dirichlet's conditions-General Fourier Series-Odd and Even Functions- Half range sine series and cosine series - Parseval's Identity-Harmonic analysis.

Module 2: Fourier Transform and Z Transform **15 Hrs**

Fourier Transform: Complex form of Fourier Transforms – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem and Parseval's Identity (Statement only) – Evaluation of integrals using Parseval's Identity. Z- Transform: Convergence of Z transform - Z-transform of Standard Functions-Properties -Inverse Z- transform-Convolution theorem (Statement only)-Partial fraction method - Formation of difference equations - Solution of difference equations using Z-transform Techniques.

Module 3: Partial Differential Equations **5 Hrs**

Introduction to PDE – Solving PDE by Lagrange's linear equations-Linear homogeneous partial differential equations of second and higher order with constant coefficients-Classifications - Numerical Solution to Partial differential Equation-Elliptic equations - Laplace equation - Liebmann's Iteration Process -Poisson equation - Parabolic Equation (one dimensional heat equation) - Bender-Schmidt's Difference Scheme – Crank-Nicholson's Difference Scheme- Hyperbolic Equation (one dimensional wave equation).

Total Hours	**45**

Course Outcomes: (Laboratory)
Upon the completion of the course, students shall have ability to:

C301.1	Understand the need for a function or its approximation as an infinite series.
C301.2	Represent discontinuous function which occurs in electrical circuits and signal processing by using Fourier series.
C301.3	Demonstrate the use of Fourier transform to connect the time domain and frequency Domain.

C301.4	Understanding Z- transform and analyzing discrete signals by using Z- transform.
C301.5	To describe homogeneous and higher order partial differential equations using PDE Techniques.
C301.6	Understanding of basic concepts in application of partial differential equations in onedimensional heat and wave equations.

Laboratory Component:

S.No	List of Experiments	CO Mapping	RBT
1.	To perform symbolic Fourier series calculation of the given full range signals using suitable mathematical software.	C301.1	[AP]
2.	To perform symbolic Fourier series calculation of the given half range signals using suitable mathematical software.	C301.2	[AP]
3.	To plot the Fourier transform of time function using suitable mathematical software.	C301.3	[AP]
4.	To find the Z transform of given expression f(n) using suitable mathematical software.	C301.4	[AP]
5.	To find the inverse Z transform of given expression f(n) using suitable mathematical software.	C301.4	[AP]
6.	To find the solution of homogeneous partial differential equation using suitable mathematical software.	C301.5	[AP]
7.	To find the solution for higher order partial differential equations using suitable mathematical software.	C301.5	[AP]
8.	To solve initial and boundary value problems for systems of partial differential equations in one spatial variable x and time t using suitable mathematical software.	C301.5	[AP]
9.	To perform the solution of Laplace equation using suitable mathematical software.	C301.6	[AP]
10.	To perform the solution of Poisson equation using suitable mathematical software.	C301.6	[AP]
11.	To solve the one-dimensional heat equation using suitable mathematical software.	C301.6	[AP]
12.	To solve the one-dimensional wave equation using suitable mathematical software.	C301.6	[AP]

Text Books:

1	Erwin E., “Advanced Engineering Mathematics”, John Wiley and Sons (Asia) Limited, Hoboken,2020.
2	Grewal. B.S, “Higher Engineering Mathematics”, 44th edition, Khanna Publications, Delhi, 2018.
3	Jain M.K. Iyengar, K & Jain R.K., Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd, Publishers,6th edition, 2016.

Reference Books:

1	Veerarajan. T, “Transforms and Partial differential equations”, 3rd edition, Tata McGraw-HillPublishing Company Ltd., reprint, 2016.
2	N.P.Bali ,”A Text book of Engineering Mathematics Sem-III/IV” 13th edition, Laxmi Publications Ltd, 2017.
3	Glyn James, ”Advanced Modern Engineering Mathematics”, Pearson Education, 4th edition,2016.
4	P. Kandasamy, K. Thilagavathy and K. Gunavathy, “Numerical Methods”,S.Chand Co. Ltd., New Delhi, 2015.

Web References:

1	https://www.youtube.com/watch?v=jNC0jxb0OxE
2	https://www.youtube.com/watch?v=iRXXmtcocAQ
3	https://www.youtube.com/watch?v=OGT59INHz3Y

Online Resources:	
1	https://nptel.ac.in/courses/111/106/111106111/
2	https://nptel.ac.in/courses/111/107/111107111/
3	https://nptel.ac.in/courses/111/107/111107107/

Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination Theory [40 marks]
	Theory			Practical & Project	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50
Analyze	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Articulation Matrix (Theory)

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C301.1	1	1											1		
C301.2	2	2											1		
C301.3	3	3													
C301.4	3	3											1		
C301.5	3	3													
C301.6	3	3											1		
1	Reasonably Agreed				2	Moderately Agreed					3	Strongly Agreed			

Course Articulation Matrix (Laboratory)

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C301.1	1	1			3								1		
C301.2	2	2			3								1		
C301.3	3	3			3										
C301.4	3	3			3								1		
C301.5	3	3			3										
C301.6	3	3			3								1		
1	Reasonably Agreed				2	Moderately Agreed					3	Strongly Agreed			

20CS311	Data Structures Using C++ (COMMON TO BE ECE & BE EEE)	3/0/2/4
Nature of Course	F (Theory Programming)	
Pre-requisites	Nil	

Course Objectives:

1	To learn object-oriented programming concepts using C++
2	To explain linear data structures lists, stacks, and queues
3	To understand various non-linear data structures-Tree, Graph
4	To apply efficient data structures in solving real-world problems

Course Outcomes:

Upon completion of the course, students shall have ability to

C311.1	Describe the object oriented paradigm with concepts of classes, functions, arrays,data and objects.	[R]
C311.2	Implement dynamic memory management techniques using pointers, constructors,destructors and the concept of inheritance, polymorphism.	[U]
C311.3	Apply appropriate data structures like arrays, linked list, stacks and queues to solvereal world problems efficiently.	[AP]
C311.4	Interpret the applications of stack, queue and use the appropriate data structure incontext of solution to a given problem	[AP]
C311.5	Represent and manipulate data using nonlinear data structures like trees and graphsto design algorithms for various applications.	[AP]
C311.6	Illustrate and compare various data structures for solving real time problems.	[AP]

Course Contents:

Module1: C++ Programming **15 Hrs**

An overview of C++ - Difference between procedure and object oriented programming language, Data Types, Variables, Operators, Expressions and Statements - Functions and Arrays- C++ Class Overview- Class Definition, Objects, Class Members, Access Control, Constructors and destructors, parameter passing methods, Inline functions, static class members, this pointer, friend functions, dynamic memory allocation and deallocation (new and delete) - Inheritance basics, base and derived classes, inheritance types, runtime polymorphism using virtual functions, abstract classes - Generic Programming- Function and class templates.

Module 2: Linear Data Structures - List, Stack, Queue **15 Hrs**

Abstract Data Types (ADTs) - List ADT – Array based implementation - Linked list implementation - Singly linked lists - Doubly linked lists. Stack ADT - Operations - Applications - Evaluating arithmetic expressions - Conversion of Infix to postfix expression - Queue ADT - Operations - Linear Queue,Circular Queue - Applications of queue.

Module 3: Non-Linear Data Structures - Trees, Graphs **15 Hrs**

Trees: Binary Trees - Tree Traversals - Expression Trees - Binary Search Tree - AVL Tree. **Graph Algorithms:** Breadth First Search (BFS), Depth First Search (DFS), Minimum Spanning Tree (MST) - Prims Algorithm, Kruskal's Algorithm - Single Source Shortest Paths, Bi-connectivity, Cut vertex, Euler circuits.

Total Hours	**45**

Laboratory Component:

S.No	List of Experiments	CO Mapping	RBT
1.	Implement basic C++ programs	C311.1	[AP]

2.	Implementation of classes and objects	C311.2	[AP]
3.	Implementation of Inheritance and polymorphism	C311.3	[AP]
4.	Implementation of Linked List	C311.4	[AP]
5.	Implementation of stack using array and Linked List	C311.4	[AP]
6.	Implementation of stack applications	C311.5	[AP]
7.	Implementation of queue using array and Linked List	C311.5	[AP]
8.	Implementation of Binary Search Tree and its traversal	C311.5	[AP]
9.	Implement BFS and DFS Graph Traversal	C311.6	[AP]
10.	Implement a Minimum Spanning Tree Algorithm in a graph	C311.6	[AP]
11.	Design a program to employ a stack for balancing symbols such as parentheses,flower braces and square brackets, in the code snippet given below. for(i=0;i<n;i++) { if(i<5) {z[i]=x[i]+y[i]; p=(((a+b)*c)+(d/(e+f)*g);} Ensure that your program works for any arbitrary expression.	C311.6	[AP]
	Total Hours	**30**	

Text Books:	
1	Herbert Shildt , " The Complete Reference C++" , Fourth Edition, TMH, 2017.
2	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education India, 3rd Edition, 2013.
3	Debasis Samanta, "Classic data structures", Prentice Hall of India, 2nd edition, 2014.
Reference Books:	
1	Bjarne Stroustrup, "The C++ programming language"; Addison Wesley, fourth edition.
2	Seymour Lipschutz, "Data Structures by Schaum Series", 2nd edition, Tata McGraw Hill, 2013.
3	Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures andAlgorithmic Puzzles", 5th Edition, CareerMonk,2016.
Web References:	
1	https://nptel.ac.in/
2	https://visualgo.net/en
3	https://www.codechef.com/
Online Resources:	
1	https://www.coursera.org/learn/c-plus-plus-a
2	https://www.coursera.org/learn/c-plus-plus-b
3	https://nptel.ac.in/courses/106/102/106102064/
4	https://www.hackerrank.com/domains/data-structures

Assessment Methods & Levels (based on Bloom's Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination Theory [40 marks]**
	Theory			**Practical & Project**	
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	**Rubric based CIA [30 Marks]**	
Remember	40	20	10	10	20
Understand	30	30	30	30	30
Apply	30	50	60	60	50
Analyze	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Articulation Matrix (Theory)															
No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C311.1	2	2	1		1						1	2		2	1
C311.2	3	3	2		2						1	3		2	1
C311.3	2	3	3		3						2	3		3	2
C311.4	2	3	2		1						2	3		3	2
C311.5	2	3	3		1						2	3		3	2
C311.6	3	3	3		2						3	3		3	2
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

Course Articulation Matrix (Laboratory)															
No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C311.1	1	1			3								1		
C311.2	2	2			3								1		
C311.3	3	3			3										
C311.4	3	3			3								1		
C311.5	3	3			3										
C311.6	3	3			3								1		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE305	Electrical Machines – I Laboratory	0/0/2/1
Nature of Course	M (Practical Application)	
Pre-requisites	Basics of Electrical Circuits	

Course Objectives:

1	To determine the characteristics of DC machines by using simulation and experimental methods.
2	To know the performance characteristics of transformers based on various tests underno load, loading conditions, open circuit and short circuit conditions.
3	To analyse the equivalent circuit parameters of transformers.

Course Outcomes:
Upon completion of the course, students shall have ability to

C305.1	Analyze the no load and load characteristics of DC Separately excited DC generator.	[A]
C305.2	Illustrate the mechanical and electrical characteristics of Shunt ,Series and Compound motor.	[U]
C305.3	Analyze the OCC characteristics of DC shunt generator using Simulation software.	[A]
C305.4	Sketch the equivalent circuit of Single phase Transformer and calculate the parameters of equivalent circuit.	[AP]
C305.5	Demonstrate the indirect method of testing of DC machine to determine its efficiency.	[AP]
C305.6	Analyze the different types of three phase transformer Connections.	[A]

Course Contents:

S.No	List of Experiments	CO Mapping	RBT
1.	Analysis of open circuit characteristics of DC shunt generator using Simulation software.	C305.1	[A]
2.	Analysis of no-load and load characteristics of separately excited DC generator.	C305.2	[A]
3.	Determination of efficiency of DC machine through Hopkinson's Test.	C305.3	[U]
4.	Examine the effective efficiency and speed-torque characteristic of DC shuntmotor, DC series motor.	C305.4	[U]
5.	Determination the load characteristics of DC compound motor.	C305.4	[U]
6.	Predetermination of Efficiency using Swinburne's test	C305.5	[U]
7.	Examine the Speed Control methods of DC shunt motor by following methods i) Field Control ii) Armature control iii) Voltage Control Method / Chopper based Control	C305.5	[A]
8.	Sketching of the equivalent circuit parameters of a single phase transformer.	C305.5	[AP]
9.	Testing of transformers using Sumpner's Test.	C305.6	[AP]
10.	Study of Scott Connection of Two Single phase Transformers.	C305.6	[R]
11.	Verification of Three phase Transformer connections.	C305.6	[A]
12.	Separation of No load losses in single phase transformers.	C305.6	[U]
	Total Hours	**30**	

Text Books:	
1	Stephen J. Chapman, “Electric Machinery Fundamentals”, Tata McGraw Hill International Edition, New Delhi, 5th Edition 2011.
2	Matthew N. O. Sadiku, “Elements of electromagnetics”, Oxford University Press, 6th Edition, 2007.
3	D.P. Kothari and I.J. Nagrath, “Electric Machines”, Tata McGraw Hill Publishing Company Ltd, 2010
Reference Books:	
1	P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011
2	J B Gupta, “Theory &Performance of Electrical machines”, SK Kataria and sons, 2015
3	A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
Web References:	
1	https://courses.lumenlearning.com/boundless-physics/chapter/magnetism-and-magnetic-fields/
2	https://library.automationdirect.com/selecting-motors-industrial-applications/
3	https://electrical-engineering-portal.com/erection-procedure-for-power-transformer

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Rubric based Continuous Assessment [60 marks]	End Semester Examination[40 marks]
Remember	10	10
Understand	20	20
Apply	30	30
Analyze	40	40
Evaluate	0	0
Create	0	0

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
0	60	40	100

Course Articulation Matrix

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C305.1	3	3	2	2			1	2	2	2			3		3
C305.2	3	2	1	1			1	2	2	2			3		3
C305.3	3	3	2	2	3		1	2	2	2			3		3
C305.4	3	2	1	1			1	2	2	2			3		3
C305.5	3	2	1	1			1	2	2	2			3		3
C305.6	3	3	2	2			1	2	2	2			3		3

1	Reasonably Agreed	2	Moderately Agreed	3	Strongly Agreed

20EE306	Digital Circuits Laboratory	0/0/2/1
Nature of Course	M (Practical Application)	
Pre-requisites	Basics of Electrical Circuits	

Course Objectives:

1	To impart the concept of Boolean reduction techniques and verify the output.
2	To design and verify the output of combinational circuits.
3	To realize the output of Synchronous Sequential circuits.
4	To realize the output of Asynchronous Sequential circuits.

Course Outcomes:
Upon completion of the course, students shall have ability to

C306.1	Interpret the various Boolean Algebra and Boolean reduction techniques.	[U]
C306.2	Design and verify the output of combinational circuits.	[A]
C306.3	Design and verify the output of Sequential circuits.	[A]
C306.4	Design a simple processor.	[A]
C306.5	Synthesis and simulate the state machines.	[AP]

Course Contents:

S.No	List of Experiments	CO Mapping	RBT
1.	Analysis and Synthesis of Boolean Expressions using Basic Logic Gates.	C305.1	[A]
2.	Design of Adder and Subtractor using logic gates.	C305.1	[A]
3.	Design of Code convertors using logic gates	C305.2	[A]
4.	Design of parity generator and checker using logic gates	C305.2	[A]
5.	Design of Combinational Circuits: Encoders, Decoders, Multiplexer and Demultiplexer using logic gates.	C305.3	[A]
6.	Design and implementation of counters using flip-flops.	C305.3	[A]
7.	Design and Implementation of Shift Registers using flip-flops.	C305.4	[A]
8.	Design of Arithmetic Logic Unit (ALU) (Simulation)	C305.4	[A]
9.	Analysis and Synthesis of Logic Functions using Multiplexers and Decoders (Simulation)	C305.5	[A]
10.	Complex state machine design (Simulation)	C305.5	[A]
	Total Hours	**30**	

Text Books:

1	M. Morris R. Mano, Michael D. Ciletti, “Digital Logic Design”, Prentice Hall,5th Edition,2013.
2	Floyd, “Digital Fundamentals”, Pearson education, 11th edition, 2015.
3	A.Anand kumar, “Fundamental of Digital Circuits”, PHI Learning Private Ltd, 4th edition,2016.

Reference Books:

1	R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 4th Edition, 2009.
2	Tocci R.J., Neal S. Widmer, “Digital Systems: Principles and Applications”, Pearson Education Asia, 2014.
3	Donald P Leach, Albert Paul Malvino, Goutam Sha, “Digital Principles and Applications”, Tata McGraw Hill, 7th Edition, 2010.

Web References:	
1	M. Morris R. Mano, Michael D. Ciletti, “Digital Logic Design”, Prentice Hall,5th Edition,2013.
2	Floyd, “Digital Fundamentals”, Pearson education, 11th edition, 2015.
3	Theodore F. Bogart, Jeffery S. Beasley and Guilermo Rico, “Electronic Devices and Circuits”, Pearson Education, 6th edition, 2013.

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Rubric based Continuous Assessment [60 marks]		End Semester Examination[40 marks]
Remember	10		10
Understand	20		20
Apply	30		30
Analyze	40		40
Evaluate	0		0
Create	0		0
Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**60**	**40**	**100**

Course Articulation Matrix

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C306.1	3	3	2	1		1	1	2	2	2	1			3	
C306.2	3	3	2	1		1	1	2	2	2	1			3	
C306.3	3	3	2	1		1	1	2	2	2	1			3	
C306.4	3	3	2	1		1	1	2	2	2	2			3	
C306.5	3	3	2	1	3	1	1	2	2	2	2			3	
C306.6	3	3	2	1		1	1	2	2	2	1			3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE401	Electrical Machines - II	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Electrical Machines - I	

Course Objectives:

1	To know the concepts of Rotating Magnetic Field.
2	To impart the knowledge of Synchronous and Induction Machines.
3	To analyze the performance of Synchronous and Induction Machines.

Course Outcomes:
Upon completion of the course, students shall have ability to

C401.1	Illustrate the construction and operation of salient and non-salient pole alternators and synchronous motors.	[U]
C401.2	Examine the performance of synchronous machines by various methods	[A]
C401.3	Interpret the construction and operation of single and three phase induction motor.	[U]
C401.4	Analyze the performance of induction machines by various methods.	[A]
C401.5	Explain the operation of various starters and speed control methods of Induction motor.	[A]

Course Contents:

Module 1: Synchronous Machines **20 Hrs**

Introduction - MMF distribution - Rotating Magnetic Field. **Alternators:** Constructional details- Principle of operation and types of Rotor- EMF equation- Armature reaction - Voltage regulation - EMF, MMF and ZPF- Two Reaction Theory - Synchronization and Synchronizing Power - Parallel operation and Load sharing, Operation on Infinite bus-bar- typical applications. **Synchronous motors:** Starting methods, Synchronous Machines on Infinite bus bars, Phasor diagram, V and Inverted - V Curves, Hunting and its suppression, Effect of change in Excitation, Synchronous Condenser.

Module 2: Induction Machines **15 Hrs**

Three phase induction motors: Constructional details - Principle of Operation and types of Rotor - Slip - Starting and Maximum torque - Slip-Torque Characteristics, No Load and Blocked Rotor test - Equivalent Circuit- Circle Diagram - Crawling and Cogging- Separation of No-Load losses - Induction Generators - Double Cage Induction Motor. **Single- Phase Induction Motors:** Constructional details - Principle of Operation and types - Double Field Revolving Theory - Equivalent Circuit and its applications.

Module 3: Starting and Speed Control Methods of Induction Motors **10 Hrs**

Need for Starting - Types of Starters - Rotor Resistance, Star- Delta, Autotransformer and Soft Starters, Speed control - Change of Voltage, Frequency, Number of Poles, V/F Control, Slip-Cascaded Connection - Slip Power Recovery Scheme - Braking Methods, Case study on Industry based Soft Starters.

Total Hours	**45**

Text Books:

1	I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 5th Edition, 2017.
2	A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, McGraw Hill Education, 2013.
3	P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.

Reference Books:	
1	P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, Third Edition, 2013.
2	M.G. Say,” Alternating Current Machines”, Pitman Publishing Ltd., 4th edition, 2013.
3	A. S. Langsdorf, “Alternating current machines”, McGraw Hill Education, 2010.
Web References:	
1	http://nptel.ac.in/syllabus/syllabus.php?subjectId=108105018
2	http://freevideolectures.com/Course/2335/Basic-Electrical-Technology/23
3	https://www.electrical4u.com/deep-bar-double-cage-induction-motor/
4	https://www.youtube.com/watch?v=b24jORRoxEc
5	http://www.engineeringmatters.com/EngineeringMatters_Project_Maglev.pdf

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C401.1	Understand	Technical Quiz Writing Skills Class Presentation Group Assignment	**20**
C401.2	Analyse		
C401.3	Understand		
C401.4	Analyse		
C401.5	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment				End Semester Examination [50 marks]
	Theory			Formative Assessment [20 Marks]	
	CIA-I [10 Marks]	CIA-II [10 Marks]	CIA-II [10 Marks]		
Remember	50	-	20	25	20
Understand	50	50	40	50	40
Apply		30	20	-	20
Analyse	-	20	20	25	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C401.1	2	1							2			1	3		3
C401.2	3	3	2	2					2			1	3		3
C401.3	2	1							2	2		1	3		3
C401.4	3	3	2	2					2			1	3		3
C401.5	2	1							2	2		1	3		3
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE402	Transmission and Distribution	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Basics of Electrical Circuits	

Course Objectives:

1	To understand the transmission line parameters calculation for different conductors.
2	To analyze the concept of modelling, corona loss and efficiency of transmission line.
3	To introduce the transmission line Sag calculation methods, Substation layout and Distribution system.
4	To examine the load duration curve, economic aspects and power tariff calculation.
5	To demonstrate the selection of cables and insulators in power system network.

Course Outcomes:

Upon completion of the course, students shall have ability to

C402.1	Explore the knowledge in the electrical circuit parameters calculation and transmission line losses.	[A]
C402.2	Investigate the modelling and simulation concepts of transmission lines.	[A]
C402.3	Illustrate the concept of Sag Calculation, DC distribution, Feeders, Substation layout.	[AP]
C402.4	Analyze the load duration curve, economic aspects and power tariff calculation methods.	[A]
C402.5	Interpret the overhead line insulators, underground cables and its losses.	[U]

Course Contents:

Module 1: Transmission line parameters calculation **15 Hrs**

Resistance, inductance, capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing of solid and bundled conductors, effect of earth on capacitance. Introduction to transmission loss, Ferranti effect and corona loss, Travelling wave phenomena.

Module 2: Modelling and Performance of transmission lines - Substation and Distribution system **15 Hrs**

Modelling and simulation of medium and long transmission lines, efficiency and regulation Mechanical design of transmission lines. Sag Calculation, Load Duration Curve. Introduction to DC distribution system and its losses, Substation layout, radial and ring systems, selection of feeders and distributors, economic aspects and tariff calculations.

Module 3: Overhead line insulators, Underground cables **15 Hrs**

Selection of Insulators, different types, string efficiency. Selection of cables, rating of cables, constructional details of various types of cables, oil and gas-filled cables, XLPE cable, capacitance grading, sheath loss, thermal ratings.

Total Hours	**45**

Text Books:

1	Leonard.L. Grigsby, Electric Power Generation, Transmission and distribution, Third Edition, CRC Press, 2012.
2	C.L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy, Third Edition, New Age International, 2015.
3	Colin Bayliss, Brain Hardy, Transmission and Distribution Electrical Engineering, Fourth Edition, Newnes Publishers, 2011.

Reference Books:	
1	V.K. Mehta, Principles of Power System, S. Chand Publication, 2011.
2	A. S. Pabla, Electric Power Distribution, McGraw Hill International Edition, 2012.
3	S.N. Singh, Electric Power Generation, Transmission and Distribution, Twelfth Printing (Second Edition) Published by Asoke K. Ghosh, Prentice-Hall of India Private Limited, New Delhi, 2011.
Web References:	
1	http://nptel.ac.in/video.php?subjectId=108102047
2	http://textofvideo.nptel.iitm.ac.in/108102047/lec20.pdf
3	https://www.edx.org/course/smart-grids-electricity-future-ieeex-smartgrid-x-0

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C402.1	Analyze	Quiz Group Assignment Class Presentation Tutorial Problems	**20**
C402.2	Apply		
C402.3	Apply		
C402.4	Analyze		
C402.5	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination [50 marks]
	Theory			Formative Assessment [20 Marks]	
	CIA-I [10 Marks]	CIA-II [10 Marks]	Term End Examination [10 marks]		
Remember	-	20	20	20	20
Understand	20	30	30	20	30
Apply	30	30	30	30	30
Analyse	50	20	20	30	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C402.1	3	3	2	2		2	2			1	1		3	2	
C402.2	3	2	1	2	1	2	2			1	1		2		
C402.3	3	3	2	3		2	2	2		1	1	1	3		1
C402.4	3	3	2	2		2	2	2		1	1	1	3		1
C402.5	3	2	1	2		2	2			1	1		3		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE403	Control Systems	3/1/0/4
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Nil	

Course Objectives:

1	To understand the methods of systems representation and to derive their transfer function models.
2	To provide an adequate knowledge of systems in time domain and its stability analysis.
3	To accord basic knowledge in obtaining the open loop and closed loop frequency responses of systems.
4	To introduce the design of controllers and compensators
5	To impart the concept of state variable representation of physical systems

Course Outcomes:
Upon completion of the course, students shall have ability to

C403.1	Construct the mathematical models of various control systems and obtain the transfer function of a system.	[AP]
C403.2	Analyse the first and second order systems in time domain and frequency domain.	[A]
C403.3	Analyse the frequency responses using Bode Plot and Polar plot and examine the stability of the control systems using Root locus, Routh-Hurwitz Criteria methods.	[A]
C403.4	Design and realize the controllers and compensators.	[C]
C403.5	Construct state space model of a system and test its controllability and observability.	[AP]

Course Contents:

Module 1: System modelling **15 Hrs**

Basic elements of control systems - Open loop and closed loop systems - Transfer function modelling: Electrical systems and Mechanical system - Translational, Rotational - Block diagram reduction using signal flow graph.

Module 2: Time and frequency response analysis **20 Hrs**

Time domain specifications - Types of test signals - First order system response – Step, Ramp, Impulse - Second Order System Response - Step input-- Steady state error -Generalized error coefficients - Concept of stability - Routh Hurwitz criterion - Root locus technique - Frequency domain specifications - Bode plot - Polar plot - Gain margin and Phase margin.

Module 3: Controllers, compensators and state variable analysis **25 Hrs**

Controllers: Design of P, PI and PID controllers - Compensators: Introduction to lag, lead and lag-lead networks - Lag, lead and lag - lead compensator design using Bode plot - Concepts of state variables: State space model of Mechanical and Electrical systems - State Variable approach - Controllability and Observability - Introduction to Digital Control Systems: Basic Elements of discrete data control systems, advantages of discrete data control systems.

Total Hours	**45**

Text Books:

1	I. J. Nagrath & M. Gopal, „Control Systems Engineering„, 6th Edition, New Age International Publishers, 2017.
2	Katsuhiko Ogata, „Modern Control Engineering", 5th edition, Pearson, New Delhi, 2015.
3	Farid Golnaraghi & Benjamin C. Kuo, „Automatic Control systems", 9th Edition, Wiley,2014.

Reference Books:	
1	Norman S. Nise, „Control Systems Engineering", Wiley, New Delhi, 2018.
2	Richard Poley, „Control Theory Fundamentals", 2nd Edison, Createspace, 2014.
3	Richard C. Dorf, Robert H.Bishop, „Modern Control Engineering", 13th Edition, Pearson Education, New Delhi, 2016.
4	A.Nagoorkani, "Control Systems Engineering", RBA Publications 2014.
Web References:	
1	http://www.nptel.ac.in/courses/108101037/
2	https://nptel.ac.in/courses/108101037/14

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C403.1	Apply	Writing Skill Problem Solving Group Assignment Simulation exercises Quiz	**20**
C403.2	Analyse		
C403.3	Analyse		
C403.4	Create		
C403.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination [50 marks]
	Theory			Formative Assessment [20 Marks]	
	CIA-I [10 Marks]	CIA-II [10 Marks]	CIA III [10 Marks]		
Remember	-	-	-	-	-
Understand	-	-	20	-	20
Apply	50	25	25	40	20
Analyze	50	75	25	40	40
Evaluate	-	-	-	-	-
Create	-	-	30	20	20

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C403.1	3	2	1	1						1		2	3		
C403.2	3	3	2	2						1		2	3		
C403.3	3	3	2	2								1	3		
C403.4	3	3	3	3	3			1	2	1		3	3		1
C403.5	3	2	1	1								2	3		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE404	Linear Integrated Circuits	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Nil	

Course Objectives:

1	To analyse circuit characteristics with signal analysis using Op-amp ICs.
2	To design and construct application circuits with ICs as Op-amp, 555, 566 etc
3	To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator ICs and DAC/ADCs.

Course Outcomes:

Upon completion of the course, students shall have ability to

C404.1	Infer the IC fabrication and DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.	[U]
C404.2	Apply mathematical concepts to characterize and model the circuits using IC 741.	[AP]
C404.3	Design the A/D and D/A converters and study their characteristics.	[A]
C404.4	Explain and compare the working of multivibrators using special application IC 555 and general-purpose op-amp.	[U]
C404.5	Design and troubleshoot simple analog circuits using Op amp, Timer ICs and PLLs.	[A]

Course Contents:

Module 1: IC Fabrication and Op-amp Characteristics **15 Hrs**

Advantages of ICs over discrete components – Manufacturing process of monolithic ICs – Construction of monolithic bipolar transistor – Monolithic diodes – Integrated Resistors –Monolithic Capacitors – Inductors, General operational amplifier stages and internal circuit diagrams of IC 741- Ideal Op-amp characteristics, DC and AC performance characteristics, slew rate, Open and closed loop configurations, Frequency response of Op-amp.

Module 2: Application of Op-amps **15 Hrs**

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters. **Analog and Digital Data Conversions**: D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type - Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters.

Module 3: Waveform Generators and Special ICs **15 Hrs**

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, Function generator circuit, Timer IC 555: Functional block diagram, characteristics & applications - Astable and monostable multivibrator -566 Voltage Controlled Oscillator circuits, IC Voltage regulators - Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator - Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

Total Hours	**45**

Text Books:

1	D. Roy Choudary, S.B. Jain, " Linear Integrated Circuits", Third edition, New Age publishers, 2014.

2	Ramakant A Gayakwad , " Opamps and Linear Integrated Circuits" , IV edition, Pearson Education/ PHI, 2009.
3	J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.
Reference Books:	
1	Robert F. Coughlin, and Driscoll,” Operational Amplifiers and Linear Integrated Circuits”, 6/e, Pearson Education. Reprint 2007.
2	P. R. Gray and R. G. Meyer,” Analysis and Design of Analog Integrated Circuit, John Wiley, 4th Ed, Reprint 2009.
3	Sergio Franco, ‟ Design with operational amplifiers and Analog Integrated circuits”, Tata McGraw Hill 3rd Edition 2002.
Web References:	
1	Ron Manchini, “Op-Amps for Everyone “, Design Reference-Texas Instruments, August 2002, Available from: http://www.ti.com/lit/an/slod006b/slod006b.pdf
2	www.ti.com/amplifier-circuit/overview.html
3	https://www.ti.com/seclit/ml/ssqu016/ssqu016.pdf
4	http://www.ti.com/lit/ds/symlink/opa2192.pdf

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C404.1	Understand	Quiz Simulation exercises Class Presentation Assignment	**20**
C404.2	Apply		
C404.3	Analyze		
C404.4	Understand		
C404.5	Analyze		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment				End Semester Examination [50 marks]
	Theory			Formative Assessment [20 Marks]	
	CIA-I [10 Marks]	CIA-II [10 Marks]	CIA III [10Marks]		
Remember	20	-	-	20	10
Understand	30	20	40	20	20
Apply	50	40	20	30	30
Analyse	-	40	40	30	40
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C404.1	3	3	2	2	3		1						3	2	
C404.2	3	3	2	2	3		2				2	2	3	2	
C404.3	3	3	2	2	3		2				2	2	3	2	
C404.4	2	1			2		2				2	2	2		
C404.5	2	1			2		2				2	2	2		

20MA403	Applied Mathematics EEE	2/1/2/4
Nature of Course	J (Problem analytical)	
Course Pre-requisites	Concepts of basic differentiation and Integration	

Course Objectives:

1	To find the numerical solutions of large system of differential equations and interpolations of the given numerical data.
2	To study the concept of fitting a curve of best fit to the given numerical data and to calculate the deviation of the expected value from the observed value.
3	To understand numerical methods when the huge amounts of data are given such as series of measurements to observations or some other empirical information.
4	To give adequate exposure in applying numerical methods in predicting missing data.
5	To study the basic probability concepts.
6	To understand standard distributions which can be used to study digital signal processing and power system.

Course Outcomes:
Upon completion of the course, students shall have ability to

C403.1	Recall the concepts of basic probability.	[R]
C403.2	Fit a polynomial or special function curve for the given data.	[U]
C403.3	Apply numerical methods to find the interpolation of numerical data.	[AP]
C403.4	Analyzes the numerical solution of the large system of differential equations.	[AP]
C403.5	Apply the probability concept in protocol designing problems	[AP]
C403.6	Use distribution in analysis of power system	[AP]

Course Contents:

Module 1: Interpolation and Numerical Solution to ODE **18 Hrs**

Interpolation And Approximation - Lagrangian Polynomials-Divided differences -Newton's forward and backward difference formulas- Numerical Differentiation - Differentiation using Newton forward and Backward interpolation formulae - Numerical solution to first order ordinary differential equations: Single step methods: Taylor series method - Modified Euler's Method – Runge-Kutta Method of fourth order - Multistep method: Milne's Predictor- Corrector Method- Adam-Bashforth Predictor- Corrector Method.

Module 2: Curve Fitting **10 Hrs**

Curve Fitting-Empirical laws -Linear law - Laws reducible to Linear law- Method of group averages - straight line and parabola -Principle of Least squares -Fitting straight line, parabola and exponential curve

Module 3: Probability **17 Hrs**

Basic concepts-Addition and Multiplication law of probability – Conditional probability - Random Variable- One dimensional random variable Discrete and continuous random variables- moment generating functions -Simple problems - Probability mass function - Probability density function - Standard distributions-Discrete distributions -Binomial, Poisson, Geometric– Continuous distributions - Uniform, Exponential, Normal distributions..

Total Hours	**45**

Course Outcomes: (Laboratory)
Upon the completion of the course, students shall have ability to

C403.1	Use MATLAB visualization tools analyze engineering problems
C403.2	Use MATLAB in-built functions for numerically solve engineering problems.

C403.3	Understand and apply basic functions in MATLAB for curve fitting.
C403.4	Use R programming basic functions for fitting a line and curves
C403.5	Able to apply the R programming from a Probability perspective
C403.6	To apply the R programming in-built functions for probability distribution functions

Laboratory Component:

S.No	List of Experiments	CO Mapping	RBT
1.	To Calculating Newton's forward and backward difference Interpolation using MATLAB	C403.1	[AP]
2.	To calculate the value of Numerical Differentiation by Newton forward and Backward interpolation formulae using MATLAB.	C403.1	[AP]
3.	To find the solution of ODE by single step methods using MATLAB	C403.2	[AP]
4.	To find the solution of ODE by Multistep methods using MATLAB	C403.2	[AP]
5.	Use least square fit in MATLAB to find coefficients of a function.	C403.3	[AP]
6.	Use least square fit in R programming to find coefficients of afunction.	C403.4	[AP]
7.	To fit straight line and parabola curve Using R programming.	C403.4	[AP]
8.	To fit exponential curve Using R programming.	C403.4	[AP]
9.	To find mean and standard deviation of random variable Using R programming.	C403.5	[AP]
10.	To find the Probability density function Using R programming	C403.5	[AP]
11.	To find the probability of discrete distribution Using R programming.	C403.6	[AP]
12.	To find the probability of continuous distribution Using Rprogramming.	C403.6	[AP]

Text Books:

1	Grewal B.S., Numerical methods in Engineering and Science. 10th edition, Khanna Publishers, 2014.
2	Kreyszig. E, —Advanced Engineering Mathematics, tenth Edition, John Wiley and Sons (Asia) Limited, Singapore, 2014.
3	Gupta, S.C., & Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & sons, 2000,Reprint 2014.
4	Palaniammal.S.,-Probability and Random Processes, Prentice hall of India, New Delhi, 2014,Reprint 2015

Reference Books:

1	Glyn James, —Advanced Modern Engineering Mathematics, Pearson Education, 4th edition, 2012.
2	Jain M.K. Iyengar, K & Jain R.K., Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd, Publishers 2013.
3	Kandasamy.P,Thilagavathy,K,P.Gunavathy,"Numerical Methods",3rd edition, S.Chand and company Pvt.Ltd.,2013
4	Peebles Jr.P.Z.,-Probability Random Variables and Random signals principles , Tata McGraw- Hill Publishers, Fourth edition , New Delhi , 2002.
5	G. Jay Kerns, "Introduction to Probability and Statistics Using R", Lulu Publishers First Edition, 2010.

Web References:	
1	https://nptel.ac.in/courses/111/106/111106101/
2	http://nptel.ac.in/courses/112106064/
3	http://nptel.ac.in/courses/111103070/
Online Resources:	
1	https://ocw.mit.edu/courses/.../18-335j-introduction-to-numerical-methods
2	www.edx.org/Probability
3	https://ocw.mit.edu/courses/.../18-440-probability-and-random-variables-spring-2014/

Assessment Methods & Levels (based on Blooms' Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical& Project	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Articulation Matrix (Theory)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-
2	2	2	-	-	-	-	-	-	-	-	-	-	1	-	-
3	3	3	-	-	-	-	-	-	-	-	-	-		-	-
4	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-
5	3	3	-	-	-	-	-	-	-	-	-	-		-	-
6	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-
Avg	**2.5**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.6**	**-**	**-**

1	**Reasonably agreed**	**2**	**Moderately agreed**	**3**	**Strongly agreed**

Course Articulation Matrix (Laboratory)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	1	1	-	-	3	-	-	-	-	-	-	-	1	-	-
2	2	2	-	-	3	-	-	-	-	-	-	-	1	-	-
3	3	3	-	-	3	-	-	-	-	-	-	-		-	-
4	3	3	-	-	3	-	-	-	-	-	-	-	1	-	-
5	3	3	-	-	3	-	-	-	-	-	-	-		-	-
6	3	3	-	-	3	-	-	-	-	-	-	-	1	-	-
Avg	**2.5**	**2.5**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.6**	**-**	**-**

1	**Reasonably agreed**	**2**	**Moderately agreed**	**3**	**Strongly agreed**

20IT101	Python Programming (COMMON TO CSE / IT / ECE / EEE / MCT)	3/0/2/4

Nature of Course	F (Theory Programming)
Course Pre-requisites	Nil

Course Objectives:

1.	To understand and execute Python script using types and expressions.
2.	To understand the difference between expressions & statements and to understand the concept of assignment semantics.
3.	To utilize high level data types such as lists and dictionaries.
4.	To import and utilize a module and to perform read & write operations on files.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recognize the general principles and good Algorithmic Problem Solving.	[R]
C101.2	Read, write, execute by hand simple Python programs.	[U]
C101.3	Structure simple Python programs for solving problems.	[U]
C101.4	Decompose a Python program into functions.	[AP]
C101.5	Represent compound data using Python lists, tuples anddictionaries.	[AP]
C101.6	Read and write data from / to files in Python Programs.	[AN]

Course Contents:

Module 1 :Algorithmic Problem Solving, Data, Expressions, Statements **15 Hrs**

Algorithms, Building Blocks of Algorithms (Statements, State, Control Flow, Functions), Notation (Pseudo Code, Flow Chart, Programming Language), Algorithmic Problem Solving, Simple strategies for developing algorithms (Iteration, Recursion). Illustrative Problems: Find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range. Python Interpreter and Interactive Mode; Values and Types: Int, Float, Boolean, String and List; Variables, Expressions, Statements, Tuple Assignment, Precedence of Operators, Comments; Modules and Functions, Function Definition and Use, Flow of Execution, Parameters and Arguments; Illustrative Programs: Exchange the values of two Variables, Circulate the values of n variables, distance between two points.

Module 2 : Control Flow, Functions **15 Hrs**

Conditionals: Boolean Values and Operators, Conditional (If), Alternative (If-Else), Chained Conditional (If-Elif-Else); Iteration: State, While, For, Break, Continue, Pass; Fruitful Functions: Return Values, Parameters, Local and Global Scope, Function Composition, Recursion; Strings: String Slices, Immutability, String Functions and Methods, String Module; Lists as Arrays. Sets -Set Operations, Classes. Illustrative Programs: Sum an array of numbers.

Module 3 : Lists, Files, Modules, Packages **15 Hrs**

Lists: List Operations, List Slices, List Methods, List Loop, Mutability, Aliasing, Cloning Lists, List Parameters; Tuples: Tuple Assignment, Tuple as Return Value; Dictionaries: Operations and Methods; Advanced List Processing - List Comprehension; Files and Exception: Text Files, Reading and Writing Files, Format Operator; Command Line Arguments, Errors and Exceptions, Handling Exceptions, Modules, Packages; Numpy and Numpy Operations, Pandas and pandas operations, Matplotlib: types of plots. Case study: Analyze the academic performance of students and plot a graph.

Total Hours	**45**

Laboratory Component		
S. No	**List of Experiments**	
1.	Compute the GCD of two numbers.	
2.	Find the square root of a number (Newton's method).	
3.	Exponentiation (power of a number).	
4.	Find the maximum of a list of numbers.	
5.	Linear search and Binary search.	
6.	Selection sort, Insertion sort.	
7.	Merge sort.	
8.	First n prime numbers.	
9.	Multiply matrices.	
10.	Programs that take command line arguments (word count).	
11.	Plotting datasets.	
12.	File handling and plotting.	
	Total Hours:	**30**
Text Books:		
1	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd Edition, Updated for Python 3, Shroff / O'Reilly Publishers, 2016. (http://greenteapress.com/wp/think-python/).	
2	Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python" – Revised and updated for Python 3.2, Network Theory Ltd., 2011.	
3	Tony Gaddis, "Starting out with Python'', 2nd edition, Addison Wesley, Pearson, 2012.	
Reference Books:		
1	Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.	
2	Timothy A. Budd, "Exploring Python‖", Mc-Graw Hill Education (India) Private Ltd., 2015.	
3	John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press, 2013.	
Web References:		
1	http://nptel.ac.in/courses/106106145/	
2	https://www.codecademy.com/learn/learn-python	
3	https://www.coursera.org/learn/python-data-analysis#syllabus	
Online Resources:		
1	https://www.programiz.com/python-programming	
2	https://www.fullstackpython.com/best-python-resources	

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy					
Summative assessment based on Continuous and End Semester Examination					
Revised Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	**Rubric based CIA [30 Marks]**	
Remember	30	30	20	-	20
Understand	40	30	30	30	30
Apply	30	40	50	70	50
Analyse					
Evaluate					
Create					

No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C101.1	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.2	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.3	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.4	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.5	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.6	3	3	3	3	3	3	1	1			1	1	3	3	3
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE405	Electrical Machines - II Laboratory	0/0/2/1
Nature of Course	M (Practical Application)	
Course Pre-requisites	Electrical Machines - I Laboratory	

Course Objectives:
To expose the operation of Synchronous and Induction Machines and give them experimental skills.

Course Outcomes:
Upon completion of the course, students shall have ability to

C405.1	Inspect the performance of Synchronous Generator by conducting various tests.	[A]
C405.2	Examine the characteristics of V and inverted V curves in Synchronous Motor.	[A]
C405.3	Analyze the performance of Induction Machines.	[A]
C405.4	Investigate the performance of Induction Machines using Simulation Software.	[A]
C405.5	Demonstrate a specific Braking operation on an Induction Machine.	[A]

List of Experiments

1.	Performance characteristics of Three Phase Alternator by direct loading.	[A]
2.	Regulation of Three Phase Alternator by EMF and MMF methods.	[A]
3.	Regulation of Three Phase Alternator by ZPF method.	[A]
4.	Regulation of Three Phase Salient Pole Alternator by Slip test.	[A]
5.	V and Inverted V curves of Three Phase Synchronous Motor.	[A]
6.	Load test on Single and Three Phase Induction Motor.	[A]
7.	No Load and Blocked Rotor tests on Single Phase and Three Phase Induction Motor (Determination of Equivalent Circuit parameters).	[A]
8.	Separation of No-Load losses of Three Phase Induction Motor.	[A]
9.	Performance characteristics of Single Phase and Three Phase Induction Motors using Simulation.	[A]
10.	Braking of Three Phase Induction Motor.	[A]
	Total Hours:	**30**

Text Books:

1	I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education 5th Edition,2017.
2	A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, McGraw Hill Education, 2013.
3	P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.

Reference Books:

1	P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, Third Edition, 2013.
2	M.G. Say,” Alternating Current Machines”, Pitman Publishing Ltd., 4th edition, 2013.
3	A. S. Langsdorf, “Alternating current machines”, McGraw Hill Education, 2010.

Web References:

1	http://nptel.ac.in/syllabus/syllabus.php?subjectId=108105018
2	http://freevideolectures.com/Course/2335/Basic-Electrical-Technology/23
3	https://www.electrical4u.com/deep-bar-double-cage-induction-motor/
4	https://www.youtube.com/watch?v=b24jORRoxEc
5	http://www.engineeringmatters.com/EngineeringMatters_Project_Maglev.pdf

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks]**	**End Semester Examination [40 marks]**
Remember	10	10
Understand	20	20
Apply	30	30
Analyse	40	40
Evaluate	0	0
Create	0	0

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester examination**	
0	**60**	**40**	**100**

No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C405.1	2	1							2			1	3		3
C405.2	2	1							2			1	3		3
C405.3	2	3	2	2					2			1	3		3
C405.4	2	1			3				2			1	3		3
C405.5	3	2	1	1					2			1	3		3
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE406	Control Systems Laboratory	0/0/2/1
Nature of Course	M (Practical Application)	
Course Pre-requisites	Control Systems	
Course Objectives:		
To enable the students to strengthen their understanding of the design and analysis of control systems using modern software resources.		
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C406.1	Construct the transfer function a DC separately excited generator and obtain its characteristics	[AP]
C406.2	Construct the transfer function of the given DC Motor for Armature controlled and Field controlled cases	[AP]
C406.3	Demonstrate Servo and stepper motor System also to set up a closed loop position control system and study the system performance.	[U]
C406.4	Analyse the time response and stability of first and second order Systems	[A]
C406.5	Design a Controllers and lag compensator for uncompensated system using simulation software	[C]
Course Contents:		
List of Experiments		
1.	Determination of transfer function of separately excited DC Generator	[AP]
2.	Determination of transfer function of Armature Controlled DC Motor	[AP]
3.	Determination of transfer function of Field Controlled DC Motor	[AP]
4.	Servo motor position control systems	[U]
5.	Stepper motor position control systems	[U]
6.	Simulation of first and Second order system for different test inputs	[A]
7.	Time response analysis for a second order system using simulation software	[A]
8.	Stability analysis of linear systems using digital s simulation software	[A]
9.	Design of P,PI,PD and PID controllers for type-0 and type-1 system using	[C]
10.	Design of lag, lead and lag-lead compensator for uncompensated system using simulation software.	[C]
	Total Hours:	**30**
Text Books:		
1	I. J. Nagrath & M. Gopal, “Control Systems Engineering”, 6th Edition, New Age International Publishers , 2017	
2	Katsuhiko Ogata, “Modern Control Engineering”, 5th edition, Pearson, New Delhi, 2015.	
3	Farid Golnaraghi & Benjamin C. Kuo, “Automatic Control systems‟, 9th Edition, Wiley,2014.	
Reference Books:		
1	Norman S. Nise, “Control Systems Engineering”, Wiley, New Delhi, 2018.	
2	Richard Poley, “Control Theory Fundamentals‟, 2nd Edison, Createspace, 2014.	

3	Richard C. Dorf, Robert H.Bishop, “Modern Control Engineering”, 13th Edition, Pearson Education, New Delhi, 2016.
4	A.Nagoorkani, “Control Systems Engineering”, RBA Publications 2014.
5	S.Palani, “Control Systems Engineering”, 2nd Edition, Tata McGraw-Hill Education,2010.
Web References:	
1	http://www.nptel.ac.in/courses/108101037/
2	http://www.nptel.ac.in/courses/108102043/
3	https://nptel.ac.in/courses/108101037/14

Assessment Methods & Levels (based on Bloom’s Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom’s Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	0	0
Understand	20	20
Apply	30	30
Analyse	30	30
Evaluate	0	0
Create	20	20

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester examination**	
0	**60**	**40**	**100**

No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C406.1	3	2	1	1						2			3		
C406.2	3	2	1	1						2			3	1	
C406.3	2	1											2	1	
C406.4	3	3	2	2	3			2	2	1		2	2	1	
C406.5	3	3	3	3	3			2		1	1	2	2		2
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE407	Linear Integrated Circuits Laboratory	0/0/2/1
Nature of Course	M (Practical Application)	
Course Pre-requisites	Linear Integrated Circuits	

Course Objectives:
To enable the students to strengthen their understanding of the design and analysis of OPAMP circuits.

Course Outcomes:

Upon completion of the course, students shall have ability to

C407.1	Evaluate the linear and non-linear applications of Op-amp circuits.	[A]
C407.2	Examine the electrical parameters of Op-amp and the input/output voltage relations of the precision circuits.	[A]
C407.3	Design Waveform generator using OPAMP circuits.	[A]
C407.4	Design oscillator circuit using IC-741.	[A]
C407.5	Construct A/D and D/A converter using OPAMP.	[A]

Course Contents:

List of Experiments

1	Implementation of Inverting and Non inverting Amplifier using Op-amp.	[AP]
2	Implementation of Zero crossing detector, Peak Detector using Op-amp	[AP]
3	Implementation of Adder and subtractor using Op-amp	[AP]
4	Implementation of Comparator, Integrator and Differentiator using Op-amp	[AP]
5	Design of Astable and Monostable multi vibrators using 555 timers	[A]
6	Design and testing of precision rectifier and peak detector circuits using Op-amp.	[A]
7	Design of square wave generator for a specified frequency and duty cycle, using OPAmp IC741	[A]
8	Design of triangular wave generator from square wave generator.	[A]
9	Design of a sinusoidal oscillator for specified frequency based on Wien bridge and RC phase shift oscillators using IC-741	[A]
10	Design of A/D and D/A converters using Op-amp.	[A]
11	Implement the design of voltage regulator in 78XX and 79XX series	[AP]
	Total Hours:	**30**

Text Books:

1	D. Roy Choudary, S.B. Jain, " Linear Integrated Circuits", Third edition, New Age publishers, 2014.
2	Ramakant A Gayakwad , " Opamps and Linear Integrated Circuits" , IV edition, Pearson Education/ PHI, 2009
3	J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.

Reference Books:

1	James M.Fiore, “Opamps and Linear Integrated Circuits”, Cengage Learning India Pvt Ltd, 1st edition, 2010.
2	P. R. Gray and R. G. Meyer,” Analysis and Design of Analog Integrated Circuit, John Wiley, 4th Ed, Reprint 2009.
3	Jacob MillmanChristos, HalkiasChetan D Parikh, “Integrated Electronics: Analog and Digital Circuits and Systems”, McGraw Hill,2nd edition, 2011.

Web References:	
1	www.ti.com/amplifier-circuit/overview.html
2	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-101-introductory-analog-electronics-laboratory
3	https://electricvlab.com/vtu-analog-electronics-lab/

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment[60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	0	0
Understand	20	20
Apply	30	30
Analyse	30	30
Evaluate	0	0
Create	20	20

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester examination**	
0	**60**	**40**	**100**

No. ofthe CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C407.1	3	2	1	1						2			3		
C407.2	3	2	1	1						2			3	1	
C407.3	2	1											2	1	
C407.4	3	3	2	2	3			2	2	1		2	2	1	
C407.5	3	3	3	3	3			2		1	1	2	2		2
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE501	Power Electronics	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Analog Electronics	

Course Objectives:

1	To understand the characteristics of Power Semiconductor devices.
2	To provide adequate knowledge of DC choppers.
3	To impart the concepts of PWM inverters.
4	To illustrate the operation of AC voltage regulators.

Course Outcomes:

Upon completion of the course, students shall have ability to

C501.1	Examine the operation of DC-DC converter and resonant converters.	[A]
C501.2	Infer the operation of various types of controlled rectifiers.	[A]
C501.3	Design the suitable filter for power converters and analyze the effect the source impedance.	[AP]
C501.4	Examine the operation of voltage and current source inverters.	[A]
C501.5	Illustrate the working principle of AC-AC Converter.	[U]
C501.6	Acquire and analyze various applications of power electronic circuits.	[AP]

Course Contents:

Module 1: DC to DC Converter **15 Hrs**

Silicon carbide power devices, MOSFET and its characteristics, protection and gate drive circuits - Circuit Configuration and analysis - Buck, boost, buck - boost converter- Cuk and SEPIC converter - SMPS - Introduction to Resonant Converters- classification: ZVS and ZCS.

Module 2: Rectifiers **15 Hrs**

SCR and its characteristics - Single phase half and full wave rectifiers with R, RL, RLE load -Three phase half and full wave rectifiers with R, RL, RLE load - Design of filters – Dual Converter - Power factor improvement - Effect of source impedance.

Module 3: Inverters and AC Voltage Controllers **15 Hrs**

IGBT and its characteristics, gate drive circuits and heat sink - Single phase Half bridge and full bridge inverter - three phase inverters - constant voltage source and constant current source inverters - PWM control of inverters - single pulse, multi pulse, sinusoidal, space vector modulation techniques - AC to AC voltage controller - Introduction to Multilevel inverters - Role of power converters in Renewable energy and Electric vehicles.

Total Hours	**45**

Text Books:

1	Ned Mohan, Tore M. Undeland and William P. Robbins, “Power Electronics - Converters, Applications and Design”, John Wiley & Sons edition 2011.
2	M.H. Rashid, “Power Electronics Circuits, devices and applications”, Pearson Education, Inc. Edition 2014.
3	P.S. Bhimbra, “Power Electronics”, Khanna Publishers edition 2018.

Reference Books:

1	Vedam Subramanian, “Power Electronics” New age international Second edition 2018.
2	M.D.Singh, “Power Electronics”, Tata McGraw-Hill, 2 nd Edition 2014.
3	Bimal K. Bose, “Modern Power Electronics & AC Drives”, Pearson,2015.

Web References:

1	https://nptel.ac.in/courses/108101038/
2	https://www.tutorialspoint.com/power_electronics/index.htm
3	https://in.mathworks.com/videos/developing-dc-dc-converter-control-with-
4	https://in.mathworks.com/videos/developing-dc-dc-converter-control-with-simulinkautomatically-generating-controller-code-for-implementation-on-embedded-

	processor1535540362783.html
5	https://in.mathworks.com/videos/series/developing-dc-dc-converter-control-with simulink.html

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	Bloom'sLevel	AssessmentComponent	Marks
C501.1	Analyze	Quiz Simulation exercises Class Presentation Group Assignment	**20**
C501.2	Apply		
C501.3	Analyze		
C501.4	Analyze		
C501.5	Understand		
C501.6	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	-	-	-	-
Understand	-	-	20	20
Apply	50	40	50	50
Analyze	50	60	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C501.1	3	3	2	2			1						3	2	
C501.2	3	2	1	1	2		2				1	2	3	3	
C501.3	3	3	2	2	2		2				1	2	3	3	
C501.4	3	3	2	2	1		2				1	2	3	2	
C501.5	2	1			1							2	3	2	
C501.6	3	2	1	1	2		3		2		2	3	3	3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE502	Microcontrollers	3/0/0/3
Nature of Course	F (Theory Programming)	
Course Pre-requisites	Digital Circuits	

Course Objectives:

1	Understand the architecture of Microcontrollers.
2	Analyze the working of various interfacing ICs.
3	To develop application-based Assembly Language programs.

Course Outcomes:

Upon completion of the course, students shall have ability to

C502.1	Illustrate the architecture of 8051 Microcontroller	[U]
C502.2	Develop assembly language programs using 8051 for various applications.	[AP]
C502.3	Analyze the architecture of PIC Microcontroller and Construct the simple programs.	[A]
C502.4	Infer the architecture of ARM controller.	[A]
C502.5	Construct the simple programs using ARM.	[C]

Course Contents:

Module 1: 8051 Microcontroller **15 Hrs**

Overview of Microprocessors - 8051: Functional block diagram - Instruction set - addressing modes - Interrupt structure - Timer - I/O ports - Serial Communication, Simple programming - Key board and display interface - DC motor control - Stepper motor control.

Module 2: PIC Microcontroller **15 Hrs**

PIC18FXXX: Architecture - Data and program memory organization - Addressing modes -Instruction set - Move / Copy instructions, Arithmetic instructions, Logic instructions, Branches instructions, Bit Manipulation instructions, Read/Write instructions, Machine Control instructions - Timers - Interrupt, ISR, priority - Speed Control of Induction Motor.

Module 3: ARM Controller **15 Hrs**

ARM7TDMI: Features - Block diagram - Architecture - Addressing modes - Instruction set - Thumb instructions - Data processing instructions, Data transfer instructions, Branch and control instructions, Register load and store instructions, Multiple register load and store instructions, Status register access instructions, Coprocessor instructions - Seven Segment Display Interfacing with ARM Controller.

Total Hours	**45**

Text Books:

1	Kenneth Ayala, “The 8051 Microcontroller”, Cengage Learning Publications, 2 nd Edition, 2017.
2	John. B.Peatman , “ Design with PIC Microcontroller” , Prentice hall, 2012.
3	Subrata Ghoshal, 8051 Microcontroller Internals, Instructions, Programming and Interfacing, Second edition, Pearson Education Asia, 2014.
4	Myke Predko, “Programming and customizing the PIC microcontroller”, Tata McGraw Hill Publishing Company Limited, Third Edition, 2008.
5	Steve Furber, ‟ ARM System –On – Chip architecture “, Addision Wesley, 2009.

Reference Books:

1	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems using Assembly and C”, Prentice Hall Publications, 2nd Edition, 2008.

2	Krishna Kant, “Microprocessor and Microcontrollers” Eastern Company Edition, Prentice Hall of India, New Delhi, 2 nd edition, 2013.
3	Joseph Yiu, „The Definitive Guide to the ARM Cortex-M0‟ Newnes – Elsevier, 2011.
4	Muhammad Tahir and Kashif Javed, „ARM Microprocessor Systems - Cortex-M Architecture, Programming, and Interfacing‟, CRC Press, 2011.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc18_ec03
2	https://nptel.ac.in/courses/108107029/
3	http://www.ti.com/microcontrollers/overview.html
4	https://swayam.gov.in/course/3490-digital-electronics-and-microprocessor
5	https://nptel.ac.in/courses/117104072/

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C502.1	Understand	Quiz Class Presentation Group Assignment Case study	**20**
C502.2	Apply		
C502.3	Analyse		
C502.4	Analyse		
C502.5	Create		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	-	-	-	-
Understand	50	-	-	40
Apply	50	50	30	20
Analyze	-	50	40	40
Evaluate	-	-	-	-
Create	-	-	30	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C502.1	3	3	2	2	3									3	
C502.2	3	2	1	1	3	2	1	1	2		2	1		3	1
C502.3	3	3	2	2	3									3	
C502.4	3	3	2	2	3	2	1	1	2		2	1		3	1
C502.5	3	2	1	1	3									3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE503	Power System Analysis	3/1/0/4
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Transmission and Distribution	

Course Objectives:

1	To understand the concepts of power systems and its components.
2	To apply various numerical methods to analyze a power system in steady state and fault conditions
3	To analyze the stability concepts of power systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C503.1	Model the various power system components and calculate the per unit quantities.	[AP]
C503.2	Construct the bus admittance and impedance matrices.	[AP]
C503.3	Analyze various load flow conditions and calculate the load flow results.	[A]
C503.4	Classify the types of faults and analyze the power system on different fault conditions.	[A]
C503.5	Compute the stability of the system with the help of equal area criteria and Modified-Euler and Runge - Kutta methods.	[AP]

Course Contents:

Module 1: Modelling of Power System and Load Flow Analysis **21 Hrs**

Modelling of power, Single line diagram, per unit analysis, Formation of admittance matrix with and without mutual admittance, Study on sparse technique, Z - bus building algorithm without mutual system components impedances. Power flow analysis - Formation of load flow equations, load flow analysis - Gauss-Seidel, Newton- Raphson (polar form) and fast decoupled method. IEEE standard 3002 series (IEEE 3002.2, 3002.3 and 3002.9).IEC standard 60909.

Module 2: Short Circuit Analysis **21 Hrs**

Short circuit analysis - Symmetrical fault - behavior of short circuit transients in generator and transmission line - Symmetrical fault analysis using Z bus algorithm - Current limiting reactors, Sequence components, sequence networks, Unsymmetrical fault analysis - Line to Ground, Line to Line, Double Line to Ground faults.

Module 3: Power System Stability **18 Hrs**

Power angle equation, Synchronizing power co-efficient, steady state, dynamic and transient stability, Equal area criterion, power swing curve, Swing equation - Solution using Rangekutta and Euler's method, Multi machine stability.

Total Hours	**60**

Text Books:

1	Hadi Saadat, Power System Analysis, Tata McGraw Hill, 2015.
2	John J. Grainger and Stevenson Jr. W. D, "Power System Analysis", McGraw Hill International edition, 2016.
3	Kothari D. P and Nagrath I. J., "Modern Power System Analysis",3 rd Edition., Tata McGraw- Hill Publishing Company Limited.2011.

Reference Books:

1	J. Duncan Glover, M.S Sarma & Thomas J Over bye, "Power System Analysis and Design" Cengage Learning , 5 th Edition 2011.
2	Pai M. A., "Computer Techniques in Power System Analysis", 3 rd Edition, Tata McGraw-Hill Publishing Company Limited. 2014.
3	Prabha Kundur.,"Power System Stability and Control" 5 th Edition., Tata McGraw-Hill Publishing Company Limited 2008.
4	Abhijit Chakrabarti and Sunita Halder, "Power System Analysis Operation and Control",3rd Edition, PHI Publications.2010.

Web References:	
1	https://nptel.ac.in/courses/108105067/
2	https://www.vlab.co.in/broad-area-electrical-engineering
3	https://youtu.be/TdAqh20DDhE
4	https://cosmolearning.org/courses/power-system-analysis-304/video-lectures/
5	https://www.youtube.com/watch?v=biApXHVsRa8

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C503.1	Apply	Quiz Problem Solving Case Study Simulation Tutorial	**20**
C503.2	Apply		
C503.3	Analyze		
C503.4	Analyze		
C503.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	10	-	10	10
Understand	20	20	20	10
Apply	70	40	70	40
Analyze	-	40	-	40
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C503.1	3	2	1	1	2				1				2		
C503.2	3	2	1	1	2				1				2		
C503.3	3	3	2	2	3				1				3		
C503.4	3	3	2	2	3	1			1	1			3		
C503.5	3	2	1	1	2	1			1	2			3		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE504	Power Electronics Laboratory	0/0/2/1
Nature of Course	M (Practical Application)	
Course Pre-requisites	Analog Electronics	

Course Objectives:

1. To provide an opportunity to understand the operation, function and interaction between various components
2. To impart the knowledge in design, modelling and simulation of Power electronic converter based systems

Course Outcomes
Upon completion of the course, students shall have ability to

C504.1	Examine the operation and characteristics of various power electronic components.	[AP]
C504.2	Analyze the working of single - phase converter.	[A]
C504.3	Analyze the characteristics of DC to DC chopper.	[A]
C504.4	Illustrate the working operation of Three phase AC voltage controller.	[A]
C504.5	Select the suitable simulation tool for constructing power converters	[A]
C504.6	Examine the power converter application in DC drives.	[AP]

Course Contents

S.No	List of Experiments	CO Mapping	BT
1.	V-I characteristics of SCR and TRIAC.	C504.1	[AP]
2.	V-I characteristics of MOSFET and IGBT.	C504.1	[AP]
3.	Switching characteristics of SCR and IGBT.	C504.1	[AP]
4.	Single-phase half and fully controlled Rectifiers.	C504.2	[A]
5.	Design a buck converter and boost converter circuit using power MOSFET.	C504.3	[A]
6.	Single phase IGBT based Inverter performance verification.	C504.4	[A]
7.	ZVS and ZCS converter.	C504.3	[A]
8.	AC-AC Voltage controller.	C504.4	[A]
9.	(a) Three phase fully Controlled rectifier.	C504.2	[A]
	(b) Three phase bridge inverter.	C504.2	[A]
10.	Speed control of DC and AC motors using power converter circuits	C504.6	[AP]
11.	Simulation of PE circuits (1Φ and 3Φ Semiconverter,1Φ and 3Φ Full converter, DC-DC converters , AC voltage controller)	C504.5	[E]
		Total Hours	**30**

Text Books:	
1.	Ned Mohan, Tore M. Undeland & William P. Robbins, “Power Electronics – Converters, Applications and Design”, John Wiley & Sons edition 2011.
2.	M.D.Singh, “Power Electronics”, Tata McGraw-Hill, 2nd edition 2014
3.	P.S. Bhimbra, “Power Electronics”, Khanna Publishers edition 2018.
Reference Books:	
1.	Vedam Subramanian, “Power Electronics” New age international Second edition 2018.
2.	P.C. Sen, “Modern Power Electronics”, Tata McGraw-Hill, edition 2018.
3.	Bimal K. Bose, “Modern Power Electronics & AC Drives”, Pearson,2015
Web References:	
1.	https://nptel.ac.in/courses/108101038/
2.	https://www.tutorialspoint.com/power_electronics/index.htm

3.	https://in.mathworks.com/videos/developing-dc-dc-converter-control-with-simulinkautomatically-generating-controller-code-for-implementation-on-embedded-processor1535540362783.html
4.	https://in.mathworks.com/videos/series/developing-dc-dc-converter-control-withsimulink.html

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 Marks]**	**End Semester Examination [40 Marks]**
Remember	-	-
Understand	-	-
Apply	60	60
Analyze	30	30
Evaluate	10	10
Create	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**60**	**40**	**100**

Course Articulation Matrix (Laboratory)															
No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C504.1	2	1			3								3	2	
C504.2	3	3	2	2	3	2	2		2		2	2	3	3	
C504.3	3	3	2	2	3	2	2		2		2	1	3	3	
C504.4	3	3	2	2	3	2	2		2		2	2	3	3	
C504.5	3	2	1	1	2	2	2				2	3	2	2	
C504.6	3	2	1	1	3	2	2		2		2	2	3	3	
1	**Reasonably agreed**					**2**	**Moderately agreed**				**3**	**Strongly agreed**			

20EE505	Microcontrollers Laboratory	0/0/2/1
Nature of Course	M (Practical application)	
Course Pre-requisites	Digital Circuits	

Course Objectives:

1	To illustrate the arithmetic and logical operations.
2	To interface the external devices with the Microcontroller.

Course Outcomes:

Upon completion of the course, students shall have ability to

C505.1	Develop the ALP to solve the arithmetic operations using Microcontroller.	[AP]
C505.2	Analyze various Logical and Control operations using 8051.	[A]
C505.3	Analyze on various interfacing ICs according to the users requirements.	[A]
C505.4	Design and verify the output of Assembly Language Programs using motors.	[AP]
C505.5	Apply the knowledge for real-time problems using ARM and PIC	[AP]

Course Contents:

List of Experiments

1.	Arithmetic operation using 8051 Microcontroller.	[A]
2.	Minimum, maximum and sorting data using 8051 Microcontroller.	[A]
3.	Code conversion using 8051 Microcontroller.	[A]
4.	8279 Keyboard & display interfacing with 8051 Microcontroller.	[AP]
5.	Stepper motor control using 8051.	[AP]
6.	DC motor speed measurement and control using 8051.	[AP]
7.	Simple arithmetic operations: Addition/Subtraction/Multiplication/Divisionusing PIC Controller	[A]
8.	Simulation based Speed control of Induction Motor using PIC controller.	[AP]
9.	ARM Assembly program for Arithmetic and Logical Operations.	[A]
10.	Simulation based Seven Segment Display Interfacing with ARM Controller.	[AP]
	Total Hours:	**30**

Reference Books:

1	Krishna Kant, “Microprocessors and Microcontrollers, Architecture, Programming and System Design - 8085, 8086, 8051, 8096”, Prentice Hall India Ltd Publications, 1st Edition, 2010.
2	Kenneth Ayala, “The 8051 Microcontroller”, Cengage Learning Publications, 3rd Edition,2017.
3	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay “The 8051 Microcontroller and Embedded Systems using Assembly and C”, Prentice Hall Publications, 2nd Edition, 2008.

Web References:

1	https://www.youtube.com/watch?v=nPi3fmJpM8Y
2	https://nptel.ac.in/courses/108105102/59
3	https://nptel.ac.in/downloads/106108100/

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 Marks]**	**End Semester Examination[40 Marks]**
Remember	-	-
Understand	-	-
Apply	60	60
Analyse	40	40
Evaluate	-	-
Create	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**60**	**40**	**100**

No. ofthe CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C505.1	3	3	3	3	3	2	1	1	3	2	1	3		3	
C505.2	3	3	2	1	3	2			3	2	1	3		3	
C505.3	3	3	2	1	3	2			3	2	1	3		3	
C505.4	3	3	3	3	3	2	1	1	3	2	1	3		3	1
C505.5	3	2	1	1	3	2	1	1	3	2	1	3		3	1
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE506	Power System Simulation Laboratory	0/0/2/1
Nature of Course	M (Practical Application)	
Course Pre Requisites:	Transmission and Distribution	

Course Objectives:

1 To know and study about the transmission line parameters.

2 To apply iterative techniques for power flow analysis.

3 To Impart Knowledge on stability

Course Outcomes:

Upon completion of the course, students shall have ability to

C506.1	Construct the bus admittance and impedance matrices.	[AP]
C506.2	Examine the Load flow problems and calculate the load flow results.	[A]
C506.3	Classify the types of faults and analyze the power system on differentfaulted conditions.	[AP]
C506.4	Illustrate the concepts of transient and steady state stability in power systems.	[A]
C506.5	Analyze the multi machine stability	[A]

Course Contents:

List of Experiments

1.	Computation and Modelling of Transmission Line Parameters.	[AP]
2.	Formation of Bus Admittance Matrix with and without mutual element.	[AP]
3.	Formation of Bus Impedance Matrix.	[AP]
4.	Load Flow Analysis by Gauss - Seidel Iterative Technique.	[A]
5.	Load Flow Analysis by Newton Raphson Technique.	[A]
6.	Symmetrical Fault Analysis.	[A]
7.	Unsymmetrical Fault Analysis.	[A]
8.	Steady State Stability Analysis.	[A]
9.	Transient Stability by point by point method.	[A]
10.	Stability analysis of Multi-Machine Infinite Bus System.	[A]
11.	State Estimation of Weighted-Least-Square State Estimation	[AP]
	Total Hours:	**30**

Text Books:

1	Tharangika Bambaravanage, Asanka Rodrigo, Sisil Kumarawadu,"Modeling, Simulation, and Control of a Medium-Scale Power System", Springer Nature Singapore Pte Ltd, 2018.
2	Hadi Saadat, " Power System Analysis", Tata McGraw Hill, 2015.
3	John J. Grainger and Stevenson Jr. W. D, "Power System Analysis", McGraw Hill International edition, 2016..
4	Kothari D. P and Nagrath I. J., "Modern Power System Analysis",3rdEd., TataMcGraw-Hill Publishing Company Limited, 2011.

Reference Books:

1	J.Duncan Glover,M.S Sarma & Thomas J Overbye, "Power System Analysis anddesign" Cengage Learning , 5th edition 2011.
2	Pai M. A., "Computer Techniques in Power System Analysis", 3rd Ed., Tata McGraw-Hill Publishing Company Limited. 2014.
3	Prabha Kundur.,"Power System Stability and Control"5th Ed., Tata McGraw -Hill Publishing Company Limited 2008,

Web References:	
1	https://nptel.ac.in/courses/108105067/
2	https://www.vlab.co.in/broad-area-electrical-engineering
3	https://youtu.be/TdAqh20DDhE
4	https://www.youtube.com/watch?v=BaKC7v8bRsg&t=3099s
Online Resources:	
1	https://cosmolearning.org/courses/power-system-analysis-304/video-lectures/
2	https://www.youtube.com/watch?v=biApXHVsRa8

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 Marks]**	**End Semester Examination [40 Marks]**
Remember	10	10
Understand	20	20
Apply	30	30
Analyse	20	20
Evaluate	20	20
Create	-	-
Remember	10	10

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**60**	**40**	**100**

No. ofthe CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C506.1	3	2			3				1				3		
C506.2	3	3	2	2	3			2	1				3		2
C506.3	3	2	1	1	3				1				3		
C506.4	3	3	2	2	2			2	1				3		2
C506.5	3	3	3	3	3			2	1				3		2
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EC611	Communication Engineering	3/0/0/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	Nil	

Course Objectives:

1	To introduce the concepts of mobile and satellite communications.
2	To realise the effect of noise on communication systems.
3	To introduce different methods of analog and digital communication and their significance.

Course Outcomes:

Upon completion of the course, students shall have ability to

C611.1	Impart Knowledge on principle of communication system and sources of noise.	[U]
C611.2	Analyze different modulation and demodulation techniques used in analog communication.	[A]
C611.3	Infer the different modulation and demodulation schemes for digital communications.	[U]
C611.4	Analyze the digital communications techniques in various fields.	[A]
C611.5	Examine applications of data communication in mobile and satellite communication.	[AP]

Course Contents:

Module 1: Signal Analysis and Noise Analysis **15 Hrs**

Communication Process - Sources of Information - Communication Channels - Modulation Process - Types of Communication - External Noise - Internal Noise - White Noise - Narrow Band Noise - Representation of Narrow Band noise in phase and Quadrature Components - Noise Figure - Noise Bandwidth - Noise Temperature.

Module 2: Analog Communication **15 Hrs**

AM - Frequency spectrum - power relations - generation of AM - DSB, DSB/SC, SSB, VSB AM Transmitter & Receiver; FM and PM - frequency spectrum - power relations: NBFM & WBFM, Generation of FM and DM - Amstrong method - Simulation experiments on analog communication methods.

Module 3: Digital Communication **15 Hrs**

Pulse modulation - concepts of sampling and sampling theorems, PAM, PWM, PPM, PTM, quantization and coding: DCM, DM, slope overload error. ADM, DPCM, OOK systems - ASK, FSK, PSK, BPSK, QPSK, applications of Data communication. Introduction to Mobile communication and Satellite communication - Global System for Mobile Communications (GSM) - Code Division Multiple Access (CDMA).

TotalHours	**45**

Text Books:

1	Simon S. Haykin, “An Introduction to Analog and Digital Communications”, 2nd Edition, John Wiley & Sons, 2009.
2	Taub & Schiling “Principles of Communication Systems”, Tata McGraw Hill 2014.
3	John G.Proakis and Masoud Salehi, “Communication Systems Engineering”, Pearson Education, 2015.

Reference Books:

1	B. Carlson, “Introduction to Communication Systems” (4/e), McGraw-Hill, 2009.
2	B.P.Lathi, “Modern Digital and Analog Communication Systems”, 3rdEdition, Oxford UniversityPress,2012.
3	Steven Roman,“Introduction to Coding and Information Theory”, Springer-Verlag New York,2011.

Web References:	
1	http://www.mee.tcd.ie/~sigmedia/pmwiki/uploads/Teaching.3C1/handout1.pdf
2	https://nptel.ac.in/courses/117101053/
3	https://www.tutorialspoint.com/digital_communication/digital_communication_delta_modulation.html
4	https://www.elprocus.com/wireless-communication-project-ideas/
5	https://www.tonex.com/wireless-training/

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C611.1	Understand	Quiz Writing Skills Class Presentation Group Assignment	**20**
C611.2	Analyze		
C611.3	Understand		
C611.4	Analyze		
C611.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	-	-	20
Understand	30	30	30	30
Apply	50	30	40	30
Analyze	-	40	40	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
0	**50**	**50**	**100**

No .of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C611.1	2	1												3	
C611.2	3	3	2	2	2					2			2	3	
C611.3	2	1												3	
C611.4	3	3	2	2						2			2	3	
C611.5	3	2	1	1						2			2	3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EC612	Principles of Digital Signal Processing	2/1/0/3
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Transforms and Fourier Analysis	

Course Objectives:

1	To study and analyse various signals and systems and their mathematical operations.
2	To study various transformation techniques in signal processing.
3	To design analog and digital filters for signal processing applications.
4	To learn about programmable digital signal processor and multi-rate signal processing

Course Outcomes:

Upon completion of the course, students shall have ability to

C612.1	Explain various types of signals and systems.	[U]
C612.2	Analyse the mathematical operations on signals and systems.	[A]
C612.3	Analyse various transformation techniques.	[A]
C612.4	Illustrate various types of digital filters using IIR and FIR filter design.	[AP]
C612.5	Explain the programmable digital signal processor and multi-rate signal processing	[U]

Course Contents:

Module 1: Signals and Systems **20 Hrs**

Introduction to DSP - Signals and systems - Standard signals - Classification of signals - Discrete Time (DT) signals: Deterministic and Random signals, Periodic and Aperiodic signals, Energy and Power signals, Odd and Even signals - Classification of systems - Discrete Time systems: Static and Dynamic, Causal & Non-causal, Linear & Nonlinear, Time - variant & Time - invariant, Stable and Unstable. LTI System - Convolution and Correlation.

Module 2: Transformation Techniques **20 Hrs**

Z Transform: properties, ROC - Inverse Z transforms - Stability analysis - Discrete Fourier Transforms - Properties - Circular Convolution - Fast Fourier Transform algorithms - Decimation in Time Algorithm & Decimation in Frequency Algorithm. Discrete time Fourier Transform - Relation between DFT and DTFT.

Module 3: Design of Digital Filters and Architecture of DSP **20 Hrs**

FIR filter: design of linear phase FIR filters - design of FIR filters using windowing technique - Rectangular, Hamming, Hanning windows. IIR filter: Analog low pass filter design - Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation. Architecture of DSP - Von Neumann and Harvard architecture - Architecture and features of TMS 320C55xx DSP processor. Architecture of one DSP processor for motor control. Introduction to multi rate digital signal processing - Applications in power systems.

Total Hours	**60**

Text Books:

1	J.G. Proakis and D.G. Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, Pearson Education, New Delhi, 5th edition, 2022.
2	A.Nagoorkani, “Digital Signal Processing”, Tata McGraw Hill, New Delhi, 2012.
3	S. K. Mitra, “Digital Signal Processing: A computer based approach”, McGraw Hill, 2011.

Reference Books:	
1	A.V. Oppenheim and R. W. Schafer, “Discrete Time Signal Processing”, Prentice Hall, 2011
2	Salivahanan, A. Vallavaraj, C. Gnanapriya, “Digital Signal Processing”, Tata McGraw Hill,New Delhi, 2011.
3	Vinay K. Ingle and J.G. Proakis, “Digital Signal Processing Using MATLAB”, 3rd Edition', Pearson Education, 2010.
Web References:	
1	http://nptel.ac.in/courses/117102060/
2	https://www.tutorialspoint.com/digital_signal_processing/
3	https://www.allaboutcircuits.com/projects/category/embedded/digital-signal-processing/
4	https://www.dspguide.com/ch28/3.htm
5	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-341-discrete-time-signal-processing-fall-2005/
6	http://www.ictacademy.in/Pages/Digital-Signal-Processing.aspx

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C612.1	Understand	Quiz Problem solving Group Assignment Tutorial Case study	**20**
C612.2	Analyze		
C612.3	Analyze		
C612.4	Apply		
C612.5	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	20	20
Understand	70	30	30	20
Apply	-	30	30	30
Analyze	10	20	20	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C612.1	2	1			2						2	3	1	1	
C612.2	3	3	2	2	3							2	2	2	
C612.3	3	3	2	2	3								2	2	
C612.4	3	2	1	1	3				2		2		1	2	
C612.5	2	1			2						2	2		3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EN602	Business Communication and Value Science (B.E EEE)	2/0/2/3
Nature of Course	B (Language Usage)	
Course Objectives:		
1	Understand the life skills and their importance in leading a happy life.	
2	Learn the correct grammatical structures in English language.	
3	Introduce them to key concepts of values, life skills and business communication.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C602.1	Remember the need for life skills and values.	[U]
C602.2	Recognize own strengths and opportunities.	[A]
C602.3	Apply the life skills to different situations.	[A]
C602.4	Understand the basic tenets of communication.	[AP]
C602.5	Apply the basic communication practices in different types of communication.	[U]

Course Contents:

Module 1: **20 Hrs**

Introduction to Values - Its importance and necessity - Business Communication - Oral Communication - Written Communication - Listening skills - Hearing vs Listening - Body Language.

Module 2: **20 Hrs**

Tenses - Verbs - Helpings Verbs - Subject-Verb Agreement - Articles - Prepositions -Conjunctions - Adjectives – Adverbs – Voice - Parts of Sentence - Identification of Errors -Types of Communication Skills - Barriers to Effective Communication - Tips to Develop Communication Skills - Principles of Listening - The Process of Listening - Types of Listening.

Module 3: **20 Hrs**

Verbal Communication Vs Email Writing - Advantages and Disadvantages - Pronunciation and Enunciation - Summary Writing - Story Writing - Vocabulary Enrichment - Life Skills - Importance and Necessity - Thinking skills - Social skills - Emotional skills - Howard Gardner's Multiple Intelligence - Embracing Adversity.

Total Hours	**60**

Text Books:	
1	APAART: Speak Well 1 (English language and communication)
2	APAART: Speak Well 2 (Soft Skills)
Reference Books:	
1	Alan Mc'carthy and O'dell – English Vocabulary in Use – Third Edition – Cambridge University Press 2017
2	Dr. Saroj Hiremath – Business Communication – NiraliPrakashan.
Web References:	
1	Train your mind to perform under pressure - Simon sinek https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under - pressure- capture - your - flag/
2	Brilliant way one CEO rallied his team in the middle of layoffs https://www.inc.com/ video/simon-sinek-explains-why-you-should-put-people-before-numbers.html
3	Will Smith's Top Ten rules for success https://www.youtube.com/ watch? v=bBsT9omTeh0

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model(Max.Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C602.1	Understand	Immersion Activity (Interview) Create Resume Group Assignment (Community Service) Situational Role Play Group activities Record a conversation	**30**
C602.2	Understand		
C602.3	Apply		
C602.3	Apply		
C602.4	Understand		
C602.5	Apply		

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	40	40
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
20	**30**	**50**	**100**

No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C602.1									2	3		2			2
C602.2									3	3		1			1
C602.3								2	2	2		1			1
C602.4								1	1	2					1
C602.5								1	3	3		2			2
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EC613	Principles of Digital Signal Processing Laboratory	0/0/2/1
Nature of Course	M (Practical Application)	
Course Pre-requisites	Engineering Mathematics III	

Course Objectives:

1	To provide an opportunity to understand the operation and function of various Signals.
2	To impart the knowledge in design, modelling and simulation of digital based systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C613.1	Create elementary Discrete-Time sequences.	[C]
C613.2	Analyze the basic signal processing operations.	[A]
C613.3	Realize the FIR digital filters using a simulation tool and analyze the response of the filter.	[AP]
C613.4	Realize the IIR digital filters using a simulation tool and analyze the response of the filter.	[AP]
C613.5	Analyze signal processing using DSP processors.	[A]

Course Contents:

S.No	List of Experiments	CO Mapping	BT
1.	Representation of basic signals.	C613.1	[C]
2.	Verification of sampling theorem.	C613.2	[A]
3.	Computation of linear convolution.	C613.2	[A]
4.	Computation of circular convolution	C613.2	[A]
5.	Design and analysis of FIR filter using windowing technique	C613.3	[AP]
6.	Frequency response of LTI system.	C613.2	[A]
7.	Design of Butterworth filter	C613.4	[AP]
8.	Chebyshev filter	C613.4	[AP]
9.	Generation of Signals using DSP processor	C613.5	[A]
10.	Convolution using DSP processor	C613.5	[A]
		Total Hours	**30**

Text Books:

1	J.G. Proakis and D.G. Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, Pearson Education, New Delhi, 5th edition, 2022.
2	A.Nagoorkani, “Digital Signal Processing”, Tata McGraw Hill, New Delhi,2012
3	S. K. Mitra, “Digital Signal Processing: A computer based approach”, McGraw Hill, 2011.

Reference Books:

1	A.V. Oppenheim and R. W. Schafer, “Discrete Time Signal Processing”, Prentice Hall, 2011
2	Salivahanan, A. Vallavaraj, C. Gnanapriya, “Digital Signal Processing”, Tata McGraw Hill,NewDelhi, 2011.
3	Vinay K. Ingle and J.G. Proakis, “Dig6ital Signal Processing Using MATLAB”, 3rd Edition', Pearson Education, 2010.

Web References:

1	http://nptel.ac.in/courses/117102060/
2	https://www.tutorialspoint.com/digital_signal_processing/
3	https://www.allaboutcircuits.com/projects/category/embedded/digital-signal-processing/
4	https://www.dspguide.com/ch28/3.htm
5	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-341-discrete-time-signal-processing-fall-2005/

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Summative assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment**		**End Semester Examination [50 marks]**
	Rubric based Continuous Assessment [60 Marks]		
Remember	-		-
Understand	30		30
Apply	30		30
Analyze	30		30
Evaluate	10		10
Create	-		-
Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**60**	**40**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C613.1	3	2	1	1	3				2				1	3	
C613.2	3	3	2	2	3				1				2	3	
C613.3	3	3	2	2	3				2				2	3	
C613.4	3	3	3	3	3				2				2	3	
C613.5	3	3	3	3	3				2				2	3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE701	Power System Protection and Switchgear	3/0/0/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	Transmission and Distribution, Power System Analysis	

Course Objectives:

1	To learn the fundamentals of protective equipment's used in power systems
2	To give a broad coverage on types of protective relays and circuit breakers.
3	To study about the theory of arching and protection against over voltage.

Course Outcomes:

Upon completion of the course, students shall have ability to

C701.1	Interpret the importance of protective devices in power systems.	[U]
C701.2	Examine the working of various protective relays.	[A]
C701.3	Apply suitable protection schemes for different apparatus, feeders and bus bar faults.	[AP]
C701.4	Illustrate the causes of overvoltage and protection against overvoltage.	[U]
C701.5	Examine the operation of various circuit breakers with arcing concepts.	[A]

Course Contents:

Module 1: Protective Relays **15 Hrs**

Fundamentals of protection and switchgear in Power systems - Causes, need of protection and types of protection, Relays - Classification of Electromechanical and induction relays, its operating principle, types and applications, Types of Overcurrent Relay - Definite Time, Inverse Time & IDMT Relays, Static relays and Numerical relays - Introduction, Block diagram, operating principle and application, Recent developments of relays and switchgear for Smart grid operations, Case study - relay coordination and importance of relay selection.

Module 2: Apparatus Protection **15 Hrs**

Generator protection - stator and rotor protection. Transformer Protection - Differential protection. Line Protection - Distance, Differential protection and Carrier current protection, Feeder and Bus bar protection. Causes of over voltage - Ground wires, Surge diverters or Lighting Arresters, Surge absorbers, Applications of artificial intelligence in Power System Protection.

Module 3: Circuit Breakers **15 Hrs**

Fault clearing process - Theory of arcing and arc quenching - Circuit breakers and its classification - Minimum oil, Air blast,SF6 and Vacuum circuit breakers - Case studies on SF6 and Vacuum circuit breaker - RRRV, current chopping, interruption of capacitive current, Resistor switching - Introduction of miniature circuit breakers, Molded case circuit breakers, Solid state and Hybrid circuit breakers.

Total Hours **45**

Text Books:

1	Paul M. Anderson, Charles Henville, Rasheek Rifaat, Brian Johnson and Sakis Meliopoulos, "Power System Protection", IEEE Press, Wiley, Second Edition, 2022.
2	Badri Ram, Vishwakarma "Power System Protection and Switchgear" Tata McGraw Hill, 2011.
3	B. Ravindranath and N. Chander, "Power System Protection & Switchgear", New Age Publishers, 2010.
4	Y.G Paithangar, "Fundamentals of Power System Protection" PHI learning Pvt Ltd, Second Edition, 2010.

Reference Books:

1	Omar Salah Elsayed Atwa, Practical Power System and Protective Relays Commissioning, Academic Press, Elsevier, 2019.

2	Ramesh Bansal, “Power System Protection in Smart Grid Environment”, Taylor and Francis, CRC Press, 2019.
3	C.L. Wadhwa, “Electrical Power Systems”, New Age International (P) Ltd., 2017.
4	V.K Mehta and Rohit Mehta, “Principle of Power System”, S Chand, reprint 2010.
Web References:	
1	https://www.youtube.com/watch?v=khgdMHt9X8A
2	https://www.youtube.com/watch?v=id72r7QuGaM
3	https://www.youtube.com/watch?v=iL9m354sHWs
4	https://www.youtube.com/watch?v=8OVyLscA4fs
5	https://www.youtube.com/watch?v=oj1NwZL01io

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C701.1	Understand	Assignment Online Technical Quiz Class Presentation Case Study	**20**
C701.2	Analyse		
C701.3	Apply		
C701.4	Understand		
C701.5	Analyse		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	-	-	-	-
Understand	50	-	30	30
Apply	10	50	40	40
Analyze	40	50	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C701.1	2	1					1						3		
C701.2	2	1					1						3		
C701.3	3	2	1	1			1						3		
C701.4	2	1								2			3		
C701.5	2	1					1			2			3		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20MG701	Engineering Economics	3/0/0/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	Nil	

Course Objectives:

1	To make the students understand the role of macro and micro Economics for business applications.
2	To familiarize the students about the cost behaviour in short and long run.
3	To expose the students to the methods of investment analysis.
4	To provide the students with an insight in to Indian and International Economics.

Course Outcomes:

Upon completion of the course, students shall have ability to

C701.1	Understand the needs, roles, scope of Engineering Economics.	[U]
C701.2	Analyse costs and their role in pricing.	[A]
C701.3	Understand the cost behaviour and cost calculations.	[U]
C701.4	Have working knowledge of investment analysis.	[A]
C701.5	Understand the external environment for industries in India and the basics of international business.	[U]

Course Contents:

Module 1: Introduction to Economics **15 Hrs**

Economics - Definition, Scope; Micro Economics; Macro Economics; Law of Demand; Law of supply; Types of efficiency- Technical efficiency, Economic efficiency; Types of costs fixed cost vs variable cost, Total cost, Average cost, Marginal cost, opportunity cost, Short run cost, Long run cost, Sunk cost Break - Even analysis.

Module 2: Investment Analysis **15 Hrs**

Investment aim, purpose, considerations; Time value of money, Capital budgeting - meaning, purpose; Capital expenditure vs Revenue expenditure; Discount rate; Methods of evaluating project feasibility payback period method, Net present value method, Internal rate of return method, Profitability Index Method. Replacement and Maintenance Analysis Types of replacements, Types of maintenance, Determination of Economic life of an asset.

Module 3: Indian and International Economics **15 Hrs**

Indian Economy Salient features, Planning for Economic - Development of India Five Year Plans, Objectives and achievements; Role of small scale industry, Liberalization, Privatization and Globalization (LPG), International Economics - International trade Purchasing Power Parity Theory; Free Trade Vs Protection; Terms of trade, Balance of Trade, Balance of payment, Exchange Rate Meaning, Factors affecting exchange rates.

Total Hours	**45**

Text Books:

1	Pannerselvam, R., "Engineering Economics, Prentice-Hall of India Pvt. Ltd, New Delhi, 2nd Edition, 2013.
2	Seema Singh, Economics for Engineering Students, I.K. International Publishing House, 2nd edition, 2014.
3	James L. Riggs, David D. Bedworth and Sabah. U. Randhawa, Engineering Economics, TMH Publication, 4th edition, reprint 2004.

Reference Books:

1	Ruddar daff and K.P.M Sundharam, Indian Economy , S. Chand and Company Ltd, 66th revised edition, 2015.

2	Henry Thompson, International Economics , Cambridge University Press India Pvt Ltd, 3rd edition, 2011.
3	Ian Fraser, John Gionea and Simon Fraser, Economics for Business , Tata McGraw Hill Publication, 4th edition, 2011.
Web References:	
1	https://icmai.in/upload/Students/Syllabus2012/Study_Material_New/FoundationPaper1.pdf
2	http://fzp.ujep.cz/~vosatka/ERASMUS/Principles_of_Economics/Principles-of Economics--Mankiw-(5th).pdf

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C701.1	Understand	Quiz Case Study Class Presentation Assignment	**20**
C701.2	Analyze		
C701.3	Understand		
C701.4	Analyze		
C701.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	50	-	20	20
Understand	50	50	60	20
Apply	-	-	-	30
Analyze	-	50	20	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C701.1						2		2		2	2	1			
C701.2						2		2		2	3	1			
C701.3						2		2		2	2	2			
C701.4						2		2		2	3	1			
C701.5						2		2		2	2	1			
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE702	Digital Simulation for Electrical Systems Laboratory	0/0/2/1

Nature of Course	M (Practical Application)
Course Pre-requisites	Design of Electrical Machines, Power Electronics

Course Objectives:

1. To provide an opportunity to understand and analyze the operation and function of electrical components in the power system.
2. To impart the knowledge in design, modelling and simulation of Power Electronic Converter based systems used in renewable energy generation system.
3. To impart the knowledge in intelligent controllers used in hybrid power generation systems.

Course Outcomes
Upon completion of the course, students shall have ability to

C702.1	Examine the performance and characteristics of transformer and DC motor.	[AP]
C702.2	Analyze the working of wind energy conversion system	[A]
C702.3	Analyze the performance characteristics of solar and fuel cell power generation system.	[A]
C702.4	Illustrate the working operation of standalone connected solar power system.	[A]
C702.5	Select the suitable simulation tool for analyzing the operation of power converters suitable for Hybrid (Solar-Wind) power system.	[A]
C702.6	Examine the performance of the hybrid power system with the various intelligent controllers.	[AP]

Course Contents

S.No	List of Experiments	CO Mapping	BT
1.	Performance analysis of Transformer and DC Motor using Motor solve software.	C702.1	[AP]
2.	Wind turbine emulation using DC motor.	C702.2	[AP]
3.	Design of Electric hybrid vehicle with the simulation software.	C702.2	[AP]
4.	Maximum power point tracking of wind energy conversion systems.	C702.3	[A]
5.	Study of getting Solar Radiation Data and making record for particular location with Homer software.	C702.3	[A]
6.	Testing of Inverter with SPV Emulator input.	C702.3	[A]
7.	Performance Assessment of 100W Fuel Cell.	C702.3	[A]
8.	VI-Characteristics and Efficiency of 1kWp Solar PV System.	C702.4	[A]
9.	Performance assessment of Grid connected and Standalone 1kWp Solar Power System.	C702.4	[A]
10.	Simulation study on Hybrid (Solar-Wind) Power System.	C702.5	[A]
11.	Simulation study on Intelligent Controllers for Hybrid Systems.	C702.6	[AP]
		Total Hours	**30**

Text Books:

1.	Ned Mohan, Tore M. Undeland & William P. Robbins, “Power Electronics – Converters, Applications and Design”, John Wiley & Sons edition 2011.
2.	Weidong Xiao, Power Electronics Step –by Step: design, Modeling, Simulation and control, McGraw Hill, 2021.
3.	P.S. Bhimbra, “Power Electronics”, Khanna Publishers edition 2018.

Reference Books:

1.	Hedaya Mamood Alasooly, Some power Electronics Case Studies using Matlab Simpowersystem Blockset, BookRix, 2020.

2.	Bimal K. Bose, “Modern Power Electronics & AC Drives”, Pearson, 2015.
Web References:	
1.	https://onlinecourses.nptel.ac.in/noc20_ee28/preview
2.	https://nptel.ac.in/courses/121106014
3.	https://in.mathworks.com/videos/developing-dc-dc-converter-control-with-simulinkautomatically-generating-controller-code-for-implementation-on-embedded-processor1535540362783.html
4.	https://nptel.ac.in/courses/103107157

Assessment Methods & Levels (based on Bloom’s Taxonomy)			
Summative assessment based on Continuous and End Semester Examination			
Bloom’s Level	**Rubric based Continuous Assessment [60 Marks]**	**End Semester Examination [40 Marks]**	
Remember	-	-	
Understand	-	-	
Apply	60	60	
Analyze	30	30	
Evaluate	10	10	
Create	-	-	
Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**60**	**40**	**100**

Course Articulation Matrix (Laboratory)

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C702.1	2	1			3								3	2	
C702.2	3	3	2	2	3	2	2		2		2	2	3	3	
C702.3	3	3	2	2	3	2	2		2		2	1	3	3	
C702.4	3	3	2	2	3	2	2		2		2	2	3	3	
C702.5	3	2	1	1	2	2	2				2	3	2	2	
C702.6	3	2	1	1	3	2	2		2		2	2	3	3	
1	**Reasonably agreed**					**2**	**Moderately agreed**				**3**	**Strongly agreed**			

Professional Elective

20EE901	Smart Grid Technology	3/0/0/3
Nature of Course	D (Theory Application)	
Pre-requisites	Nil	

Course Objectives:

1	To study the concept, benefit and function of smart grid and its international view on smart grid.
2	To learn smart grid technologies, smart meters and advanced metering infrastructure.
3	To know the power quality management issues in smart grid.
4	To realize the high performance computing for smart grid applications.

Course Outcomes:

Upon completion of the course, students shall have ability to

C901.1	Enumerate the benefits and functions of smart grid	[U]
C901.2	Examine the role of Automation in Transmission and Distribution systems.	[AP]
C901.3	Analyze the power quality management issues using smart meters.	[A]
C901.4	Illustrate the operation and importance of PMUs, IED and AMI in Micro Grids.	[AP]
C901.5	Investigate the integration of renewable energy systems in smart grid	[AP]

Course Contents:

Module 1: Introduction **12 Hrs**

Introduction to smart grid- Difference between conventional grid & smart grid, Concept of Resilient & Self-Healing grid, Need, Benefits and functions of Smart grid and micro grid, opportunities and challenges of smart grid Electricity. Present development and international policies of smart grid. National & International Standards of Smart grid.

Module 2: Smart Grid Technologies **15 Hrs**

Smart energy resources, Smart substations, Substation Automation, Feeder Automation, eStorage. Transmission systems: EMS, FACTS and HVDC, Wide area monitoring Protection and control - DMS, Volt/VAR control, Fault Detection, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers. Plugin Hybrid Electric Vehicles (PHEV): Role of big data and IoT, Cyber Security for Smart Grid. Impacts of Smart Grid.

Module 3: Smart Grid components and Power quality management **18 Hrs**

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their applications for monitoring & protection. Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources; Power Quality Conditioners for Smart Grid, Web based Power Quality Monitoring- Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Basics of Web Service and CLOUD Computing for Smart Grids.

Total Hours	**45**

Text Books:

1	Janaka Ekanayake, Kithsiri Liyanage, Jianzhong.Wu, AkihikoYokoyama, Nick Jenkins, “Smart Grid: Technology and Applications”, Wiley Publications, 2013.
2	James Momoh, “Smart Grid: Fundamentals of Design and Analysis”,Wiley Publications, 2012.
3	Nouredine Hadjsaïd, Jean-Claude Sabonnadière, “Smart Grids”, Wiley-ISTE, May 2012.
4	Stuart Barlose, “Smart Grid Infrastructure, Technology & Solutions”, CRC Press-2012.

Reference Books:

1	Lars T. Berger, Krzysztof Iniewski,“Smart Grid Applications, Communications, and Security”, Wiley Publications,2015.

2	Chen-chingg Liu,Stephen McArthur and Seung-Jae Lee, “Smart Grid Handbook”, 3 volume Set, Wiley-Blackwell publications, 2016.
3	Salman K. Salman “Introduction to the Smart Grid: Concepts, Technologies and Evolution”,Institute of Engineering and Technology publications,2017.
Web References:	
1	http://whatis.techtarget.com/reference/Smart-Grid-Technology-Overview
2	https://nptel.ac.in/courses/108107113/
3	https://www.youtube.com/watchv=dD1vybH-uFI
4	https://www.youtube.com/watchv=rHZ557mu7D0
5	https://www.youtube.com/watchv=1OWRsAUmDo8

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C901.1	Understand	Assignments Technical Online Quiz Class Presentation Group Presentation	**20**
C901.2	Analyse		
C901.3	Apply		
C901.4	Apply		
C901.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	10	-	-	10
Understand	40	20	40	10
Apply	10	20	60	20
Analyze	40	60	-	60
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C901.1	2	1	1										2		
C901.2	3	3	2	2				1	2	2	2		3		
C901.3	3	2	2	2						2			3		
C901.4	3	2	1	2	2		2			1		1	3	2	2
C901.5	3	2	1	1	3					1		2	3	2	2
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE902	Power System Restructuring	3/0/0/3
Nature of Course	D (Theory Application)	

Course Objectives:

1	To provide in-depth understanding of operation of deregulated electricity market systems.
2	To examine typical issues in electricity markets worldwide.
3	To analyze various types of electricity market operational and control issues using new mathematical models.

Course Outcomes:

Upon completion of the course, students shall have ability to

C902.1	Realize the operation of deregulated electricity market systems	[U]
C902.2	Analyze various types of electricity market operational and control issues using new mathematical models.	[A]
C902.3	Apply the knowledge on the various role of ISO in deregulated environment	[A]
C902.4	Analyze about the interruption values and reliability analysis	[A]
C902.5	Apply the reactive power management with deregulated electricity market systems	[AP]

Course Contents:

Module 1: Overview of Deregulation **18 Hrs**

Deregulation, Reconfiguring Power systems, unbundling of electric utilities, Background to deregulation and the current situation around the world, benefits from a competitive electricity market after effects of deregulation. Role of the independent system operator, Operational planning activities of ISO: ISO in Pool markets, ISO in Bilateral markets, Operational planning activities of a GENCO: Genco in Pool and Bilateral markets, market participation issues, competitive bidding. Power wheeling- Types of wheeling transactions- Transmission open access and types-Cost components in transmission- pricing of power transactions- Ideal Wheeling Rate.

Module 2: Deregulation Management **15 Hrs**

Power wheeling, Transmission open access, pricing of power transactions, security management in deregulated environment, and congestion management in deregulation. General description of some ancillary services, ancillary services management in various countries, and reactive power management in some deregulated electricity markets.

Module 3: Interruption and Reliability Analysis **12 Hrs**

Interruption criterion, stochastic components, component models, Calculation methods, Network model: stochastic networks, series and parallel connections, minimum cut sets, reliability cost. Generation, transmission and distribution reliability, Reliability and deregulation: conflict, reliability analysis, effects on the actual reliability, regulation of the market.

Total Hours	**45**

Text Books:

1	K. Bhattacharya, MHT Bollen and J.C Doolder, “Operation of Restructured Power Systems”, Kluwer Academic Publishers, USA, 2010.
2	Lei Lee Lai, “Power System restructuring and deregulation”, John Wiley and Sons, UK. 2013.
3	Electrical Power Systems: Analysis, Security and Deregulation Second Edition P. Venkatesh, B.V. Manikandan, S. Charles Raja , A. Srinivasan, 2017.

Reference Books:

1	Mohammad Shahidehpour and Muwaffaq Alomoush, “Restructured electrical power systems: operation, trading and volatility”, Marcel Dekker Pub, 2013.
2	Abhijit Chakrabarti and Sunita Halder, “Power System Analysis Operation and Control”, 3rdEd., PHI Publications.2010

3	Steven Stoft, “Power system economics: designing markets for electricity”, John Wiley & Sons,2011.
4	Fred I Denny and David E. Dismukes, “Power System Operations and Electricity Markets”, CRC Press, LLC, 2012.
Web References:	
1	http://www.iexindia.com/
2	http://www.powerexindia.com/
3	http://www.cercind.gov.in/

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C902.1	Understand	Online Quiz Writing Skills Class Presentation Group Assignment	**20**
C902.2	Analyse		
C902.3	Analyse		
C902.4	Analyse		
C902.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	50	-	20	20
Understand	50	70	40	40
Apply		-	20	20
Analyze	-	30	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C902.1	2	1						2					3	2	2
C902.2	3	3	2	2				2					3	2	2
C902.3	3	3	2	2				2					3	2	2
C902.4	3	3	2	2				2					3	2	2
C902.5	3	2	1	1				2					3	2	2
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE903	Energy Auditing, Conservation and Management	3/0/0/3
Nature of Course	G (Theory Analytical)	
Pre-requisites	Power System, Transmission and Distribution	

Course Objectives:

1	To introduce the outline of Energy Management Systems (EMS).
2	To understand the scope of energy savings in residential sector,industries and commercial establishments.
3	To analyze the concept of New energy saving technologies and products in themarket.
4	To apply the knowledge of thermodynamic principles, usage of thermal insulation in buildings, lighting devices and electric motors.
5	To accomplish the energy conservation is better to meet demand than constructing new power plant.

Course Outcomes:

Upon completion of the course, students shall have ability to

C903.1	Demonstrate the energy consumption, energy saving potentials and perceive knowledge about Climate change risk, building codes, renewable and Net zero concepts.	[U]
C903.2	Comprehend the role of energy managers in industries, energy management motivation	[E]
C903.3	Evaluate total Energy systems in energy audit.	[A]
C903.4	Analyze the concepts of energy conservation in Centrifugal Pumps, Fans & Blowers, Air Compressor and Distribution System.	[AP]
C903.5	Articulate the function of Bureau of energy efficiency and the importance of energy efficient appliances.	[AP]

Course Contents:

Module 1: Energy Scenario and Conservation **12 Hrs**

Energy Scenario - Energy conservation and its importance- Energy Conservation Act-2001 and its features. Climate Change Risks - Economics of various Energy Conservation schemes -ECBC 2017 (Energy Conservation Building Code)-Renewable Energy and Net Zero Buildings.

Module 2: Energy Systems, Management and Auditing **18 Hrs**

Energy monitoring, auditing & targeting - Role of Energy Managers in Industries - Energy auditing - needs & types - energy audit instruments - Energy management approach understanding energy costs, bench marking, energy performance-maximizing system efficiencies - Simple Payback calculation.

Module 3: Energy Efficiency and Case studies **15 Hrs**

Bureau of Energy Efficiency- Efficiency and it's role - Energy efficient motors, Centrifugal pumps, Fans & Blowers, Air compressor - energy efficient transformers - energy efficiency in lighting Efficiency improvement in distribution system - Soft starters with energy saver - Case studies.

Total Hours	**45**

Text Books:

1	Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, 'Guide to Energy Management', 8th Edition, The Fairmont Press, Inc., 2016.
2	Energy Audit Manual-The Practioner's Guide by NPC and EMC, Kerala (2017)
3	General aspect of energy management and energy audit, Fourth Edition 2015, by Bureau of Energy Efficiency, Ministry of Power, India.

Reference Books:

1	Hossam A. Gabbar, "Energy Conservation in Residential, Commercial, and Industrial Facilities", Wiley-IEEE Press, 1st edition, 2018
2	Turner .W.C, "Energy Management Handbook", 8th Edition, 2012.
3	John D Mc Donald, "Electric Power Substation Engineering" CRC Press, 3rd edition, 2012.

Web References:	
1	http://nptel.ac.in/video.php subject Id=108102047.
2	http://textofvideo.nptel.iitm.ac.in/108102047/lec20.pdf.
3	https://www.edx.org/course/Energy management system.

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C903.1	Understand	Group Assignment Assignment Technical Quiz Class Presentation	**20**
C903.2	Evaluate		
C903.3	Analyze		
C903.4	Apply		
C903.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	10	10	-	10
Understand	40	10	10	10
Apply	10	20	20	20
Analyze	40	60	70	60
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C903.1	2	1	1										2		
C903.2	3	3	2	2				1	2	2	2		3		
C903.3	3	2	2	2						2			3		
C903.4	3	2	1	2	2		2			1		1	3	2	2
C903.5	3	2	1	1	3					1		2	3	2	2
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE904	Power System Operation and Control	3/0/0/3
Nature of Course	G (Theory Analytical)	
Pre-requisites	Electric Power Generation	

Course Objectives:

1	To understand the economics of power system operation and planning.
2	To realize the requirements and methods of real and reactive power control in power system.
3	To recognize the recent advancements in power system operation

Course Outcomes:

Upon completion of the course, students shall have ability to

C904.1	Demonstrate the types of Electrical Tariff and Pricing Structure	[U]
C904.2	Develop generation dispatching schemes for conventional power systems.	[A]
C904.3	Appraise frequency, voltage and reactive power control schemes on power system.	[A]
C904.4	Examine the basic computer control concepts of power systems using SCADA, EMS and PMU functions.	[A]
C904.5	Interpret smart grid integration in power systems.	[U]

Course Contents:

Module 1: Power system operation and control **18 Hrs**

Load curves and forecasting - load factor, demand factor, diversity factor, capacity factor, Utilization factor - Types of Electrical Tariff - Economic decision making in power system planning - Economic Dispatch and Unit Commitment - General problem formulation and constraints, Offer and locational marginal pricing based dispatch, Solution methods - Economic Scheduling using MATLAB.

Module 2: Real power, Reactive power, Voltage and Frequency control **18 Hrs**

Load frequency control of single area and two area systems - Tie line bias control - Automatic Voltage Regulator and its dynamics - Mathematical model of speed-governing system - Turbine models, division of power system into control areas, P-f control of single control area (the uncontrolled and controlled cases) - P-F control of two area systems (the uncontrolled cases and controlled cases) - General concepts of series and shunt compensation – Introduction to FACTS.

Module 3: Computer Control of Power Systems **9 Hrs**

Need of computer control of power systems. Overview of Protocols - Modbus, Distributed Network Protocol (DNP), IEC 870-5 and 60870 series, Benefits from the IEC (International Electro technical Commission) communication Standards. Concept of energy control centre (or) load dispatch centre and the functions, SCADA, EMS and PMU functions. Network topology determination, state estimation, security analysis and control. Various operating states: State transition diagram showing various state transitions and control strategies. Smart grid integration.

Total Hours	**45**

Text Books:

1	Allen J. Wood, Bruce F. Wollenberg and Gerald B Sheble, ‘Power Generation, Operation, and Control’, John Wiley and Sons, 3rd Edition, 2014.
2	Steven Stoft, ‘Power system economics’, Wiley India, 2002.
3	Abhijit Chakrabarti &Sunita Halder, ‘Power System Analysis- Operation & Control’, PHI New Delhi, 3rd Edition, 2010.

Reference Books:

1	Robert H.Miller, James H.Malinowski, ‘Power System Operation’, Tata McGraw Hill, 2nd Edition, 2009.

2	Daniel Kirschen and Goran Strbac, 'Fundamentals of Power System Economics', John Wiley, 2004.
3	Nikos Hatziargyrio, 'Microgrids – Architectures and Control', Wiley-IEEE Press, 2014.
Web References:	
1	https://nptel.ac.in/courses/108/104/108104052/
2	https://www.youtube.com/watch?v=JRbk0_Klhr4
3	https://www.youtube.com/watch?v=3l_UN9TQ1Qg
4	https://www.youtube.com/watch?v=qqdQqtUp2vw

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C904.1	Understand	Quiz Simulation Exercises Class Presentation Group Assignment	**20**
C904.2	Analyze		
C904.3	Analyze		
C904.4	Analyze		
C904.5	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	-	-	-	-
Understand		-	20	20
Apply	50	40	50	50
Analyze	50	60	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C904.1	2	1											3		
C904.2	3	3	2	2									3		
C904.3	3	3	2	2						2			3		
C904.4	2	1											3		
C904.5	2	1											3		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE905	Power Quality	3/0/0/3
Nature of Course	G (Theory Analytical)	
Pre-requisites	Power System Analysis	

Course Objectives:

1	To introduce the power quality problem and educate on production of voltages sags, over voltages, harmonics and methods of control.
2	To study overvoltage problems, sources and effect of harmonics in power system.
3	To impart knowledge on various methods of power quality monitoring.

Course Outcomes:

Upon completion of the course, students shall have ability to

C905.1	Describe the importance of power quality.	[U]
C905.2	Analyze the impact of voltage sags and interruptions in power system.	[A]
C905.3	Analyze the problems on over voltages in power system.	[A]
C905.4	Analyze the effect of harmonics in power system.	[A]
C905.5	Apply the various methods of power quality monitoring and techniques.	[AP]

Course Contents:

Module 1: Introduction to Power Quality **12 Hrs**

Terms and definitions: Overloading - under voltage - over voltage. Concepts of transients. Long and short duration interruption Sags and swells - voltage sag - voltage swell - voltage imbalance -voltage fluctuation - power frequency variations. International standards of power quality: Limits and regulations. Computer Business Equipment Manufacturers Associations (CBEMA) curve - ITI curve.

Module 2: Voltage Sags, Interruptions and Over Voltages **15 Hrs**

Sources of sags and interruptions - estimating voltage sag performance. Analysis and calculation of various faulted condition. Voltage sag due to induction motor starting. Analysis of voltage sag estimation of the sag severity - mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches. 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. An introduction to computer analysis tools for transients - ETAP, Dig silent Power Factory and EMTP.

Module 3: Harmonics and Power Quality Monitoring **18 Hrs**

Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion – voltage and current distortion - harmonic indices - inter harmonics – Infraction harmonics. Harmonics with distortion factor and true power factor. IEEE 519-2014 and IEEE 3002.8-2018 standards. Monitoring considerations - monitoring and diagnostic techniques for various power quality problems - Solution for power quality problems using simulation tools -power line disturbance analyzer - quality measurement equipment - harmonic / spectrum analyzer - flicker meters - disturbance analyzer. Applications of expert systems for power quality monitoring.

Total Hours	**45**

Text Books:

1	Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.WayneBeaty, “Electrical Power Systems Quality” McGraw Hill,2017.
2	Eswald.F.Fudis and M.A.S.Masoum, “Power Quality in Power System and Electrical Machines,” Elseviar Academic Press, 2015.
3	P J. Arrillaga, N.R. Watson, S. Chen, “Power System Quality Assessment”, Wiley, 2011.

Reference Books:

1	G.T. Heydt, “Electric Power Quality”, 2nd Edition. West Lafayette, IN, Starsin a Circle Publications , 2009.

2	M.H.J Bollen, “Understanding Power Quality Problems: Voltage Sags and Interruptions”, New York: IEEE Press, 2013.
3	Bhim Singh, Ambrish Chandra and Kamal Al-Haddad, “Power Quality: Problems and mitigation Techniques”, Wiley 2015.
4	G.J.Wakileh, “Power Systems Harmonics – Fundamentals, Analysis and Filter Design,” Springer 2007.

Web References:	
1	https://nptel.ac.in/courses/108102179
2	https://nptel.ac.in/courses/108107157
3	http://nptel.ac.in/courses/108106025/

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C905.1	Understand	Quiz Writing Skills Case Study Group Assignment	**20**
C905.2	Analyze		
C905.3	Analyze		
C905.4	Analyze		
C905.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	30		20	10
Understand	50	40	20	30
Apply	20	30	30	30
Analyze	-	30	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C905.1	2											1	1		
C905.2	3	3	2	2		1	2						1		
C905.3	3	3	2	2		2	2	1	1			1	2		1
C905.4	3	3	2	2		2	2	1	1			1	3		1
C905.5	3	2	1	1	2	2	1	2	1			1	2		2
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE906	High Voltage Engineering	3/0/0/3
Nature of Course	G (Theory analytical)	
Pre-requisites	Generation, Transmission and Distribution	

Course Objectives:

1	To expose the students to the basic causes of over voltages in power systems.
2	To describe the fundamentals of breakdown and partial discharge in insulating solid and gas at high voltages.
3	To understand the generation and measurement of high voltages and currents.
4	To understand the concepts of high voltage testing.

Course Outcomes:

Upon completion of the course, students shall have ability to

C906.1	Identify the causes and types of overvoltage.	[U]
C906.2	Examine international standards of designing and testing.	[A]
C906.3	Infer various breakdown phenomena occurring in gaseous, liquid and solid dielectrics.	[U]
C906.4	Examine the different methods of generating various high voltages and currents.	[A]
C906.5	Infer the different methods of measuring various high voltages and currents with digital techniques.	[AP]

Course Contents:

Module 1: Causes of Over Voltages and High Voltage Testing **15 Hrs**

Causes of Over Voltages and its effect on Power System – Lightning, Switching Surges and Temporary Over Voltages – Insulation Co-ordination. High voltage testing of Electrical Power apparatus – Power Frequency, Impulse Voltage and DC testing – International and Indian standards – Design , Planning and Layout of High Voltage Laboratory.

Module 2: Electrical Breakdown in Gases, Solids and Liquids **10 Hrs**

Basic Gaseous breakdown in Uniform and Non-Uniform Fields – Corona Discharges – Vacuum breakdown - Conduction and Breakdown in Pure and Commercial Liquids – breakdown mechanisms in Solid and Composite dielectrics. Modern Power Systems protection devices, MOA – Metal Oxide Arresters

Module 3: Generation and Measurement of High Voltages **20 Hrs**

Generation of High DC, AC, Impulse Voltages and Currents. Tripping and control of Impulse Generators. High Voltage DC: Rectifier circuits, Voltage Multipliers, Van-de-graph and Electrostatic Generators. High Voltage AC: Cascaded transformers and Tesla coils. Measurement of High voltages and High Currents and Impulse Current using Sphere Gaps, Peak Voltmeters, Potential Dividers, high speed CRO – Digital techniques in High Voltage Measurement**.**

Total Hours	**45**

Text Books:

1	C.L.Wadhwa, “High Voltage Engineering”, III Edition New Age International, 2012.
2	Subir Ray, “An Introduction to High Voltage Engineering”, PHI Learning Private Limited, New Delhi, Second Edition, 2013
3	L.L. Alston, “High Voltage Technology”, Oxford University Press, First Indian Edition, 2011.

Reference Books:

1	Rakosh Das Begamudre, “High Voltage engineering, Problems and Solutions”, NewAge International Publications, 2010.
2	Naidu, M.S. and Kamaraju,V., 'High Voltage Engineering', 4th Edition, Tata McGraw- Hill Publishing Company, New Delhi,6th Edition, 2020.

Web References:

1	http://nptel.ac.in/courses/108104048/ui/Course_home1_1.html
2	http://www.electrical-engineering-portal.com

3	https://www.youtube.com/watch?v=qqdQqtUp2vw
4	https://www.youtube.com/watch?v=JRbk0_Klhr4

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C906.1	Understand	Online Quiz Problem solving Tutorials Group Assignment Class Presentation	**20**
C906.2	Analyse		
C906.3	Understand		
C906.4	Analyse		
C906.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	20	20
Understand	70	30	30	30
Apply	-	30	30	30
Analyze	10	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C906.1	3	2										1	1		1
C906.2	3	2	2	2	2								2		3
C906.3	3	2	1	1									3		2
C906.4	3	3	2	2									3		3
C906.5	3	2	3	2									3		3
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE907	Renewable Energy and Storage Systems	3/0/0/3
Nature of Course	D (Theory Application)	
Pre-requisites	Power System	

Course Objectives:

1	To study different non-conventional energy systems and its applications.
2	To enhance student's knowledge and assimilate new technologies.
3	To learn techno-economical storage methods of renewable energy systems.

Course Outcomes:
Upon completion of the course, students shall have ability to

C907.1	Enumerate the need of renewable energy and analyze the concept of Kyoto protocol, energy scenario in India and Integrated Resource Plan.	[U]
C907.2	Assess the role of Solar and wind energy in power plants.	[A]
C907.3	Apply the ideas of renewable energy sources to perform case studies.	[AP]
C907.4	Assess the role of biomass, tidal and geothermal in power plants.	[A]
C907.5	Illustrate the operation and importance of different energy storage methods.	[U]
C907.6	Investigate the integration of renewable energy systems in Power plants.	[AP]

Course Contents:

Module 1: Introduction **15 Hrs**

Over View of Conventional Power Plants - Importance of Sustainable energy source - Types of Sustainable Energy sources - Limitations of Sustainable Energy sources - Present Indian and international energy scenario of conventional and sustainable energy sources - Kyoto protocol - Concept of clean development mechanism and proto type carbon funds - Integrated resource plan.

Module 2: Wind Energy and Solar Energy **15 Hrs**

Power in the Wind - Types of Wind Power Plants (WPPs) - Components of WPPs - Working of WPPs - Site selection of WPPs - Grid integration issues of WPPs. Solar Power, Radiation Measurement, Solar thermal, solar photovoltaic, Cells, Module and array types - series and parallel connections - Maximum power point tracking, grid interactive solar PV systems - Applications. Case studies on solar PV system, wind energy system.

Module 3: Other Energy Sources and Storage Methods **15 Hrs**

Methods to generate - Biomass energy, tidal energy, geothermal energy, fuel cells and Ocean thermal energy conversion its applications - Storage methods of mechanical, chemical, electromagnetic, electrostatic and thermal energy - Selection and significance of Batteries - Hybrid energy systems and hybrid electric vehicles.

Total Hours	**45**

Text Books:

1	John T widwell and Tony Weir, “Renewable Energy Resources”,4th Edition, Routledge, 2021.
2	B.H.Khan, “Non-Conventional Energy Resources”,3rd Edition, Tata McGraw Hill New Delhi, 2017.
3	G D Rai, „Non-conventional Energy sources", Khanna Publishers, 5th Edition, 2014.

Reference Books:

1	Sukhatme, “Solar Energy”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017.
2	Aldo Vieira Da Rosa ,“ Fundamentals of Renewable Energy Processes”, Academia Press ,2013

3	G.Masters, “Renewable and Efficient Electric Power Systems”, IEEE-Wiley Publishers, 2013.
Web References:	
1	http://unfccc.int/kyoto_protocol/items/2830.php
2	https://www.coursera.org/learn/wind-energy
3	https://www.edx.org/course/solar-energy-delftx-et3034x-0

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C907.1	Understand	Online Quiz Problem solving Tutorials Group Assignment Class Presentation	**20**
C907.2	Analyze		
C907.3	Analyze		
C907.4	Analyze		
C907.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	5	5	5	5
Understand	10	10	10	10
Apply	40	40	40	40
Analyze	45	45	45	45
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C907.1	2	1				2	2	2				1			1
C907.2	3	3	2			2	3	1				3	1	2	2
C907.3	3	3	2	1		2	3	1		1		3	1	2	1
C907.4	3	3	2			2	3	1				3	1	2	1
C907.5	2	1				2	3	1				3	1	1	1
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE908	Distribution Automation Systems	3/0/0/3
Nature of Course	D (Theory Application)	
Pre-requisites	Power System Analysis	

Course Objectives:

1	To study the concept and basic control techniques involved in distribution automation.
2	To learn about the hardware used in DAS infrastructure.
3	To know the advanced distribution automation.
4	To realize the various communication systems involved in distribution automation.

Course Outcomes:
Upon completion of the course, students shall have ability to

C908.1	Understand the control techniques involved.	[U]
C908.2	Analyze the layouts of substations and feeders.	[A]
C908.3	Examine the load management and voltage management.	[A]
C908.4	Illustrate an appropriate method of communication for the distribution system automation.	[AP]
C908.5	Investigate the economic aspects of distribution system with automation.	[A]

Course Contents:

Module 1: Introduction to Distribution Automation **15 Hrs**

Introduction to Distribution Automation, Control System Interfaces, Control and Data requirements, Centralized (Vs) Decentralized Control, Distribution Automation System, DAS Hardware, DAS Software, DA Capabilities, Automation system computer facilities. Commercially Available Distribution Automation Systems.

Module 2: Components of Distribution Automation Systems **15 Hrs**

Layout of substations and feeders - design considerations. Distribution system load flow - optimal siting and sizing of substations - optimal capacitor placement. Distribution system monitoring and control - SCADA, Remote metering and load control strategies - Optimum feeder switching. Advanced Distribution Automation.

Module 3: Communication Topologies **15 Hrs**

DA Communication Requirements - reliability, Cost Effectiveness, Data Rate Requirements, Two Way Capability - outages and faults, Ease of operation and maintenance - Communication Systems used - Distribution line carrier (Power line carrier), Telephone, Cable TV, Radio, AM Broadcast, FM SCA, VHF Radio, UHF Radio etc. Applications of IEC 61850 in distribution automation. Microwave, Satellite, Fiber Optics, Hybrid Communication system, Example in field tests. Impact of DA on Distribution systems.

Total Hours	**45**

Text Books:

1	James A. Momoh, 'Electric Power Distribution, Automation, Protection, and Control', CRC Press, 2017.
2	James Northcote-Green, Robert Wilson, Control and Automation of Electrical Power Distribution Systems – CRC Press – 2017
3	Nouredine Hadjsaïd, Jean-Claude Sabonnadière, "Smart Grids", Wiley-ISTE, May 2012.

Reference Books:

1	Turan Gonen., 'Electric Power Distribution System Engineering', BSP Books, Pvt. Ltd 2007.
2	Electric Power Generation, Transmission, and Distribution, Third Edition 2012 by Leonard L. Grigsby.

Web References:	
1	IEEE Working Group on 'Distribution Automation' -2008. 201.
2	https://www.sgrwin.com/basic-understanding-iec-61850/.
3	https://www.alstom.com/press-releases-news/2015/1/alstoms-substation-automation-solutions-sas-business-unveils-new-dap-io-modules-for-smart-grid-applications.
4	https://www.ge.com/digital/applications/advanced-distribution-management-solutions-adms

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C908.1	Understand	Assignments Technical Quiz Class Presentation Group Presentation	**20**
C908.2	Analyse		
C908.3	Analyse		
C908.4	Apply		
C908.5	Analyse		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	5	5	5	5
Understand	10	10	10	10
Apply	40	40	40	40
Analyze	45	45	45	45
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C908.1	2	1	1										2		
C908.2	2	3	2	2				1	2	2	2		3		
C908.3	3	2	2	2						2			3		
C908.4	2	2	1	2	2		2			1		2	3	2	2
C908.5	3	2	1	2	3					1		2	3	2	3

1	Reasonably Agreed	2	Moderately Agreed	3	Strongly Agreed

20EE909	HVDC Transmission Systems	3/0/0/3
Nature of Course	D (Theory Application)	
Pre-requisites	Generation, Transmission, and Distribution	

Course Objectives:

1	To understand the concept, planning of DC power transmission, and comparison with AC power transmission.
2	To acquire knowledge about HVDC Converters and HVDC System Control.
3	To analyze the Harmonics of the HVDC system.

Course Outcomes:
Upon completion of the course, students shall have ability to

C909.1	Summarize the basic concepts of AC and DC power transmission.	[U]
C909.2	Enumerate the configuration of converters in HVDC Transmission.	[U]
C909.3	Analysis of VSC topologies and firing schemes.	[A]
C909.4	Explain the Principles of DC link control, Firing angle control, Current and Extinction angle control for HVDC system.	[U]
C909.5	Analysis of AC and DC filters for Reactive power and Harmonic control in HVDC system.	[A]

Course Contents:

Module 1: Introduction to HVDC Transmission **15 Hrs**

Need for DC power transmission technology, Comparison of AC and DC Transmission, Components Description of HVDC transmission system, Types of HVDC System, Planning for HVDC Transmission Modern trends in HVDC Technology, HVDC Transmission Based on Voltage Source Converters and Line commutated converters, MTDC System-Types and applications of MTDC systems, Analysis of HVDC Converters – Analysis of Graetz circuit with and without overlap, Pulse number, Choice of converter configuration, Converter bridge characteristics, Multiple pulse Converters – Analysis of VSC and LCC topologies, Firing schemes.

Module 2: HVDC System Control **15 Hrs**

Principles of DC-link control, Converter control characteristics, System control hierarchy, Firing angle control, Current and extinction angle control, Starting and stopping of DC Link, Power Control, Higher level controllers, Control of VSC-based HVDC link. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/DC systems.

Module 3: Reactive Power and Harmonics Control **15 Hrs**

Principles of DC-link control, Converter control characteristics, System control hierarchy, Firing angle Reactive power requirements in steady-state – Sources of reactive power – SVC and STATCOM – Generation of harmonics – Design of AC and DC filters – Active filters. Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis – Case study: Modern Trends in HVDC Technology. Introduction to Modular Multi-level Converters.

Total Hours	**45**

Text Books:

1	Padiyar, K. R., "HVDC Power Transmission System", New Age International (P) Ltd., New Delhi, Third Edition, 2017.
2	S Kamakshaia,h, V. Kamaraju., "HVDC Transmission" McGraw-Hill Education,2011

Reference Books:

1	Vijay K. Sood, Gil-Soo Jang, Seong-Joo Lim, Seok-Jin Lee, Chan-Ki Kim, "HVDC Transmission: Power Conversion Applications in Power Systems" Springer Publication, 2013

2	Dragan Jovcic, “High Voltage Direct Current Transmission: Converters, Systems and DC Grids”, John Wiley & Sons Ltd, Second Edition, 2019
3	Edwart, K., “Direct Current Transmission (Vol. 1)”, John Wiley and Sons, 2008.
Web References:	
1	https://nptel.ac.in/courses/108104013/
2	https://www.gegridsolutions.com/PowerD/catalog/hvdc.htm
3	https://www.youtube.com/watch?v=ZOTGuWCfS-A
4	https://www.youtube.com/watch?v=OMn653OhbLg
5	https://in.mathworks.com/videos/active-power-factor-correction-1546869199547.html

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C909.1	Analyze	Quiz Problem solving Tutorials Group Assignment Class Presentation	**20**
C909.2	Analyze		
C909.3	Analyze		
C909.4	Understand		
C909.5	Analyze		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	30	20	20	20
Understand	50	35	30	30
Apply	20	25	50	30
Analyze	-	20	-	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C909.1	2	1										1	2		
C909.2	2	1										2	2		
C909.3	3	3	2	2	1								3	2	1
C909.4	2	1											1	1	
C909.5	3	3	2	2	1							1	2	1	1
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EC940	Data Communications and Networks	3/0/0/3

Nature of Course	C (Theory Concept)

Course Objectives

1	To introduce the concept and technologies used in modern data communication and computer networking.
2	To introduce the various addressing mechanisms employed in computer networking
3	To understand the types and functions of transmission control protocols.
4	To allow students to get familiarized with the concepts behind the web and network security

Course Outcomes:

Upon completion of the course, students shall have ability to

C940.1	Understand the functions of OSI layered architecture and networking models.	[R]
C940.2	Understand the concept of different Error detecting techniques in data communications.	[U]
C940.3	Analyse the different routing algorithms and IP addressing modes in computer networks.	[A]
C940.4	Understand the concepts related to Congestion Control and QoS.	[U]
C940.5	Understand the concepts related to web Services.	[U]
C940.6	Employ the Cryptography algorithms in network security applications.	[AP]

Course Contents:

Module 1: Data Communications **15 Hrs**

Types of networks – Circuit Switching and Packet Switching – ISO / OSI model – Transmission Media – Coaxial Cable – Fiber Optics TCP/IP protocol suite. Flow Control and Error control - stop and wait – go back-N ARQ – selective repeat ARQ – sliding window – LAN – Ethernet IEEE 802.3 – IEEE 802.4 – IEEE 802.5 – IEEE 802.11 – FDDI.

Module 2: network, transport and application layer: **15 Hrs**

IP addressing methods – IPV4 – Next generation IP, IPV6, Subnetting – Routing – Distance Vector Routing – Link State Routing, Transport Layer Services –Multiplexing and Demultiplexing – User Datagram Protocol (UDP) – Principles of Reliable Data Transfer – Transmission Control Protocol (TCP), Congestion Control – Quality of services (QOS) – Integrated Services – Differentiated Services – WWW – HTTP – SMTP – FTP – Telnet – Domain name space.

Module 3: Cryptography **15 Hrs**

Symmetric Key Cryptography – Asymmetric Key Cryptography – Network security, confidentiality, cipers, Digital signature, Authentication, Key management.

Total Hours	**45**

Text Books:

1	Behrouz A. Foruzan, “Data communication and Networking”, 5th Edition Tata McGraw- Hill, 2013.
2	William Stallings, “Data and Computer Communication”, TenthEdition, Pearson Education, 2013.
3	Larry-L-Peterson& Bruce S David, “Computer-Networks a Systems Approach” Morgan Kaufmann Publishers, Fifth Edition, 2011.

Reference Books:

1	E. Andrew S. Tannenbaum, “Computer Networks”, PHI, Fifth Edition, 2011.
2	C James Krouse& W. Rouse, “Computer Networking: A Top down Approach Featuring”, Pearson Education, Sixth Edition, 2012.

Web References:

1	https://nptel.ac.in/courses/106105082/
2	https://www.coursera.org/learn/data-communication-network-services
3	https://www.tutorialspoint.com/data_communication_computer_network/
4	http://library.aceondo.net/ebooks/Computer_Science/Data_Communication_and_Networki ng_by_Behrouz.A.Forouzan_4th.edition.pdf

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C940.1	Remember	Quiz Simulation Exercise Group Assignment Seminar	**20**
C940.2	Understand		
C940.3	Analyse		
C940.4	Understand		
C940.5	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	50	20	20	20
Understand	50	30	40	40
Apply	-	20	40	20
Analyse	-	30	-	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C940.1	1				2	1						1		2	
C940.2	2	1										1		2	
C940.3	3	3	2	2								1		3	
C940.4	2	1										1		3	
C940.5	2	1				3		1				1		3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE910	Introduction to Soft Computing	3/0/0/3
Nature of Course	C (Theory Concept)	
Course Pre-requisites	Nil	

Course Objectives:

1	To design and implement the fuzzy logic controller with case study.
2	To impart the knowledge about various architectures, modeling and controlling techniques of Artificial Neural Network with case study.
3	Capable of designing hybrid control schemes, selected optimization algorithms with case study

Course Outcomes:

Upon completion of the course, students shall have ability to

C910.1	Explore the concept and logic of soft computing techniques.	[U]
C910.2	Design fuzzy controller for non-linear systems.	[AP]
C910.3	Analyze the ideology of fuzzy logic systems in electrical system.	[A]
C910.4	Apply engineering fundamentals to use optimization algorithms to obtain solution for complex engineering problems.	[A]
C910.5	Capable of using modern IT tool boxes to simulate case studies.	[AP]

Course Contents:

Module 1: Fuzzy Logic System **15 Hrs**

Evolution of Soft Computing - Soft Computing Constituents - Conventional AI to Computational Intelligence - Machine Learning Basics - Introduction to Fuzzy logic, crisp sets and fuzzy sets, Introduction to fuzzy logic modeling and control. Fuzzification, Fuzzy knowledge and rule bases Fuzzy membership functions, inferencing and Defuzzification. Case study: Fuzzy modeling and control schemes for nonlinear systems, Implementation of fuzzy logic controller in Aerospace and in-home automation using Fuzzy logic Toolbox.

Module 2: Artificial Neural Networks **18 Hrs**

Fundamentals - Biological neural network - Artificial neuron - Activation function - Learning rules - Learning factors - McCulloh-Pitts Neuron - Linear separability - Supervised Learning Neural Networks - Perceptron Networks - Adaline - Madaline - Back propagation networks - Radial Basis Function Networks - Hopfield Neural Network - Unsupervised Learning Neural Networks - Adaptive Resonance Architectures, Case study: Implementation of Pattern recognition application using ANN Toolbox - Stability analysis of Neural Network interconnection systems.

Module 3: Classical Optimization Techniques **12 Hrs**

Statement of optimization problem, Objective function, Classification of optimization problems. Single-variable & Multi-variable optimization without constraints. Multi-variable optimization with equality constraints. Lagrange multiplier method, Multi-variable optimization with inequality constraints, kuhn-Tucker conditions. Introduction to Genetic Algorithm - Operators in Genetic Algorithm. Case Study: Familiarization with ANFIS toolbox and health care using Soft computing techniques.

Total Hours	**45**

Text Books:

1	Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Third Edition, John Wiley & Sons Ltd, UK, 2011.
2	S.N.Sivanandam, S.N.Deepa, **“**Principles of Soft Computing**”**, second edition, Wiley, India,2019
3	E. K. P. Chong and S. H. Zak, An Introduction to Optimization, 2nd Edn., Wiley India Pvt. Ltd., 2010.

Reference Books:	
1	Simon Haykin, **"**Neural Networks & Learning Machines**"**, Third edition, Pearson, 2016**.**
2	S. Rajasekaram& G.A. VijyalakshmiPai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI Learning Private Limited, India, 2013.
Web References:	
1	https://nptel.ac.in/courses/106105173/2
2	http://user.engineering.uiowa.edu/~ie238/Lecture/Soft_computing
3	http://www.cse.iitm.ac.in/~vplab/courses/soft_computing.html
4	http://sftcmpgr2.github.io/

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C910.1	Understand	Quiz Simulation Exercise Group Assignment Class presentation	**20**
C910.2	Apply		
C910.3	Analyze		
C910.4	Analyze		
C910.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	20	20
Understand	60	30	30	30
Apply	-	30	30	30
Analyze	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C910.1	2	1													
C910.2	2	1			2										
C910.3	3	3	2	2	2							2	3		
C910.4	3	3	2	2	2							2	3		
C910.5	3	2	1	1	2							2	3		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EC941	VLSI Design Technology	3/0/0/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	NIL	

Course Objectives:

1	To understand the VLSI design problems, design methodologies and manufacturing technology.
2	To design the MOS circuits based on design rules and analyse the circuit as inverters and logic gates.
3	To expose the layouts of application specific devices and to become familiar with digital circuits programming.

Course Outcomes:

Upon completion of the course, students shall have ability to

C941.1	Illustrate the VLSI design problems, design domains and CMOS fabrication Technology.	[U]
C941.2	Analyze the characteristics of MOS transistors and the design concepts of MOS circuits.	[A]
C941.3	Analyze the CMOS circuits as inverters and transmission gates.	[A]
C941.4	Interpret the device layouts of specific applications.	[U]
C941.5	Apply modeling concepts of HDL programming for the design of digital circuits.	[AP]

Course Contents:

Module 1: Introduction to VLSI design methodologies **15 Hrs**

Moore's law, VLSI design problem, design domains, design methods and technologies. VLSI Fabrication Technology & MOS transistors: Fabrication - NMOS, PMOS, CMOS, Twin tub process and Silicon on insulator Technology - MOS transistors - Enhancement mode & Depletion mode, NMOS transistor Current Equation - Second order effects. MOSFET as a Switch, Nano MOSFET - MOS Layers - Stick Diagrams - Design rules and Layout, Sheet Resistance, Area Capacitance of layers, Transistor sizing, Power Dissipation.

Module 2: CMOS Circuit **15 Hrs**

NMOS Inverter - CMOS inverter - Switching characteristics. Pass Transistor and Transmission gates - NMOS and CMOS Logic gates - Stick Diagram, Layout Design Rules. ASICS: Types of ASICS - Physical Design flow - Programming Technology - Anti fuse - PREP Benchmarks - Actel ACT - Xilinx LCA - AlteraFLEX - Altera MAX - Xilinx I/Oblocks.

Module 3: Programming VLSI **15 Hrs**

Review of VLSI Design automation tools - Fundamental VHDL units - Design of 2 bit Adders and Multipliers using VHDL. Verilog HDL - Module and ports - Gate level, Behavioral and Dataflow modeling for 2 bit Adders and Multipliers.

Total Hours	**45**

Text Books:

1	D.A.Pucknell, K.Eshraghian, "Basic VLSI Design", Prentice Hall of India, New Delhi, 3rd Edition,2013.
2	M.J.S .Smith, "Application Specific Integrated Circuits", Addison –WesleyLongman Inc., 2013.
3	Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", 2nd edition, Pearson 2013.

Reference Books:

1	N.H.Weste, K.Eshraghian, "Principles of CMOS VLSI Design: a system Perspective" Pearson Education, India, 2013.

2	Volnei A. Pedroni, “Circuit Design and Simulation with VHDL”, MIT Press,2nd edition 2010.
3	S.H.Gerez,”Algorithms for VLSI Design Automation”, John Wiley &Sons, 2011.
Web References:	
1	https://nptel.ac.in/courses/117101058
2	https://www.tutorialspoint.com/vlsi_design/index.htm
3	https://www.edaplayground.com/
4	https://elearn.maven-silicon.com/
5	VLSI Classroom Training | Online VLSI Course -VLSIGuru.com

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C941.1	Understand	Online Quiz Group Assignment Class Presentation Programming	**20**
C941.2	Analyse		
C941.3	Analyse		
C941.4	Understand		
C941.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	-	-	-	-
Understand	50	50	40	40
Apply	-	-	30	30
Analyze	50	50	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C941.1	2	1												3	
C941.2	3	3	2	2										3	
C941.3	3	3	2	2										3	
C941.4	2	1												3	
C941.5	3	2	1	1	3	2			2	2		1		3	1

1	Reasonably Agreed	2	Moderately Agreed	3	Strongly Agreed

20EC921	Wireless Sensor Networks	3/0/0/3
Nature of Course	C (Theory Concept)	
Course Pre-requisites	NIL	

Course Objectives:

1	To obtain a broad understanding of wireless sensor networks
2	To study the challenges and design issues in wireless sensor networks
3	To focus on network architectures and energy efficiency
4	To study the concept of Time Synchronization and Localization
5	To focus on Routing Protocols and Operating Syst ems

Course Outcomes:

Upon completion of the course, students shall have ability to

C921.1	Learn the basics of wireless sensor networks and its applications.	[R]
C921.2	Understand the architecture and elements of wireless sensor networks	[U]
C921.3	Analyze the MAC protocols for wireless sensor networks.	[A]
C921.4	Apply the concept of Synchronization and Localization for sensor networks	[AP]
C921.5	Understand the various routing protocols of wireless sensor networks	[U]
C921.6	Understand the basics of operating systems needed to establish sensor networks	[U]

Course Contents:

Overview of Wireless Sensor Networks: **15 Hrs**

Characteristics-Types of Wireless Sensor Networks-Applications. Challenges for Wireless Sensor Networks - Enabling Technologies for Wireless Sensor Networks - Single-Node Architecture**:** Hardware Components - Energy Consumption of Sensor Nodes - Network Architecture: Sensor Network Scenarios - Optimization Goals and Figures of Merit -Design principles for WSNs – Gateway Concepts - Physical Layer and Transceiver design Considerations

Time Synchronization and Localization: **15 Hrs**

MAC Protocols for Wireless Sensor Networks - S-MAC - Wakeup radio concepts – Introduction to the time synchronization problem - Protocols based on sender/receiver synchronization - Single-hop localization - Positioning in multi-hop environments - Topology-control: Aspects of topology-control algorithms

Routing Protocols and Operating Systems: **15 Hrs**

Energy-Efficient unicast - Broadcast and multicast - Geographic Routing-Operating Systems for Wireless Sensor Networks: Operating System Design Issue - Examples of Operating Systems: TinyOS, Mate, MagnetOS and OSPM - Application specific support: Target detection and tracking.

Total Hours	**45**

Text Books:

1	Holger Karl and Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks”, John Wiley, 1st edition, 2015.
2	KazemSohraby, Daniel Minoli and TaiebZnati, “Wireless Sensor Network-Technology, Protocolsand Applications”, John Wiley, 2nd edition, 2012

Reference Books:

1	Feng Zhao and Leonidas J. Guibas, “Wireless Sensor Networks - An Information Processing Approach", Elsevier, 1st edition, 2016.
2	WaltenegusDargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks – Theory and Practice”, John Wiley, 1st edition, 2017.
3	C.S. Raghavendra, Krishna M. Sivalingam, TaiebZnati,“Wireless Sensor Networks”, Springer,1st edition, 2010.

Web References:

1	http://profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf

2	http://ijcttjournal.org/Volume4/issue-8/IJCTT-V4I8P194.pdf
3	Profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf
4	https://pdfs.semanticscholar.org/e552/059d73eef06be26fd0e1a1e4118d4f4e4b20.pdf
Online Resources:	
1	https://www.coursera.org/lecture/internet-of-things-history/sensor-networks
2	https://nptel.ac.in/courses/106105160/21
3	https://nptel.ac.in/courses/114106035/37
4	https://www.edx.org/course/computer-networks-internet-kironx-fhlcnx

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C931.1	Remember	Online Quiz Group Assignment Class Presentation Programming	**20**
C931.2	Understand		
C931.3	Analyse		
C931.4	Apply		
C931.5	Understand		
C931.6	Remember		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	50	20	30	30
Understand	50	20	30	30
Apply	-	30	20	20
Analyze	-	30	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C931.1	2	2	2	2	1	2	2	-	-	-	-	1	3	1	2
C931.2	3	3	2	3	1	1	3	-	-	-	-	1	3	2	3
C931.3	3	3	2	2	1	1	2	-	-	-	-	1	3	1	3
C931.4	3	3	2	3	1	2	2	-	-	-	-	1	3	1	3
C931.5	3	2	2	2	1	2	3	-	-	-	-	1	3	1	3
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EC942	Digital Control Systems	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Control Systems	

Course Objectives:

1	To present the basic concepts on analysis and design of sampled data control system.
2	To familiarize and practice digital control algorithms.
3	To design digital controllers and state observer.

Course Outcomes:

Upon completion of the course, students shall have ability to

C942.1	Analyze the importance of sample data control system	[A]
C942.2	Analyze the signal processing in digital control system	[A]
C942.3	Examine stability of discrete data system.	[E]
C942.4	Illustrate the state space representation for discrete data system.	[AP]
C942.5	Design digital controllers for discrete data system.	[C]

Course Contents:

Module 1: Computer Controlled System And Signal Processing **15 Hrs**

Configuration of the basic digital control system - General sampled data system variables - Signal classifications - Need of digital control system - Advantages - Disadvantages - Examples of discrete data and digital control systems. Signal processing - Signal sampling, quantizing and coding - Frequency domain analysis - Ideal samples - Shanon's sampling theorem - Generation and solution of process - Linear difference equations - Data reconstruction process - Frequency domain characteristics.

Module 2: Discrete System Modelling **12 Hrs**

Determination of the Z transform - Mapping between s and Z domains - Z transform of system equations - Open loop Hybrid sampled Data Control Systems - Open loop discrete Input Data Control System - Closed loop sampled data control system - modified Z transform method - Response between sampling instants - Stability on the Z plane and jury's stability test - Steady state error analysis for stable systems.

Module 3: State Variable Analysis and Digital Controllers **18 Hrs**

State descriptions of digital processors - Conversion of state variable models to transfer functions - Conversion of transfer functions to canonical state variable models - First comparison form - Second companion form - Jordon Canonical form - State description of sampled continuous time plants - Solution of state difference equations - Closed form solution - State Transition Matrix - Caley Hamilton Technique - Concept of Controllability and Absorbability - Design of digital control systems - Digital PI, PD and PID Controller - Position and velocity forms - State regulator design - Design of state observers - Dead beat control by state feedback and Dead beat observers.

Total Hours	**45**

Text Books:

1	M.Gopal, Digital Control and State Variables Methods, Tata McGraw HILL, 4th Edition, 2017.
2	John J. D'Azzo, Constantine H. Houpis, Linear Control System Analysis and Design, Mc Graw Hill, 2003.
3	Gene H. Hostetter, Digital Control System, Second Edition, Inc.U.S, 1997.

Reference Books:	
1	Ogata K, Discrete Time Control Systems, Pearson Education, 2005.
2	C.M. Houpis, G.B. Lamount, Digital Control Systems-Theory, Hardware, Software,International Student Edition, McGraw Hill Book Co., 1992.
3	B.C. Kuo, Digital control systems, Second Edition, Oxford University press, 2007.
4	P.B. Deshpande and R.H. Ash, Computer Process Control, ISA Publication, USA,1995.
Web References:	
1	https://nptel.ac.in/courses/108103008
2	https://engineering.purdue.edu/online/courses/digital-control
3	https://nptel.ac.in/courses/108104100
4	https://www.coursebuffet.com/sub/electrical-engineering/525/digital-control-system

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C942.1	Analyze	Quiz Group Assignment Problem Solving Assignment Tutorials	**20**
C942.2	Analyze		
C942.3	Evaluate		
C942.4	Apply		
C942.5	Create		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	10	20
Understand	20	20	10	20
Apply	-	-	-	-
Analyze	60	60	40	40
Evaluate	-	-	40	20
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C942.1	3	3	1									1	3		
C942.2	3	2	2				2					2	3	3	
C942.3	3	3	3	2			2					2	3	3	
C942.4	3	3	3				2					2	3	3	
C942.5	3	3	3	2			2				1	2	3	3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE911	Automotive Electronics	3/0/0/3

Nature of Course	D (Theory Application)
Course Pre-requisites	Analog Electronics

Course Objectives:

1. To instil a fundamental understanding of various electronic functionalities in automotive.
2. To make them gain knowledge on lighting system, sensors and accessories employed in automotive.
3. To make them familiar with Digital Engine Control System and electronic dashboard instruments
4. To broaden the importance of vehicle intelligence system and future of autonomous cars

Course Outcomes:
Upon completion of the course, students shall have ability to

C911.1	Explore the principles and construction of automotive batteries and charging system.	[U]
C911.2	Comprehend the functions of starting, ignition and injection system pertaining to electronic management techniques.	[U]
C911.3	Categorize the functionalities and types of lighting system and accessories of automotive systems.	[A]
C911.4	Articulate the function of automotive sensors in suitable monitoring applications.	[AP]
C911.5	Assess the role of electronic dashboard instruments and vehicle intelligence technology in advanced design of automotive.	[E]

Course Contents:

Module 1: Charging, Starting, Injection and Ignition System **15 Hrs**

Automotive fundamentals, Principles and construction of lead-acid battery. Characteristics of battery, rating capacity and efficiency of batteries, Types of batteries used in electric vehicles, Advanced charging system technology. Types, Construction and working of Starting system, Electronic Ignition systems, Distributor less ignition system, Electronic fuel injection systems and Digital Engine Control System.

Module 2: Lighting System, Accessories and Sensors **15 Hrs**

Lighting System – Overview of interior and exterior lights, Headlight dazzling and preventive methods, Intelligent lighting system Accessories **-** Electrical fuel pump, Speedometer, Fuel, oil and temperature gauges, Horn, Wiper system, Automotive alarms, Parking System. Sensors - Basic sensor arrangement, Oxygen sensor, Crank angle position sensor, Vehicle speed sensor, Detonation sensor, Altitude sensor, Mass Air Flow sensor and Throttle position sensors.

Module 3: Electronic dashboard instruments and Vehicle Intelligence **15 Hrs**

On-board diagnosis system, security and warning system - anti - lock braking system, Tyre pressure monitoring system, Collision avoidance system, Key less entry system and Electronic power steering system - Vehicle Intelligence - Introduction - Basics of OBD-II, CAN and LIN Protocols - Case Study: Architecture for vision based autonomous road vehicles features and applications.

Total Hours	**45**

Text Books:

1.	Judge. A.W., Modern Electrical Equipment of Automobiles, Chapman & Hall, London, 2012.
2.	Vinal. G.W., Storage Batteries, John Wiley & Sons Inc., New York, 4th edition, 2012.
3.	Bosch Automotive Electrics and Automotive Electronics, Springer,5th Ed,2014

Reference Books:

1.	William B. Ribbens, Understanding Automotive Electronics, 6th Edition, Butterworth, Heinemann Woburn, 2003.

2.	Automotive Hand Book, Robert Bosch, Bently Publishers, 2004.
3.	Hod Lipson, Melba Kurman, Driverless: Intelligent Cars and the Road Ahead, MIT Press, 2016
Web References:	
1.	www.boschindia.com/.../automotive_electronics.../automotive-electronics.html
2.	www.innovianstechnologies.com/automotive-electronics
3.	https://www.electronicsweekly.com/market-sectors/automotive-electronics

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C911.1	Understand	Quiz Case Study Class Presentation Group Assignment	**20**
C911.2	Understand		
C911.3	Analyse		
C911.4	Apply		
C911.5	Evaluate		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA III [10 marks]	
Remember	50	-	-	-
Understand	50	-	50	50
Apply	-	50	-	20
Analyse	-	50	40	20
Evaluate	-	-	10	10
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

Course Articulation Matrix (Theory)

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C911.1	3	3	2	2	3		1						3	2	
C911.2	3	3	2	2	3		2				2	2	3	2	
C911.3	3	3	2	2	3		2				2	2	3	2	
C911.4	2	1			2		2				2	2	2		
C911.5	2	1			2		2				2	2	2		
1	**Reasonably agreed**				**2**	**Moderately agreed**					**3**	**Strongly agreed**			

20EE912	Virtual Instrumentation	2/0/2/3

Nature of Course:	E (Theory Skill Based)
Course Pre-requisites	Measuring Instruments and Smart sensors

Course Objectives:

1. To understand the architecture of VI and basic programming concepts in software tool.
2. To learn different Data Acquisition system concepts.
3. To develop real time applications using software tool.
4. To study various Instrument Interfacing protocols.

Course Outcomes:
Upon completion of the course, students shall have ability to

C912.1	Explain the architecture and features of Virtual Instrument	[U]
C912.2	Create the graphical programming in LabVIEW software.	[C]
C912.3	Illustrate the basic concepts of PC based data acquisition	[U]
C912.4	Analyze the Control system design and PID Controller toolkits in LabVIEW	[A]
C912.5	Demonstrate the use of LabVIEW Toolkit in Image Processing and Machine vision applications	[A]

Course Contents:

Module 1: VI Programming Techniques **10 Hrs**

Block diagram and Architecture of VI - Graphical System Design (GSD) model - Comparison with conventional programming - LabVIEW Software environment VI's and sub -VI's - Loops - Arrays - Clusters - Graphs and charts - Case and sequence structures - Formula nodes - Local and global variable - String and File I/O.

Module 2: DAQ and Analysis Tools **10 Hrs**

Concept of PC based data acquisition - DAQ Software Architecture-DAQ Assistant - Analog Input and Analog Output - Digital Input and Digital Output - Timers-Counters - Grounding: Differential and Single Ended - Increasing Measurement Quality of DAQ - Temperature based data acquisition system

Module 3: LabVIEW Tools and Applications of VI **10 Hrs**

Control Design and Simulation Tools – PID Control Toolkit- IMAQ: Image processing and analysis - Machine Vision- Motion Control- Web Publishing Tools -Simple programming with Arduino Uno-LabVIEW interface

Total Hours	**45**

Course Outcomes: (Laboratory)
Upon completion of the course, students shall have ability to

C912.1	Develop VI programs for Simple applications using basic functions.	A
C912.2	Interpret various function palette tools and provide solutions for simple problems.	A
C912.3	Construct VI programs based on Structures, Strings, File I/O and different Toolboxes.	C
C912.4	Interface VI program with real time environment and Arduino processor to give solution.	C

Lab Component

S.No	List of Experiments	CO Mapping	BT
1.	Creating Virtual Instrumentation for simple applications	C912.1	[U]
2.	Programming exercises for loops	C912.2	[A]
3.	Programming exercises for arrays	C912.2	[A]
4.	Programming exercises for clusters	C912.2	[A]
5.	Build a VI using Graphs and Charts	C912.2	[A]
6.	Build a VI using Case and sequence structures	C912.3	[A]

7.	Programming exercises for Strings & File I/O	C912.3	[A]
8.	Real time temperature-based data acquisition system.	C912.4	[A]
9.	Programming exercises for Control Design Toolboxes	C912.4	[A]
10.	Programming exercises for IMAQ Toolboxes.	C912.4	[E]
11.	Programming exercises for Arduino Uno.	C912.4	[E]
		Total Hours	**30**

Text Books:	
1.	Jovitha Jerome, "Virtual Instrumentation using LabVIEW", Prentice Hall, 2010.
2.	Gary W. Johnson, Richard Jennings, "Lab-view Graphical Programming", Tata McGraw Hill Professional Publishing, IV Edition, 2011.
3.	Steve Mackay, Edwin Wright, John Park, and Deon Reynders, "Industrial Data Networks", Elsevier, 2010.
4.	Marco Schwartz and Oliver Manickum "Programming Arduino with LabVIEW", Kindle Edition, 2015.
Reference Books:	
1.	P.Surekha, S.Sumathi, "LabVIEW based Advance Instrumentation",Springer,2007.
2.	Sanjay Gupta and Joseph John, "Virtual Instrumentation using LabVIEW", Tata McGraw-Hill Inc, 2017.
3.	Behzad Ehsani, "Data Acquisition Using LabVIEW", Kindle Edition, 2016.
4.	Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement Instrumentation and Control",Newness, 2000.
Web References:	
1.	http://www.ni.com/academic/students/learn-labview/
2.	http://www.ni.com/academic/students/learn-daq/
3.	https://www.electronicshub.org/labview-projects/
4.	https://learn.ni.com/teach/resources

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [50 marks]
	Theory			Rubrics Based Practical Assessment [20 Marks]	
	CIA-I [10 Marks]	CIA-II [10 Marks]	CIA-III [10 Marks]		
Remember	20	-	-	-	10
Understand	30	50	40	40	40
Apply	50	20	30	40	30
Analyse	-	-	-	-	-
Evaluate	-	-	30	20	10
Create	-	30	-	-	10

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [50 marks]
	Theory			Rubrics Based Practical Assessment [20 Marks]	
	CIA-I [10 Marks]	CIA-II [10 Marks]	CIA-III [10 Marks]		
Remember	20	-	-	-	10
Understand	30	50	40	40	40
Apply	50	20	30	40	30
Analyse	-	-	-	-	-
Evaluate	-	-	30	20	10
Create	-	30	-	-	10

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
0	50	50	100

Course Articulation Matrix (Theory)

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C912.1	2	1													
C912.2	3	3	3	3	3			2	2	2		3	2		2
C912.3	2	1						2	2	2		2	2	2	
C912.4	3	2	1	1						2		2	2	2	
C912.5	3	3	2	2	3			2	2	2		3	3		2

1	Reasonably Agreed	2	Moderately Agreed	3	Strongly Agreed

Course Articulation Matrix (Laboratory)

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C912.1	1	1	1		3				2	2			1	3	1
C912.2	1	1	1		3				2	2			1	3	1
C912.3	1	1	1		3				2	2			1	3	1
C912.4	1	1	1		3				2	2			1	3	1
C912.5	1	1	1		3				2	2			1	3	1

1	Reasonably Agreed	2	Moderately Agreed	3	Strongly Agreed

20EC943	Embedded System Design	2/0/2/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	Microcontrollers	

Course Objectives:

1	To introduce the functional building blocks of embedded systems.
2	To provide sufficient knowledge to understand the embedded systems design and interfacing between processors and peripheral device.
3	To enable coding of effective Embedded C programs on any dedicated processor.
4	To familiarize with the concepts of Real time operating systems and choice for specific application.
5	To understand the real-world embedded devices.

Course Outcomes:

Upon completion of the course, students shall have ability to

C943.1	Describe the functional building blocks of embedded system, Processor and memory Organization.	[U]
C943.2	Examine the different types of Processors and Memory to be selected for different case studies.	[A]
C943.3	Interpret the architecture and functioning of network devices, I/O Programming and Schedule Mechanism.	[A]
C943.4	Apply suitable RTOS concepts with suitable real time applications.	[AP]
C943.5	Develop the embedded C programs for different peripheral interface experiments.	[A]

Course Contents:

Module 1: Processor and Memory Organization **8 Hrs**

Functional building blocks of embedded systems, Structural units in a processor; selection of processor & memory devices, memory management, DMA, Cache mapping techniques, dynamic allocation, Fragmentation, Interrupts, I/O devices, Embedded Product Design Life Cycle. Case study: Required Memory devices for an Automatic chocolate vending machine, Digital Camera and Voice recorder.

Module 2: Devices and Buses for Network **8 Hrs**

I/O devices; timer & counting devices serial communication using I2C, SPI, USB buses, ARM bus; interfacing with devices/ports, device drivers in a system - Introduction Controller Area Network (CAN), Wireless Communication using Bluetooth, Zigbee, IEEE 802.15.4 standard. Introduction to Raspberry pi and Jetson Nano. Case study: IOT based Embedded Applications.

Module 3: RTOS **14 Hrs**

Introduction to Basic concepts of OS and RTOS - Task, Process & Threads, Interrupt Routines in RTOS, Multiprocessing and Multitasking, Pre-emptive and Non-Pre-emptive Scheduling, Task Communication, shared Memory, Message Passing-, Inter Process Communication - Synchronization Between Processes - Mailbox, Pipes, Priority Inversion, Priority Inheritance, Scheduling Algorithms - Rate monotonic algorithm, Earliest Deadline algorithm, Round Robin algorithm, Embedded multitasking, semaphores, Deadlock. Software aspects of embedded systems, Real time programming languages and operating systems for embedded systems. Selection of operating systems for commercial applications.

List of Experiments:

1	Study of KEIL using 8051	[U]
2	LED Blinking using 8051	[A]
3	Interfacing LCD with 8051	[A]
4	Seven Segment Display using 8051	[A]

5	Interfacing Matrix Keyboard using 8051	[A]
6	Interfacing ADC with 8051	[A]
7	Interfacing DC Motor with 8051	[A]
8	Real Time people tracking system using Jetson Nano	[A]
9	Design of embedded based Irrigation system using Jetson Nano	[A]
10	Design of embedded based Abnormal Health Alert System using Raspberry pi.	[A]
	Total Hours	**45**

Text Books:	
1	P.Raj Kamal, Embedded System- Architecture, Programming, and Design. (2/e), Tata McGraw Hill, 2014.
2	K.V. Shibu, Introduction to Embedded Systems, Tata McGraw, 2009.
3	David E-Simon: An Embedded software Primer, Pearson Education, 2012.
4	Jeff Cicolani Beginning Robotics with Raspberry Pi and Arduino Using Python and OpenCV, Apress Publications, First Edition, 2020
Reference Books:	
1	G.H. Miller, Microcomputer Engineering, 3d edition, Pearson Education, 2013.
2	W. Wolf. Computers as components: principles of embedded computing system design. Morgan Kaufmann, 2012.
3	Jonathan. W. Valvano, Embedded Microcomputer Systems, Real Time Interfacing, Published by Thomson Brooks/Col, 2012.
Web References:	
1	http://www.infocobuild.com/education/audio-video-courses/computer-science/EmbeddedSystemsDesign-IIT-Kharagpur/lecture-10.html
2	https://nptel.ac.in/courses/106105159/
3	https://www.youtube.com/watch?v=y9RAhEfLfJs
4	https://www.coursera.org/learn/introduction-embedded-systems/lecture/SNbQd/0-introduction-to-the-course
5	https://www.youtube.com/watch?v=V3zBMnCa8Hw
6	https://www.youtube.com/watch?v=3V9eqvkMzHA

Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**				**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	**Rubrics based Practical Assessment [20 Marks]**	
Remember	20	20	20	-	20
Understand	70	30	30	-	20
Apply	-	30	30	20	30
Analyze	10	20	20	20	30
Evaluate	-	-	-	30	-
Create	-	-	-	30	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**50**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C943.1	3	2	2	2									3		
C943.2	3	2	2	2									3		
C943.3	3	2	2	2									3		
C943.4	3	2	2	2									3		
C943.5	2	2	2	2	3				1	2		2	3		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EC944	Nano Electronics	3/0/0/3
Nature of Course	C (Theory Concept)	
Course Pre-requisites	Nil	

Course Objectives:

1	To understand the concept of semiconductor devices and materials
2	To learn about the concepts of Fabrication of Nanomaterials
3	To impart the concepts of quantum electronics with new device structure
4	To examine various applications of Tunneling effects

Course Outcomes:
Upon completion of the course, students shall have ability to

C901.1	Illustrate the basic concepts of Nano electronics.	[U]
C901.2	Examine the Fabrication methods and implications.	[A]
C901.3	Analyze the Features of Quantum Electron Devices.	[A]
C901.4	Appraise SET, RTD and Tunneling Devices on various Nano electronic Devices.	[A]
C901.5	Demonstrate the concepts of Advanced Nano electronics devices.	[U]

Course Contents:

Module 1: Basic of Nano electronics **15 Hrs**

Introduction to Nanotechnology - Impacts - Limitations of Conventional Microelectronics - Capabilities of Nano electronics - Physical fundamentals of Nano electronics - Scaling Principle, Fabrication of Nano electronics - Classification of Nano-Structures - Trends in microelectronics, optoelectronics and Nano electronics.

Module 2: Quantum Electron Devices **15 Hrs**

Quantum Particle - Quantum Dot Devices - Quantum Wire Devices - Electronic Structure of Material - Low Dimensional Structures Quantum Well - Density of States and Dimensionality - Electron Wavelet Propagation - Fundamental Limits in Computation.

Module 3: Nano electronics Devices **15 Hrs**

Field Effect Transistors - Resonant Tunneling Diode - Quantum Cascade Laser - Single Electron Transistor - Carbon Nanotube Devices - MODFESTs – Hetero junction Bipolar Transistor - Scanning Tunneling Microscope - Atomic Force Microscope - Transmission Electron Microscope - Advanced Nano electronics Devices - Nanostructured: LEDs, Photo detectors.

Total Hours	**45**

Text Books:

1	W.R. Fahrner, “Nanotechnology And Nano electronics : Materials, Devices, Measurement Techniques”, Springer, 2011
2	Edward L. Wolf, “Quantum Nano electronics - An Introduction to Electronic Nanotechnology and Quantum Computing”, Wiley, 2015
3	Chattopadhyay Banerjee, “Introduction to Nano science & Technology”, PHI, 2012

Reference Books:

1	S. Datta, “Lessons from Nano electronics: A New Perspective on Transport (Lessons from Nanoscience: a Lecture Notes Series) World Scientific, 2012
2	C P. Poole and F. J. Owens, “Introduction to nanotechnology”, John Wiley & Sons, 2003.
3	V. Mitin, V. Kochelap, and M. Stroscio “Introduction to Nano electronics: Science, Nanotechnology, Engineering, and Applications”, Cambridge University Press, 2008.

Web References:

1	https://www.biolinscientific.com/blog/top-5-nanotechnology-blogs-2015
2	https://science.discoveryplace.org/blog/nanotechnology-blog

3	https://engineeringonline.ucr.edu/blog/category/nanotechnology-engineering/
4	https://nanohub.org/courses/FON1
Online Resource:	
1	https://ocw.mit.edu/courses/6-701-introduction-to-nanoelectronics-spring-2010/pages/syllabus/
2	https://nptel.ac.in/courses/117108047
3	https://www.coursera.org/learn/nanotechnology1
4	https://www.edx.org/course/fundamentals-of-nanoelectronics-part-b-quantum-tra
5	https://ocw.mit.edu/courses/6-701-introduction-to-nanoelectronics-spring-2010/pages/syllabus/

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C944.1	Understand	Quiz Writing Skills Class Presentation Group Assignment	**20**
C944.2	Apply		
C944.3	Apply		
C944.4	Apply		
C944.5	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	-	-	-	-
Understand	50	-	-	20
Apply	50	40	20	20
Analyze		30	50	30
Evaluate	-	30	30	30
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C944.1	3	3	2	2			1						3	2	
C944.2	3	2	1	1	2		2				1	2	3	3	
C944.3	3	3	2	2	2		2				1	2	3	3	
C944.4	3	3	2	2	1		2				1	2	3	2	
C944.5	2	1			1							2	3	2	

1	Reasonably Agreed	2	Moderately Agreed	3	Strongly Agreed

20EE913	Design of Electrical Machines	3/0/0/3
Nature of Course	G (Analytical)	
Pre requisites:	Electrical Machines - I and Electrical Machines - II	

Course Objectives:

1	To understand the basic design concepts.
2	To analyze the design of electrical static and dynamic machines.
3	To implement the design optimization procedures of electrical machines.

Course Outcomes:

Upon completion of the course, students shall have ability to

C913.1	Illustrate the basic parameters and design considerations of electrical machines.	[U]
C913.2	Investigate the design of DC machines.	[A]
C913.3	Analyze the design of core, yoke and windings of Transformers.	[A]
C913.4	Examine the design of Induction and Synchronous machines.	[A]
C913.5	Apply the design procedures of electrical machines using computational approach.	[AP]

Course Contents:

Module 1: Basic Design Concepts and Design of DC Machines **15 Hrs**

Considerations and Limitations in design; Choice of specific electric and magnetic loadings; MMF calculation for various types of electrical machines; Real and apparent flux density of rotating machines. Design of DC machines - Output Equation - Main Dimensions; Choice of number of poles; Armature design; Design of air gap; Design of field systems; Design of commutator and brushes.

Module 2: Design of Transformers and Computational Approach **15 Hrs**

Output rating of single phase and three phase transformers; Optimum design of transformers; Design of core, yoke and windings for core and shell type transformers; Design of tanks and cooling tubes of transformers. Introduction to Computer Aided Design of Electrical Machines - Different approaches of CAD, Design of optimization methods; Introduction to FEM based design - Computation of performance parameters of transformer using FEM Software.

Module 3: Design of AC Machines **15 Hrs**

Design of Induction Machines: Output Equation - Main dimensions; Design of stator; Design of squirrel cage rotor - Design of slip ring rotor; Design of Synchronous Machines: Output Equation - Main dimensions - Short circuit ratio; Design of stator and rotor of cylindrical pole and salient pole machines; Design of damper winding; Design of field coil; Design of turbo-alternators. Computation of performance parameters for electrical machine using FEM Software.

Total Hours	**45**

Text Books:

1	A.K.Sawhney, “A Course in Electrical Machine Design”, Dhanpat Rai and Sons, New Delhi, 2016.
2	S. K. Sen, “Principles of Electrical Machine Design with Computer Programmes”, Oxford and IBH Publishing, 2020.
3	M.V. Deshpande “Design and Testing of Electrical Machine Design” Wheeler Publications, 2011.

Reference Books:

1	R.K.Agarwal, “Principles of Electrical Machine Design”, S.K.Kataria and Sons, Delhi, 2014.

2	M.G. Say, “Theory & Performance and Design of AC Machines”, ELBS London,3rd edition, 2005.
3	K. M. V. Murthy, “Computer Aided Design of Electrical Machines”, B.S. Publications, 2008.
Web References:	
1	https://cusp.umn.edu/electric-machine-design-videos https://www.youtube.com/watch?v=LAtwaGHEVbg
2	https://motorsolver.com/workshops/electric-machine-design-lectures/
3	http://www.ppi-engineering.com/design/
4	https://www.youtube.com/watch?v=PII4pz7ohpA
5	https://nptel.ac.in/courses/108105131/

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C913.1	Understand	Online Quiz Problem solving Tutorials Class Presentation Group Assignment	**20**
C913.2	Analyze		
C913.3	Analyze		
C913.4	Analyze		
C913.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA-I [10 Marks]	CIA-II [10 Marks]	CIA-III [10 Marks]	
Remember	5	5	5	5
Understand	10	10	10	10
Apply	40	40	40	40
Analyze	45	45	45	45
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C913.1	2	1											3		
C913.2	3	3	2	2									3		
C913.3	3	3	2	2									3		
C913.4	3	3	2	2									3		
C913.5	3	2	1	1	3							1	3		
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE914	Special Electrical Machines	3/0/0/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	Nil	

Course Objectives:

1	To learn the working operation and performance characteristics of Stepper motor.
2	To realize the performance characteristics of Switched reluctance motors.
3	To impart knowledge on the performance of Permanent Magnet Brushless DC and Permanent Magnet Synchronous motors.
4	To know about the control strategies of Linear and Servo motor.

Course Outcomes:

Upon completion of the course, students shall have ability to

C914.1	Enumerate the principle of operation and performance of Stepper motors.	[U]
C914.2	Analyze the performance of Switched reluctance motors.	[A]
C914.3	Apply the principle of Permanent magnet brushless D.C motor in appropriate field.	[AP]
C914.4	Illustrate the construction and operation of Permanent magnet synchronous motors.	[AP]
C914.5	Analyze the construction and operation of Linear and Servomotor.	[A]

Course Contents:

Module 1: Stepping Motors and Switched Reluctance Motor **15 Hrs**

Stepping Motors - Constructional features - Principle of operation - Variable reluctance motor - Hybrid motor - Permanent Magnet Stepper motor - Torque equations - Modes of excitations - Characteristics - Microprocessor control of stepping motors - Closed loop control. Switched Reluctance motor: Rotary and Linear SRMs - Constructional features - Principle of operation - Torque production mechanism- Power Converters and their controllers - Methods of Rotor position sensing - Sensor less operation - Closed loop control of SRM.

Module 2: Permanent Magnet Motors **18 Hrs**

Permanent Magnet Brushless DC motors - Introduction -Principle of operation, Permeance coefficient - Types - Magnetic circuit analysis - EMF and torque equations - Commutation - Power controllers - Motor characteristics and control. Permanent Magnet Synchronous Motor - Principle of operation - Ideal PMSM - EMF and Torque equations - Armature reaction MMF - Synchronous Reactance - Sine wave motor with practical windings - Phasor diagram - Torque/speed characteristics - Power controllers - Converter Volt- ampere requirements. Torque Controllers, Self-control, Vector control, Current control schemes Application aspect related to vehicle and house hold.

Module 3: Linear and Servomotors **12 Hrs**

Linear Induction motor (LIM) classification - construction - Principle of operation - DC Linear motor (DCLM) types - circuit equation - DCLM control applications. Servomotor-Constructional features, Principle of operation, Types, Characteristics, Control strategies, linear actuators with DC servo motors. Application of linear and servo motor in automation industries. Principle of operation and characteristics of Hysteresis motor - AC series motors - Flux switching and Flux reversal motors.

Total Hours: 45

Text Books:

1	Berker Bilgin, James Weisheng Jiang, AliE madi, " Switched Reluctance Motor Drives: Fundamentals To Applications" CRC press,2018.
2	T.J.E.Miller," Switched Reluctance Motors and their Control" Magna Physics Publishing,2008.

3	Dr.Duanek Hansel man," Brushless Motors: Magnetic Design, Performance, and Control of Brushless DC and Permanent Magnet Synchronous Motors" E-Man Press LLC,2012.
4	T.Kenjo,S.Nagamori,"Permanent magnet and brushless DC motors" Oxford science publications,2003.
5	E.G Janardanan, "Special Electrical Machines" Prentice Hall India Learning PrivateLimited,2014.
Reference Books:	
1	Ahmed Tahor, Abdel Ghani Aissabui," Switched Reluctance Motor- Concept, Control and Applications", In Tech Open, 2017.
2	Riazollah Firoozian,"Servo Motors and Industrial Control Theory" Springer International Publishing AG; 2nd edition, 2014.
3	V.V. Athani," Stepper Motors: Fundamentals, Applications and Design", New Age publisher,2nd edition,2014.
4	R. Krishnan,"Permanent Magnet Synchronous and Brushless DC Motor Drives", T and F India,2016.
Web References:	
1	https://www.elprocus.com/stepper-motor-types-advantages-applications/
2	https://electrical-engineering-portal.com/characteristics-and-work-principles-of switched-reluctance-sr-motor
3	https://www.edn.com/design/sensors/4406682/Brushless-DC-Motors---Part-I--Construction-and-Operating-Principles
4	https://www.simpletecautomatics.com/company-video.html#product
5	http://www.ebs-automation.com/news/video/

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C914.1	Understand	Online Quiz Technical Presentation Class Presentation Group Assignment	**20**
C914.2	Analyse		
C914.3	Apply		
C914.4	Apply		
C914.5	Analyse		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA III [10 marks]	
Remember	40	20	20	20
Understand	60	60	40	40
Apply	-	20	20	20
Analyze	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C914.1	2	1			2										
C914.1	3	2	1	1	3								3	2	
C914.1	2	1			2										
C914.1	3	3	2	2	3				2				3	2	
C914.1	2	1			2				2	2					
1	Reasonably Agreed				2	Moderately Agreed					3	Strongly Agreed			

20EE915	PLC and Automation	3/0/0/3
Nature of Course	E (Theory Skill Based)	
Course Pre-requisites	Control Systems	

Course Objectives:

1	To expose the rudiments of PLC and Industrial Automation.
2	To know various types and programming of programmable logic controllers.
3	To familiarize with different types of HMI and Installation and maintenance procedures for PLC.
4	To learn the architecture and tools of Supervisory Control and Data Acquisition System.
5	To learn the basic principles of communication protocols.

Course Outcomes:

Upon completion of the course, students shall have ability to

C915.1	Enumerate the architecture of PLC, I/O modules and Wiring.	[U]
C915.2	Interpret the basic building blocks of PLC Programming.	[AP]
C915.3	Design PLC Ladder Logic Program for practical applications.	[A]
C915.4	Explain the installation and maintenance procedures of PLC and networking of PLC with HMI system.	[U]
C915.5	Implement the architecture and functions of SCADA.	[AP]
C915.6	Discuss the principle of communication protocols.	[U]

Course Contents:

Module 1: Introduction **15 Hrs**

Sensors**:** Proximity sensor, Light sensor, Temperature sensor, Smart sensors**,** Programmable Logic Controllers - History and developments in Industrial automation, Architecture of Industrial automation, Control elements in industrial automation. PLC Introduction, Basics of PLC, Advantages, Capabilities of PLC - Architecture of PLC, Scan cycle, Types of PLC, Types of I/O modules - Configuring a PLC, PLC wiring.

Module 2: PLC Programming **15 Hrs**

Types of Programming, Simple process control programs using Relay Ladder Logic, PLC logical functions - Timers and Counters, Data transfer - Comparison and Manipulation Instructions. HMI system and PLC networking: Necessity and Role in Industrial Automation, Text display, Operator panels, Touch panels, Panel PCs, Integrated displays, Interfacing PLC to HMI. Installation and maintenance procedures for PLC, Troubleshooting of PLC.

Module 3: SCADA **15 Hrs**

Overview, Architecture of SCADA, Tools, Tag, Internal & External graphics, Alarm logging, Tag logging, Structured tags, Trends-history-Report generation, Scripts for SCADA application. Communication protocols of SCADA: BUS configurations used for industrial automation - GPIB, HART and OLE/OPC protocols - Industrial field bus - FIP (Factory Instrumentation Protocol), PROFIBUS (Process field bus), Bit bus - Server/Client Configuration - Messaging - Recipe. User administration - Interfacing of SCADA with PLC.

Total Hours:	**45**

Text Books:

1	William J. Weindorf, “Programmable Logic Controllers Principles and Applications”, 3rd Edition, 2021.
2	Robert Radvanovsky, “Handbook of SCADA/Control Systems Security”, CRC Press, Second Edition, 2020.

Reference Books:	
1	Frank D. Petruzella, “Programmable Logic controllers”, Mc Graw Hill, Fifth Edition, 2017.
2	John.W.Webb & Ronald A. Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 2009.
3	WinCC V7.2, Software Manual, 2013.
Web References:	
1	https://nptel.ac.in/courses/112102011/12
2	https://swayam.gov.in/course/1395-industrial-automation-and-control
3	https://freevideolectures.com/course/2345/industrial-automation-and-control

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C915.1	Understand	Classroom Quiz Simulation Technical Presentation Case Study	**20**
C915.2	Apply		
C915.3	Analyse		
C915.4	Understand		
C915.5	Apply		
C915.6	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment				End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Formative Assessment [20 marks]	
Remember	30	20	20	40	20
Understand	50	30	40	20	40
Apply	20	30	20	20	20
Analyse	-	20	20	20	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C915.1	2	1											1		
C915.2	3	2	1	1					1				1		
C915.3	3	3	2	2			1		2	1	1		3	2	
C915.4	2	1					1						2	2	
C915.5	3	2	1	1			1						2	2	
C915.6	2	1								1			1		

20EE916	Servo Drives in Robotics	3/0/0/3
Course Pre-requisites	Electrical Machines - I and Electrical Machines - II	
Nature of Course	D (Theory Application)	

Course Objectives:

1	To impart the knowledge of servo motors drives and power transmission.
2	To understand the concepts of sensors and vision systems.
3	To understand the concepts of robots in various industries for automation.

Course Outcomes:
Upon completion of the course, students shall have ability to

C916.1	Interpret the basic laws and concepts of robots.	[U]
C916.2	Explain the concepts of servo mechanisms and control of electric drives.	[U]
C916.3	Analyze the sensor systems to the robotic system.	[A]
C916.4	Analyze the power transmission systems in the robotic system.	[A]
C916.5	Apply the Robots in Manufacturing and Processing Industries.	[AP]

Course Contents:

Module 1: Introduction to Fundamental concepts of Robotics **15Hrs**

History, Present status and future trends in Robotics and automation - Laws of Robotics - Robot definitions - Robotics systems and robot anatomy - Structure of a Robot, Classification of Robots: Cartesian, Cylindrical, Spherical, Articulated, SCARA - Specification of Robots - Degrees of freedom of serial and parallel manipulators - resolution, repeatability and accuracy of a manipulator.

Module 2: Sensors and Vision Systems **15Hrs**

Principle of operation, types and selection of position and velocity sensors, Potentiometers, Encoders, Resolvers, LVDT, Tacho-generators, Internal and External State Sensors, Proximity sensors. Limit switch -Tactile sensors - Touch sensors - Force and torque sensors, Robot end effectors. Vision Systems. Vision Systems for Robotics: Robot vision systems, Image capture - solid state cameras - Image Representation - Grey scale and colour images, Image sampling and quantization - Image processing and analysis - Image data reduction Segmentation - Feature extraction - Object Recognition.

Module 3: Motors Drives and Factory Automation **15Hrs**

Types Constructional features - Principle of operation - Feedback system - Sizing of servomotors - Robot drive mechanisms, hydraulic-electric servomotor- stepper motor - pneumatic drives, Mechanical transmission method - Gear transmission, Belt drives, cables, Roller chains, Link - Rod systems - Rotary-to-Rotary motion conversion, Rotary to linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws, End effectors. Control of Electrical Drives: Introduction - Parts of Electrical Drives - Fundamental Torque Equations- Speed Torque Conventions and Multi-quadrant Operation - Nature & Classification of Load Torques - Modes of Operation-Closed - Loop Control of Drives. Factory Automation: Flexible Manufacturing Systems concept - Automatic feeding lines, transfer lines, automatic inspection - Computer Integrated Manufacture - CNC, intelligent automation. HMI Systems, DCS and SCADA, Wireless controls.

Total Hours:	**45**

Text Books:	
1.	Sotiris Makris " Cooperating Robots for Flexible Manufacturing", Tata McGraw Hill Publishing, 2020.
2.	Ulrich Rembold, "Robot Technology and Applications", CRC Press, 2020.
3.	Saeed B Niku," Introduction to Robotics Analysis, Systems, Applications", PHI Pvt Ltd, New Delhi, 2016.
4.	Peter Corke, "Robotics, Vision and Control: Fundamental Algorithms In MATLAB" first edition 2011.
Reference Books:	
1.	S K Saha - Introduction to Robotics, Tata Mcgraw Hill, 2010.
2.	Mittal R K, Nagrath I J, Robotics and Control, Tata McGraw Hill, 2010.
3.	Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering - An Integrated Approach", Eastern Economy, Prentice Hall of India Pvt Ltd., 2010.
Online Reference:	
1.	https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/
2.	https://www.edx.org/course/robotics-columbiax-csmm-103x
3.	https://www.futurelearn.com/courses/begin-robotics

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C916.1	Understand	Quiz Technical Presentation Group Discussion Case Study Simulation	20
C916.2	Understand		
C916.3	Analyze		
C916.4	Analyze		
C916.5	Apply		

Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [50 marks]**
	Theory			**Formative Assessment [20 Marks]**	
	CIA-I [10 Marks]	**CIA-II [10 Marks]**	**CIA III [10 Marks]**		
Remember	40	20	20	20	40
Understand	60	60	40	40	60
Apply	-	20	20	20	-
Analyze	-	-	20	20	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C916.1	2	1			2								3		
C916.2	2	1					1						2		
C916.3	3	3	2	2			1						3	1	
C916.4	3	3	2	2									3		
C916.5	3	2	1	1	2								3	1	

20EE917	Flexible AC Transmission Systems	3/0/0/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	Power Electronics, Power System Analysis	

Course Objectives:

1	To understand the concepts of FACTS.
2	To expose the applications of FACTS controllers in power systems.
3	To learn about shunt and series compensation schemes and simulation of FACTS Controllers.
4	To understand the phenomenon of SSR and its mitigation techniques.

Course Outcomes:
Upon completion of the course, students shall have ability to

C917.1	Describe the concept of FACTS.	[U]
C917.2	Analyze the various types of compensation schemes.	[A]
C917.3	Implement the various FACTS controllers.	[AP]
C917.4	Apply the compensation techniques to simulate various FACTS controllers.	[AP]
C917.5	Illustrate the phenomena of sub synchronous resonance.	[U]

Course Contents:

Module 1: Introduction **15 Hrs**

Introduction, Electrical Transmission Network, Necessity, Power Flow in AC system, Relative importance of controllable parameter, Opportunities for FACTS, Possible benefits for FACTS Technology, Types of FACTS Controllers & its Applications. Advanced FACTS devices. Case Study: Practical Application of FACTS devices in Power quality improvement.

Module 2: Types of Compensation Techniques **15 Hrs**

Need for compensation, shunt and series compensation, Configuration - Operating characteristics, Static VAR Compensator (SVC), Thyristor Controlled Reactor (TCR), Thyristor Switched Capacitor (TSC), Comparison of TCR and TSC, Variable impedance type series compensation, Thyristor Switched Series Capacitor (TSSC), Thyristor Controlled Series Capacitor (TCSC), Basic operating control schemes for TSSC & TCSC.

Module 3: Static Voltage Phase Angle Regulator and Second-Generation Facts Controllers **15 Hrs**

Objectives of voltage and phase angle Regulators- Operations and Control Applications - TCVR Model and Thyristor Controlled Voltage and Phase Angle Regulator, TCPAR Model characteristics**,** STATCOM and UPFC, Circuit model, Basic operating principles and control structure, Introduction to sub synchronous resonance (SSR) - mitigation by FACTs controllers, NGH, SSR damping scheme, Simulation and study of FACTS under dynamic conditions. Enhanced renewable integration through Flexible Transmission option (ERIFT) NGHSSR damper, thyristor-controlled braking resistor (TCBR).

Total Hours	**45**

Text Books:

1	Narain G.Hingorani, Laszio Gyugyi, “Understanding FACTS concept and Technology”,Standard Publisher, Delhi, 2017.
2	K.R. Padiyar, “FACTS Controllers for Power Transmission and Distribution” New Age International Publishers, 2016.
3	Rajiv K. Varma R. Mohan Mathur “Thyristor-Based FACTS Controllers for Electrical Transmission Systems” Wiley ,2011.

Reference Books:	
1	Zhang, Xiao-Ping, Rehtanz, Christian**,** Pal**,** Bikash "Flexible AC Transmission Systems: Modelling and Control" Springer 2012.
2	Gyugyi L., "Unified power flow control concept for flexible AC transmission ", IEEE Proc-C, Vol.139, No.4, July 2013.
3	A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 2017.
Web References:	
1	http://www.infocobuild.com/education/audio-video-courses/electronics/flexible-ac transmission-systems-devices-iit-roorkee.html
2	https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/108107114/lec1.pdf
3	https://www.youtube.com/watch?v=YW9BGz80Yz4

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C917.1	Understand	Technical Quiz Assignment Case Study Class Presentation Group Assignment	**20**
C917.2	Analyse		
C917.3	Apply		
C917.4	Apply		
C917.5	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [50 marks]
	Theory			Formative Assessment [20 Marks]	
	CIA-I [10 Marks]	CIA-II [10 Marks]	CIA III [10 Marks]		
Remember	-	-	-	-	-
Understand	40	10	20	40	20
Apply	-	40	40	50	40
Analyse	60	50	40	10	40
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C917.1	2	1				1							2	2	1
C917.2	3	3	2	2	1								3	1	1
C917.3	3	2	1	1											
C917.4	3	2	1	1									2	2	1
C917.5	3	2	1	1											
1	**Reasonably Agreed**			**2**		**Moderately Agreed**						**3**	**Strongly Agreed**		

20EE918	Digital Simulation of Power Electronic Circuits	2/0/2/3
Nature of Course	E (Theory Skill Based)	
Course Pre-requisites	Power Electronics	

Course Objectives:

1.	To expose the basic theoretical and practical applications of power semiconductor.
2.	To develop basic AC-DC, DC-DC, DC-AC conversion circuit fed drives.
3.	To provide the basis for further study of controllers in power electronics circuits.

Course Outcomes:
Upon completion of the course, students shall have ability to

C918.1	Describe the basic applications of various power semiconductor devices.	[U]
C918.2	Analyze and design various machine models in Simulation Tool.	[A]
C918.3	Construct AC / DC rectifier circuits in Simulation Tool.	[AP]
C918.4	Design basic and advanced DC/DC converter circuits in Simulation Tool.	[A]
C918.5	Investigate the role of power electronic systems for improvement of power quality	[AP]
C918.6	Analyze and design inverter circuits for control of drives.	[A]

Course Contents:

Module 1: Principle and Models of Semiconductor Devices **15 Hrs**

Introduction to Sim Power Systems Tool Box, Modelling of Diode with R, R-L, R-C and RLE -load, SCR, MOSFET, IGBT, TRIAC in Simulation, Simulation of gate/base drive circuits, Simulation of Snubber circuit. Introduction to electrical machine modelling: Induction, DC and Synchronous machines, simulation of basic electric drives.

Module 2: Simulation of Rectifier and Chopper fed drives **15 Hrs**

Simulation of single and three phase converters - Uncontrolled, Semi controlled and fully controlled converter for R, RL, RLE load, Dual Converter. Simulation of DC-DC converter fed dc motor drives - Buck, Boost, Buck-Boost Converters for continuous and discontinuous current and Simulation of four quadrant operations of DC-DC converter. Investigation on Power factor correction schemes with controllers PWM.

Module 3: Simulation of Inverter fed drives **15 Hrs**

Simulation of single and three phase inverters with MOSFET and IGBT, Space Vector Representation, Pulse-width modulation methods for voltage and waveform control. Simulation of Inverter fed Induction and BLDC motor drives. Single and three phase AC voltage converter with R and RL load.

Total Hours	**45**

Course Outcomes: (Laboratory)
Upon completion of the course, students shall have ability to

C918.1	Modelling of various power semiconductor devices.	[A]
C918.2	Construction of converter fed drives.	[AP]
C918.3	Design of a chopper fed drives.	[A]
C918.4	Analyze the inverter fed drives.	[A]
C918.5	Investigate on synchronous motor drive.	[AP]
C918.6	Investigate on induction motor drive.	[AP]

Lab Component			
S.No.	**List of Experiments**	**CO Mapping**	**BT**
1.	Modelling and characteristics of Diode, SCR, IGBT, MOSFET, TRIAC	C918.1	[A]
2.	Simulation of AC to DC single phase half and fully controlled converter for R,RL,RLE loads.	C918.2	[AP]
3.	Simulation of AC to DC three phase half and fully controlled converter for R, RL,RLE loads.	C918.2	[AP]
4.	Implementation of Dual Converter Fed Drives	C918.2	[AP]
5.	Simulation of DC-DC Buck converter Fed DC motor Drives	C918.3	[A]
6.	Simulation of DC-DC Boost converter Fed DC motor Drives	C918.3	[A]
7.	Simulation of DC-DC Buck-Boost converter Fed DC motor Drives	C918.3	[A]
8.	Implementation of six step inverter fed BLDC motor	C918.4	[AP]
9.	Implementation of speed control of Synchronous Drive	C918.5	[AP]
10.	Implementation of SVPWM for Inverter Fed Induction Motor Drive	C918.6	[AP]
		Total Hours	**15**

Text Books:	
1.	Rashid M.H., “Power Electronics Circuits, Devices and Applications”, Prentice Hall India, 3rd Edition, New Delhi, 2014.
2.	Randall Shaffer., “Fundamentals of Power Electronics with MATLAB”, Firewall Media, India, 2010.
3.	Dr. Shailendra Jain “Modelling and Simulation using MATLAB Simulink”, Wiley, 2nd Edition, 2015.
4.	Viktor M. Perelmuter, “Electrotechnical Systems Simulation with Simulink ” and Sim Power Systems T M”, CRC Press, Taylor & Francis Group,2013.
Reference Books:	
1.	Ned Mohan, Tore M. Undeland, William P. Robbins, “Power Electronics Converters, Applications and Design”, 3rd Edition, John Wiley & Sons, 2009.
2.	Haitham Abu-Rub., Etal., “High Performance Control of AC Drives with Matlab / Simulink Models”, Wiley Publications,2012.
3.	M.B. Patil, V. Ramanarayanan, V.T. Ranganathan. Patil, Mahesh B, “Simulation of power electronic circuits”, Oxford, U.K. Alpha Science International, 2009.
Web References:	
1.	http://nptel.ac.in/downloads/108105066/
2.	https://www.coursera.org/specializations/power-electronics
3.	https://www.mathworks.com/academia/courseware.html
4.	https://www.mathworks.com/support/books/book54209.html?category=1
5.	https://www.electronicshub.org/matlab-projects-for-engineering-students/
6.	https://www.learnfly.com/matlab-for-power-electronics-simulation-analysis

Summative assessment based on Continuous and End Semester Examination					
Bloom’s Level	**Continuous Assessment**				**End Semester Examination (Theory) [50 marks]**
	Theory			**Rubrics Based Practical Assessment [20 Marks]**	
	CIA-I [10 Marks]	**CIA-II [10 Marks]**	**CIA-III [10 Marks]**		
Remember	20	-	10	-	10
Understand	50	40	20	20	20
Apply	-	20	40	20	40

Analyse	30	40	30	60	30
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**50**	**50**	**100**

Course Articulation Matrix (Theory)															
No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
C918.1	2	1			2							1	3	2	
C918.2	3	3	2	2	3				2	2		2	3	3	
C918.3	3	2	1	1	3							2	3	3	
C918.4	3	3	2	2	3				2	2		2	3	3	
C918.5	3	2	1	1	3							2	3	3	
C918.6	3	3	2	2	3				2	2		2	3	3	
1	**Reasonably Agreed**			**2**		**Moderately Agreed**					**3**	**Strongly Agreed**			
Course Articulation Matrix (Laboratory)															
No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
C918.1	2	1			2							1	3	2	
C918.2	3	3	2	2	3				2	2		2	3	3	
C918.3	3	2	1	1	3							2	3	3	
C918.4	3	3	2	2	3				2	2		2	3	3	
C918.5	3	2	1	1	3							2	3	3	
C918.6	3	3	2	2	3				2	2		2	3	3	
1	**Reasonably Agreed**			**2**		**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE919	Electric Drives and Control	2/0/2/3
Nature of Course	E (Theory Skill Based)	
Course Pre-requisites	Electrical Machines – I & II, Power Electronics	

Course Objectives:

1	To understand the basic concepts and various control techniques involved with DC and AC Drives.
2	To study and analyze the operation of the converter / chopper fed DC drive and to solve simple problems.
3	To study and understand the operation of both classical and modern induction motor drives and synchronous motor drives.

Course Outcomes:
Upon completion of the course, students shall have ability to

C919.1	Infer the basic concepts and application of drive system.	[U]
C919.2	Analyse the characteristics and control of DC motors drives.	[A]
C919.3	Correlate characteristics and control of induction motor drives.	[A]
C919.4	Discriminate the characteristics and control of synchronous motor drives.	[A]
C919.5	Construct digital control techniques in AC and DC drives.	[AP]

Course Contents:

Module 1: Introduction to Electrical Drives and DC Motor Drives **12 Hrs**

Introduction - Choice of Electric Drives and Losses, Torque equation, Mathematical condition for steady state stability, speed-torque convention and multi-quadrant operation. Control of Electrical Drives: Modes of operation, speed control and drive classifications, closed loop control of drives, Speed control of DC motors - Single phase fully controlled and half controlled rectifiers - Chopper controlled DC drive, Design of controllers: current and Speed controller.

Module 2: Induction Motor and Synchronous Motor Drives **12 Hrs**

Types of Braking and plugging, Stator voltage control - Slip-power recovery drives, Control of AC drives: v/f control, constant slip-speed control and constant air-gap flux control, Basics of voltage/current fed inverters, Block diagram of closed loop drive, Vector Control Synchronous Motor Drive: Open loop volts/hertz control and self - Control of synchronous motor - Marginal angle control and power factor control, Permanent magnet synchronous motor. Applications of Vector control in induction motor, Variable frequency drives (VFDs) and Adjustable Speed Drives (ASDs) in Industries.

Module 3: Digital Control and Drive Applications **06 Hrs**

Digital techniques in speed control - Advantages and limitations, Microprocessor / Microcontroller, PLC based control of drives and SCADA for drives, networking of drives - Selection of drives and control schemes for Steel rolling mills, Paper mills, Cement mills, Machine tools, Lifts and Cranes, Solar and battery powered drives, Simulation of DC and AC drives.

Total Hours	**30**

Course Outcomes: (Laboratory)
Upon completion of the course, students shall have ability to

C919.1	Analyse the speed control of DC drives with their performance.	[A]
C919.2	Analyse the speed control of AC drives with their performance.	[A]
C919.3	Implementation of motor control with advanced controllers.	[AP]
C919.4	Analyse the motor performance with suitable simulation tool.	[A]

Lab Component

S. No.	List of Experiments	CO Mapping	BT
1.	Analyze the Speed control of DC motor using three phase rectifier	C919.1	[A]
2.	Analyze the Speed control of DC motor using dual converter	C919.1	[A]
3.	Analyze the Speed control of three phase induction motor using	C919.2	[A]

	PWM inverter		
4.	Analyze the Speed control of chopper fed DC motor	C919.1	[A]
5.	Implementation of FPGA based motor control	C919.3	[A]
6.	Implementation of DSP based motor control	C919.3	[A]
7.	Simulation of closed loop control of chopper fed DC motor.	C919.4	[AP]
8.	Simulation of three-phase synchronous motor drive.	C919.4	[AP]
9.	Implementation of PLC based drives.	C919.4	[A]
10.	Virtual lab/ Simulation – Closed loop control of DC and AC Drives	C919.4	[A]
		Total Hours	**30**

Text Books:	
1.	R. Krishnan, "Electric Motor and Drives: Modeling, Analysis and Control", Prentice Hall of India,New Delhi, 2017.
2.	Gopal.K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi,2018.
3.	P.C.Sen, "Principles of Electric Machines and Power Electronics", Wiley, 2018.
4.	Mohammed Fazlur Rahman, Sanjeet K. Dwivedi, "Modeling, Simulation and Control of Electrical Drives", IET, 2019.
Reference Books:	
1.	Bimal K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, 2015.
2.	S.K. Pillai, "A First Course on Electrical Drives", Wiley Eastern Limited, 2015.
3.	Vedam Subramanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill Ltd, New Delhi, 2014.
4.	Shaahin Filizadeh, "Electric Machines and Drives: Principles, Control, Modeling, and Simulation", CRC Press LLC, New York, 2013.
Web References:	
1.	https://www.coursera.org/learn/electronics /
2.	https://nptel.ac.in/courses/108108077/
3.	https://nptel.ac.in/courses/108104140
4.	https://nptel.ac.in/courses/108104011

Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [50 marks]**
	Theory			**Rubrics Based Practical Assessment [20 Marks]**	
	CIA-I [10 Marks]	**CIA-II [10 Marks]**	**CIA-III [10 Marks]**		
Remember	-	-	-	-	-
Understand	60	40	40	60	40
Apply	-	20	40	20	20
Analyse	40	40	20	20	40
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
0	**50**	**50**	**100**

Course Articulation Matrix (Theory)															
No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C919.1	2	1											1	2	2
C919.2	1													1	1
C919.3	2	1											1	2	2
C919.4	2	1			2								1	2	2
C919.5	3	2	1		3								2	3	3
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

Course Articulation Matrix (Laboratory)															
No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C919.1	2	1	1		3				2	2			1	3	1
C919.2	2	1	1		3				2	2			1	3	1
C919.3	2	1	1		3				2	2			1	3	1
C919.4	2	1	1		3				2	2			1	3	1
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE920	Line-Commutated and Active PWM Rectifiers	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Power Electronics	

Course Objectives:

1	To analyze the performance of controlled rectifier with passive filters.
2	To acquire the knowledge about multi-phase voltage generation for converters.
3	To assess the performance of AC / DC single switch and bidirectional boost converter.
4	To analyze the performance of isolated single-phase AC/DC fly back converters.

Course Outcomes:

Upon completion of the course, students shall have ability to

C920.1	Analyze the performance of controlled rectifiers with different passive filter configuration.	[A]
C920.2	Interpret the concept of generation of multiphase voltage generation for converter.	[U]
C920.3	Examine the basic concept of single switch AC/DC boost Converter.	[A]
C920.4	Appraise AC/DC bidirectional boost converter in steady state and at different power factors.	[E]
C920.5	Analyze the performance of isolated single-phase AC/DC fly back Converter.	[A]

Course Contents:

Module 1: Thyristor rectifiers with passive filtering **15 Hrs**

Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L, C and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current wave shape. Multi-Pulse converter: Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, Commutation overlap, notches during commutation.

Module 2: Single-phase AC-DC single-switch Bidirectional boost converter **18 Hrs**

Power circuit of single-switch AC-DC converter - steady state analysis, unity power factor operation, closed-loop control structure. AC-DC bidirectional boost converter**:** Power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure, voltage doubler mechanism. Bridge Boost Converter Topologies - Applications

Module 3: Isolated single-phase AC-DC fly back converter **12 Hrs**

Power circuit of AC-DC fly back converter - Steady state analysis, unity power factor operation, closed loop control structure. Single-phase single-stage AC-DC stacked fly back converter, Fly back converter with energy regenerative snubber, Multi-output fly back converter - Principle and Application.

Total Hours	**45**

Text Books:

1	Muhammad H.Rashid, Power Electronics Handbook,4th edition, Elsevier, 2018.
2	R. W. Erickson and D. Maksimovic, Fundamentals of Power Electronics, Springer Science & Business Media, 2013.
3	Ned Mohan, Tore M.Undeland, William P. Robbins, Power Electronics, 3rd edition (An Indian Adaption, Converter, Application and Design) , Wiley Editorial Team, 2022.

Reference Books:	
1	L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.
2	Keng Chih Wu, Pulse Width Modulated DC-DC Converters, 3rd edition, Springer Science Business Media, 2012.
3	J.G. Kassakian, M.F.Schlecht and G.C.Verghese,“Principles of Power Electronics”, Addison – Wesley Publication, 2010.
Web References:	
1	https://nptel.ac.in/syllabus/108999902/
2	https://archive.nptel.ac.in/courses/108/102/108102145/
3	https://nptel.ac.in/courses/108108036
4	https://nptel.ac.in/courses/108107128

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C920.1	Analyze	Online Quiz Writing Skills Class Presentation Group Assignment	**20**
C920.2	Understand		
C920.3	Analyze		
C920.4	Evaluate		
C920.5	Analyze		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	10	20
Understand	20	20	10	20
Apply	-	-	-	-
Analyze	60	60	40	40
Evaluate	-	-	40	20
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C920.1	3	3	2	2									3	2	
C920.2	3	3	2	2									3	2	
C920.3	3	3	3	3						2			3	2	
C920.4	3	3	3	3									3	2	
C920.5	3	3	2	2						2			3	2	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE921	Electric and Hybrid Vehicles	3/0/0/3
Nature of Course	C (Theory Concept)	
Course Pre-requisites	Electrical Machines, Power Electronics	

Course Objectives:

1	To study about the working of electric vehicles.
2	To understand the configuration of hybrid vehicles.
3	To impart the knowledge on energy storage device.
4	To learn electric vehicle drive systems.

Course Outcomes:
Upon completion of the course, students shall have ability to

C921.1	Describe the basic fundamentals, working principles of Electric Vehicles and types of engines.	[U]
C921.2	Analyze the transmission characteristics and mathematical models of Electric Vehicles.	[A]
C921.3	Analyze the configuration and control methods of Electric Propulsion unit.	[A]
C921.4	Enumerate the Energy Storage Requirements in Hybrid and Electric Vehicles.	[U]
C921.5	Apply the energy management strategies to hybrid and electric vehicles.	[AP]

Course Contents:

Module 1: Hybrid Electric Vehicles **15 Hrs**

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. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. Stratified charge engines, Learn burn engines, Low heat rejection engines.

Module 2: Hybrid Electric Drive-Trains and Electric propulsion unit **15 Hrs**

Electric Drive-trains: Introduction to various electric drive-train topologies, power flow control in electric drive-train topologies. Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drive and Induction Motor drive. Autonomous driving system.

Module 3: Energy Storage and Sizing the drive system **15 Hrs**

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery and Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices. Sizing of 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. Design of a Battery Electric Vehicle (BEV).

Total Hours	**45**

Text Books:

1	Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2018.
2	T. Denton, “Electric and Hybrid Vehicles”, Second Edition , Routledge, 2020.
3	M. Ehsani, Y. Gao and A. Emadi, ‘Modern electric, hybrid electric and fuel cell vehicles: Fundamentals,Theory and design’,3rd edition, CRC press, 2018.

Reference Books:	
1	C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications withPractical Perspectives”, John Wiley & Sons, 2017.
2	S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”,Springer, 2015.
3	K. T. Chau, ‘Electric vehicle machines and drives: Design, analysis and application’, first edition, John Willey and Sons Singapore pvt. ltd., 2015.
Web References:	
1	https://nptel.ac.in/syllabus/108103009/
2	http://web.mit.edu/evt/links.html
3	http://www.chalmers.se/SiteCollectionDocuments/Energi%20och%20milj%C3%B6/Elteknk/EmmaGrunditz_PhDthesis_lowrez
4	https://www.hyundai.com/in/en/find-a-car/kona electric/highlights.html
5	https://tech.hyundaimotorgroup.com/tag/futuretechnology/?gclid=EAIaIQobChMImdOHi6T06AIViH0rCh2V4w5PEAAYASAAEgI90_D_BwE
6	https://afdc.energy.gov/files/pdfs/hev_ev_ghgreductions.pdf&ved=2ahUKEwi_tv-KpPToAhV06nMBHdeSAcQFjAAegQIBBAB&usg=AOvVaw2KfAnH97Y4gTmkGP5xJQWN
7	http://support.skillscommons.org/showcases/open-courseware/energy/e-vehicle-tech-cert/
8	https://www.edu.autobotindia.com

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C921.1	Understand	Online Quiz Class Presentation Assignment	**20**
C921.2	Analyze		
C921.3	Analyze		
C921.4	Understand		
C921.5	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	[10 marks]	CIA-III [10 marks]	
Remember	20	20	20	20
Understand	70	30	30	30
Apply	-	30	30	30
Analyze	10	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C921.1	2	1											2	3	
C921.2	2	1											2	3	
C921.3	3	3	1	1										3	
C921.4	3	3	2	2					2				2	3	
C921.5	3	2	2	2					2	2				3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

OPEN ELECTIVES

20EE001	Power Generation Systems	3/0/0/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	Nil	

Course Objectives:

1	To compare the working of different types of Conventional Power Plants.
2	To interpret in detail about the necessity and importance of Combined Operation of PowerPlants.
3	To understand the Power Generation Techniques using different non-conventional energysources and Major Electrical Equipment in Power Plants.

Course Outcomes:
Upon completion of the course, students shall have ability to

C001.1	Interpret the working of thermal and Hydro Power Plant and analyze various techniques for Pollution Control in Steam Power Plant.	[AP]
C001.2	Illustrate the operation and subsystems of Nuclear and Gas Turbine Power Plant.	[U]
C001.3	Compare the various aspects of different Conventional Power Generation Methods and discuss its merits and Demerits	[A]
C001.4	Model New Combined Power Generation Cycle Options	[AP]
C001.5	Discuss the Power Generation using renewable energy and their energy scenarios.	[U]

Course Contents:

Module 1: Thermal and Hydropower Plants **15 Hrs**

Layout of modern coal power plant- Operational Circuits of Thermal Power Plant, Selection of site, Pollution Control Techniques, Steam Turbines, Control and auxiliaries, Binary cycles. Hydro Electric power Plants - Typical layout and components, Classification, Selection of site, Water Turbines, Pumped Storage Plants. Case studies on thermal and hydro power plants.

Module 2: Nuclear and Gas Turbine Power Plants **15 Hrs**

Layout and subsystems of nuclear power plants, Types of reactors, Selection of site, Safety waste disposal for nuclear power plants, Case study on nuclear power plant, Layout of Gas turbine power plant, Types of Gas Turbine Power Plant, Combined Operation of Different power plants - Integrated Gasifier based Combined Cycle(IGCC) systems, Hydro Electric Plant in combination with Steam Plant, Pumped Storage Plant with Nuclear Power Plant.

Module 3: Renewable Energy Sources **15 Hrs**

Construction and working of Wind, Tidal, solar PV and Solar thermal, Geothermal, Biogas and Fuel cell systems. Major Electrical equipment in power plants - Switchgear, Control room, Substations - Classifications.

Total Hours	**45**

Text Books:

1	Rai,G.D,"Non-Conventional Energy Sources", Khanna Publishers,2011.
2	El Wakil M.M., "Power Plant Technology", Tata McGrawHill,2013.
3	R.K.Hegde.,"Power Plant Engineering", Pearson Publisher Limited Ltd.,2015.

Reference Books:

1	PC Sharma, "Power Plant Engineering „", S.K.Kataria and Sons, New Delhi,2013.
2	Deshpande.M.V, "Elements of Electrical Power Station Design", PHI Learning Pvt Ltd, 2018.
3	Wadhwa.C.L," Generation, Distribution and Utilization of Electrical Energy", Wiley Eastern Limited,3rd Edition, 2011.

Web References:	
1	https://nptel.ac.in/courses/108105058/8
2	http://indianpowersector.com/home/power-station/thermal-power-plant/
3	www.altenergy.org/renewables/renewables.html
4	https://www.energy.gov/fe/how-gas-turbine-power-plants-work

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C001.1	Apply	Case Studies Quiz Group Discussion Class Presentation Class Presentation/Powerpoint Presentation	**20**
C001.2	Understand		
C001.3	Analyze		
C001.4	Apply		
C001.5	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	30	50	30
Analyze	-	20	-	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C001.1		3											3		
C001.2	2	1				3		2					3		3
C001.3	2	1					3	2					3		3
C001.4	2	1					3	2					3		3
C001.5	1														
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE002	Autonomous Vehicle	3/0/0/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	Measuring Instruments and Smart Sensors	

Course Objectives:

1	To introduce the concepts of mobile and satellite communications.
2	To realize the effect of noise on communication systems.
3	To introduce different methods of analog and digital communication and their significance.

Course Outcomes:

Upon completion of the course, students shall have ability to

C002.1	Understand the fundamental theory of operation of electronic control systems	[U]
C002.2	Understand the basics of how automotive ECUs function in conjunction with the vehicle data bus networks and sensors	[U]
C002.3	Understand the concept of remote sensing and the types of sensor technology needed to implement remote sensing.	[U]
C002.4	Understand the basic concepts of wireless communications and wireless data networks	[U]
C002.5	Analyze the various types of advanced driver assistance systems and issues.	[A]

Course Contents:

Module 1: Connected and Autonomous Vehicle Technology **15 Hrs**

Basic Control System Theory applied to Automobiles - Overview of the Operation of ECU - Basic Cyber-Physical System Theory and Autonomous Vehicles - Role of Surroundings Sensing Systems and Autonomy.

Module 2: Sensor Technology for Advanced Driver Assistance Systems **15 Hrs**

Basics of Radar Technology and Systems - Ultrasonic Sonar Systems - Lidar Sensor Technology and Systems - Camera Technology - Night Vision Technology - Use of Sensor Data Fusion.

Module 3: Advanced Driver Assistance System Technology **15 Hrs**

Basics of Theory of Operation - Integration of ADAS Technology into Vehicle Electronics - Role of Sensor Data Fusion - Driverless Car Technology - Moral, Legal, Roadblock Issues - Technical Issues -Security Issues.

TotalHours	**45**

Text Books:

1	G. Mullett, Wireless Telecommunications Systems and Networks, Thomson Delmar Learning, ISNB#1-4018-8659-0,2006.
2	G. Mullett, Basic Telecommunications : The Physical Layer, Thomson – Delmar Learning, ISBN#1-4018-4339-5, 2003

Reference Books:

1	Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot, “Creating Autonomous Vehicle Systems” Morgan & Claypool Publishers, 2020.

Web References:

1	https://freevideolectures.com/course/4278/nptel-advanced-iot-applications/19
2	https://www.coursera.org/specializations/self-driving-cars

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model(Max.Marks:20)			
Course Outcome	**Bloom'sLevel**	**AssessmentComponent**	**Marks**
C002.1	Understand	Quiz Class Presentation Group Assignment	**20**
C002.2	Analyze		
C002.3	Understand		
C002.4	Analyze		
C002.5	Apply		

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	
Remember	20	20	20	20
Understand	70	30	30	30
Apply	-	30	30	30
Analyze	10	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
20	**30**	**50**	**100**

No. of the CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
C002.1	2	1											2	3	
C002.2	2	1											2	3	
C002.3	3	3	2	2										3	
C002.4	3	3	2	2					2				2	3	
C002.5	3	2	1	1					2	2				3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE003	Industrial Safety Management	3/0/0/3
Nature of Course	C (Theory Concept)	
Course Pre-requisites	Nil	

Course Objectives:

1	To equip with knowledge of basic maintenance of industrial electrical systems in a safe and environmentally sound manner
2	To imbibe knowledge on protection systems.
3	To study about protective devices to protect from electrical hazards.
4	To know about the automation in electrical systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C003.1	Illustrate the extreme importance of observing all safety requirements and practices connected with electricity	[R]
C003.2	Summarize about various electrical hazards and demonstrate what to do during an electrical accident.	[U]
C003.3	Analyze various protection methods for hazardous electrical equipment.	[A]
C003.4	Enumerate various components of industrial electrical systems.	[U]
C003.5	Paraphrase the role of automation in electrical systems.	[U]

Course Contents:

Module 1: Concepts and Statutory Requirements **12 Hrs**

Working principles of electrical equipment - Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety – first aid - cardio pulmonary resuscitation (CPR).

Module 2: Electrical Hazards **15 Hrs**

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity, Safety in handling of war equipment, hazardous conditions, control, electrical causes of fire and explosion.

Module 3: Protection Systems **18 Hrs**

Protection components- Fuse, MCB, MCCB, ELCB -Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipment**.** Industrial Electrical Systems**-** DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks. Industrial Electrical System Automation**-** Study of basic PLC, Role of PLC in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Total Hours	**45**

Text Books:

1	Mary Capelli-Schellpfeffer , Dennis Neitzel, John Cadick, Al Winfield “Electrical Safety Handbook”, McGraw-Hill Education,4th Edition,2012.
2	Hemant Joshi ,” Residential, Commercial and Industrial Electrical Systems: Equipment and Selection, McGraw Hill Education,2008
3	S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.

Reference Books:	
1	Power Engineers – Handbook of TNEB, Sixth Edition, Chennai, 2002.
2	Indian Electricity Act and Rules, Government of India, The Electricity Act, 2003.
3	Martin Glov Electrostatic Hazards in powder handling, Research Studies Pvt. LTd., England, 2003.
Web References:	
1	www.osha.gov https://library.e.abb.com
2	www.osha.gov https://library.e.abb.com

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C003.1	Remember	Assignment Technical Quiz Class Presentation	**20**
C003.2	Understand		
C003.3	Analyze		
C003.4	Understand		
C003.5	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	30	10	10	10
Understand	30	20	40	40
Apply	60	20	20	20
Analyze	-	50	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C003.1	3	3	2	2									3	2	
C003.2	3	3	2	2									3	2	
C003.3	3	3	3	3						2			3	2	
C003.4	3	3	3	3									3	2	
C003.5	3	3	2	2						2			3	2	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE004	Renewable Energy Sources	3/0/0/3
Nature of Course	D (Theory Application)	
Pre Requisites	Nil	

Course Objectives:

1	To study different non- conventional energy systems and its applications.
2	To enhance student's knowledge and assimilate new technologies.
3	To learn techno-economical storage methods of renewable energy systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C004.1	Enumerate the need of renewable energy and Analyze the concept of Kyoto protocol, energy scenario in India and Integrated Resource Plan	[A]
C004.2	Assess the role of Solar and wind energy in power plants	[U]
C004.3	Apply the ideas of renewable energy sources to perform case studies	[AP]
C004.4	Assess the role of biomass, tidal and geothermal in power plants	[A]
C004.5	Illustrate the operation and importance of different energy storage methods	[U]
C004.6	Investigate the integration of renewable energy systems in Power plants	[AP]

Course Contents:

Module1: Introduction **15 Hrs**

Importance and types of renewable sources of energy, Limitations of RE sources, PresentIndian and international energy scenario of conventional and renewable energy sources, Kyoto protocol, concept of clean development mechanism and prototype carbon funds, Integratedresource plan.

Module2: Wind Energy and Solar Energy **15 Hrs**

in the Wind, Types of Wind Power Plants (WPPs) - Components of WPPs - Working ofWPPs - Site selection of WPPs, Solar Power, Solar thermal, Solar photovoltaic - Module, panelland array - series and parallel connections. Maximum PowerPoint Tracking, Applications. Casestudies on solar PV system, wind energy system.

Module3: Other Energy Sources and Storage Methods **15 Hrs**

Methods to generate - Biomass energy, tidal energy, geothermal energy and Fuel cell, applications, Storage methods of mechanical, chemical, electromagnetic, electrostatic and thermal energy - Selection and significance of Batteries - Hybrid energy systems and hybrid electric vehicles.

Total Hours	**45**

Text Books:

1	JohnT widwell and Tony Weir,“ Renewable Energy Resources”,4th Edition,Routledge,2021.
2	B.H.Khan, “Non-Conventional Energy Resources”,3rd Edition, Tata McGraw Hill, New Delhi,2017.
3	G D Rai, „Non-conventional Energy sources“, Khanna Publishers, 5th Edition, 2014.

Reference Books:

1	G.N.Tiwari, “Solar Energy”, Tata McGraw Hill Publishing Company Ltd.,NewDelhi, 2009.
2	Aldo Vieira Da Rosa, “Fundamentals of Renewable Energy Processes”, Academia Press, 2012.
3	G.Masters, “Renewable and Efficient Electric Power Systems”, IEEE-Wiley Publishers,2013.

Web References:

1	http://unfccc.int/kyoto_protocol/items/2830.php
2	https://www.coursera.org/learn/wind-energy
3	https://www.edx.org/course/solar-energy-delftx-et3034x-0

4	http://unfccc.int/kyoto_protocol/items/2830.php

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C004.1	Understand	Online Quiz Writing Skills Class Presentation Group Assignment	**20**
C004.2	Analyze		
C004.3	Apply		
C004.4	Analyze		
C004.5	Understand		
C004.6	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	10			5
Understand	60	10	10	15
Apply	-	40	50	30
Analyze	30	50	40	50
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C004.1	2	1				2	2	2				1			1
C004.2	3	3	2			2	3	1				3	1	2	2
C004.3	3	3	2	1		2	3	1		1		3	1	2	1
C004.4	3	3	2			2	3	1				3	1	2	1
C004.5	2	1				2	3	1				3	1	1	1
C004.6	3	3	2	2		2	3	2		1		3	1	2	2
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE005	Servo and Robot Drives	3/0/0/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	Nil	

Course Objectives:

1	To impart the knowledge of servo motors drives and power transmission.
2	To understand the concepts sensors and vision systems.
3	To understand the concepts of robots in various industries for automation

Course Outcomes:

Upon completion of the course, students shall have ability to

C005.1	Interpret the basic laws and concepts of robots.	[U]
C005.2	Explain the classification of robots and degrees of freedom ofserial and parallel manipulators	[U]
C005.3	Analyze the sensor systems to the robotic system.	[A]
C005.4	Analyze the power transmission systems in the robotic system.	[A]
C005.5	Apply the Robots in Manufacturing and Processing Industries.	[AP]

Course Contents:

Module 1: Introduction to Fundamental Concepts of Robotics **15 Hrs**

History, Present status and future trends in Robotics and automation - Laws of Robotics- Robot definitions - Robotics systems and robot anatomy - Structure of a Robot, Classification of Robots: Cartesian, Cylindrical, Spherical, Articulated, SCARA - Specification of Robots - Degrees of Freedom of Serial and Parallel Manipulators- resolution, repeatability and accuracy of a manipulator.

Module 2: Sensors and Vision Systems **15 Hrs**

Principle of operation, types and selection of position and velocity sensors, Potentiometers, Encoders, Resolvers, LVDT, Tacho-generators, Internal and External State Sensors, Proximity sensors. Limit Switches-Tactile sensors -Touch sensors -Force and torque sensors, Robot End Effectors. Vision Systems. Vision Systems for Robotics: Robot vision systems, Image capture-Solid State Cameras-Image Representation-Grey scale and colour images, image sampling and quantization - Image processing and analysis - Image data reduction Segmentation - Feature extraction — Object Recognition.

Module 3: Motors Drives and Factory Automation **15 Hrs**

Types Constructional features — Principle of operation- Feedback system - Robot drive mechanisms, hydraulic-electric servomotor- stepper motor - pneumatic drives. Control of Electrical Drives: Introduction-Parts of Electrical Drives- Fundamental Torque Equations- Speed Torque Conventions and Multi - quadrant Operation-Nature and Classification of Load Torques - Modes of Operation-Closed - Loop Control of Drives. Factory Automation: Flexible Manufacturing Systems concept - Automatic feeding lines, transfer lines, automatic inspection - Computer Integrated Manufacture-CNC, intelligent automation HMI Systems, DCS and SCADA, Wireless controls.

Total Hours	**45**

Text Books:

1	Deh SR., "Robotics Technology and Flexible Automation", Tata Mc Graw Hill Publishing, CompanyLtd.,2nd edition, 2017.
2	Mikel IP Grooveret.al.," Industrial Robots- Technology, Programming and Applications", Mc Graw Hill, NewYork, 2017.
3	Saeed B Niku,"Introduction to Robotics Analysis, Systems, Applications", PHI Pvt Ltd, NewDelhi,2016.

4	Peter Corke, “Robotics,Vision and Control: Fundamental Algorithms In MATLAB” first Edition 2011.
Reference Books:	
1	SK Saha-Introduction to Robotics, Tata Mcgraw Hill, 2010
2	Mittal RK, Nagrath IJ, „“Robotics and Control, Tata McGrawHill, 2010
3	Richard D Klafter, Thomas A Chmielewski, Michael Negin,“Robotics Engineering – An Integrated Approach”, Eastern Economy, Prentice Hall of India Pvt Ltd.,2010.
Web References:	
1	https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/
2	https://www.edx.org/course/robotics-columbiax-csmm-103x
3	https://www.futurelearn.com/courses/begin-robotics

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C005.1	Understand	Quiz Technical Presentation Group discussion Case Study Simulation	**20**
C005.2	Understand		
C005.3	Analyze		
C005.4	Analyze		
C005.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	40	20	20	20
Understand	60	60	40	40
Apply	-	20	20	20
Analyze	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C005.1	2	1			2								3		
C005.2	2	1					1						2		
C005.3	3	3	2	2			1						3	1	
C005.4	3	3	2	2									3		
C005.5	3	2	1	1	2								3	1	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE006	Special Purpose Machines	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Nil	

Course Objectives:

1	To learn the working operation and performance characteristics of Stepping and Switched reluctance motors.
2	To realize the constructional features of Synchronous reluctance motor.
3	To impart knowledge on the performance of Permanent Magnet Brushless DC and Permanent Magnet Synchronous motors.
4	To know about the control strategies of Servo motor.

Course Outcomes:

Upon completion of the course, students shall have ability to

C006.1	Enumerate the principle of operation and performance of Stepper motors	[U]
C006.2	Apply the principle of operation and performance of Switched Reluctance and Servomotors	[AP]
C006.3	Analyze the construction and operation of Permanent Magnet Brushless DC motor	[A]
C006.4	Illustrate the construction and operation of Permanent Magnet Synchronous Motors.	[U]
C006.5	Analyze the characteristics and select special motors for specific applications	[A]

Course Contents:

Module 1: Stepping Motors and Switched Reluctance Motor **15 Hrs**

Stepper motor: Constructional features, Principle of operation, Special features of stepper motors, Variable reluctance, Permanent magnet stepping motor, Torque versus stepping rate characteristics - Linear actuators with Stepper Motors. Application aspects related to textile industries and integrated circuit fabrications. Switched Reluctance Motor: Constructional features, Principle of operation, Torque equation, Characteristics, Control Techniques and Drive Concept.

Module 2: Permanent Magnet DC and Synchronous Motor **15 Hrs**

Brushless DC. Motors - Commutation in DC motors, Difference between mechanical and electronic commutators, Torque and EMF equation, Rotor position sensors, Multiphase Brushless DC motor, Square wave permanent magnet brushless DC motor drives and their torque-speed characteristics. Application aspect related to vehicle and house hold-Permanent Magnet Synchronous Motor - Principle of operation, EMF, Power input and torque expressions, phasor diagram, Power Controllers, Torque speed characteristics.

Module 3: Servomotor **15 Hrs**

Servomotor - Constructional features, Principle of Operation, Types, Characteristics, Control strategies. Applications of servomotor requiring precise position control - AC Tachometer Operating principle and its schematic diagram, Case study-Selection of motors for hydraulic and Pneumatic systems - Gear, Piston and Vane motors.

Total Hours	**45**

Text Books:

1	Berker Bilgin, James Weisheng Jiang, Ali Emadi "Switched Reluctance Motor Drives: Fundamentals to Applications" CRC press, 2018
2	R.Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives" T&F India, 2016
3	Dr.Duanek Hanselman,"Brushless Motors: Magnetic Design, Performance, and Control of Brushless DC and Permanent Magnet Synchronous Motors" E-Man Press LLC,2012

Reference Books:

1	Ahmed Tahor, Abdel Ghani Aissabui "Switched Reluctance Motor Concept, Control and Applications",InTech Open,2017

2	Riazollah Firoozian “Servo Motors and Industrial Control Theory“ Springer International Publishing AG;2nd edition.2014
3	V.V. Athani, ”Stepper Motors: Fundamentals, Applications and Design” New Age publisher,2nd edition,2014
Web References:	
1	https://www.elprocus.com/stepper-motor-types-advantages-applications/
2	https://electrical-engineering-portal.com/characteristics-and-work-principles-of-switched-reluctance-sr-motor
3	http://machineryequipmentonline.com/hydraulics-and-pneumatics/applications-on-pneumatic air-motors/
4	https://www.site.uottawa.ca/~rhabash/ELG2331SPM.pdf

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C006.1	Understand	Case Study Assignment Technical Quiz Class Presentation	**20**
C006.2	Apply		
C006.3	Analyse		
C006.4	Understand		
C006.5	Analyse		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	50	-	20	40
Understand	50	50	40	40
Apply		50	20	20
Analyze	-	-	20	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C006.1	2	1			2										
C006.2	3	2	1	1	3								3	2	
C006.3	2	1			2										
C006.4	3	3	2	2	3								3	2	
C006.5	2	1			2										

1	Reasonably Agreed	2	Moderately Agreed	3	Strongly Agreed

EMERGING ELECTIVES

20EE007	Machine Learning Applications in Energy Systems	3/0/0/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	Power System Analysis, Python Programming	

Course Objectives:

1	Understand the concept of Machine Learning (ML).
2	Recognize the applications in Renewable energy sources.
3	To investigate the effectiveness of ML in power systems.
4	To Study about load forecasting and fault detection in power system using ML topics.
5	To accomplish the approach of machine learning based Artificial Neural Network (ANN) and Genetic Algorithm (GA) in power system.

Course Outcomes:

Upon completion of the course, students shall have ability to

C007.1	Perceive knowledge about Machine learning concepts and its classifications.	[U]
C007.2	Analyze load forecasting and fault detection in power system using Machine Learning concepts.	[A]
C007.3	Analyze the concepts of machine learning in Renewable energy generation and monitoring.	[A]
C007.5	Understand the concept of GA and ANN in power system.	[U]
C007.4	Demonstrate Machine learning applications in smart grid.	[AP]

Course Contents:

Module 1: Introduction **12 Hrs**

Introduction to Machine learning - History and early works - Theoretical aspects of ML - Different types of Machine Learning algorithms - Linear regression, Logistic regression, K - Nearest Neighbour, Artificial Neural Networks, Random Forest, and Support Vector.

Module 2: Machine learning in Power Systems **17 Hrs**

Operation and control problems of load forecasting - Renewable energy forecasting - Load flow studies - Economic load dispatch, Unit commitment, power plant monitoring, fault identification and security assessment - Unconstrained and constrained optimization using Genetic Algorithm and NN in power system - Machine learning applications in smart grid.

Module 3: Machine learning in Renewable Energy Systems **16 Hrs**

Machine learning techniques for renewable energy generation - Machine learning applications in Forecasting renewable energy sources (Wind, Solar and Hydro power) - Determining plant location, size and configuration, Managing renewable energy integrated smart grid - Forecasting accuracy of algorithms - Battery Management Using Machine Learning. Case Study: Wind power forecasting based on daily mean wind speed and standard deviation.

Total Hours	**45**

Text Books:

1	Andrew Kelleher, Adam Kelleher, 'Machine Learning in Production- Developing & Optimizing Data Science Workflows and Applications, 1st Edition, Pearson publishers, 2020.
2	Saifullah Khalid, 'Applications of Artificial Intelligence in Electrical Engineering', 1st Edition, GI Global Knowledge publisher, 2020.
3	Rakesh Sehgal, Neeraj Gupta, Anuradha Tomar, Mukund Dutt Sharma and Vigna Kumaran, 'Smart Electrical and Mechanical Systems: An Application of Artificial Intelligence and Machine Learning' Elsevier Science, 2022.

Reference Books:	
1	Mohssen Mohammed, Muhammad Badruddin Khan, Eihab Bashier Mohammed Bashier ,"Machine Learning: Algorithms and Applications", CRC Press Taylor and Francis group, 1st edition, 2020
2	Morteza Nazari-Heris, Milad Sadat-Mohammadi, Houtan Jebelli, Moloud Abdar, Somayeh Asadi, Behnam Mohammadi-Ivatloo, 'Application of Machine Learning and Deep Learning Methods to Power System Problems' Springer International Publishing, 1st edition, 2021.
Web References:	
1	https://nptel.ac.in/courses/106105152
2	https://www.datarevenue.com/en-blog/machine-learning-for-energy-distribution
3	https://www.mdpi.com/journal/energies/special_issues/Machine_Learning_Optimization_Power_System

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C007.1	Understand	Technical Quiz Writing Skills Class Presentation Group Assignment	**20**
C007.2	Analyze		
C007.3	Analyze		
C007.4	Apply		
C007.5	Understand		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	10	20
Understand	40	20	30	20
Apply	20	-	40	20
Analyze	20	60	20	40
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C007.1	3	3	2	2									3	2	
C007.2	3	3	2	2									3	2	
C007.3	3	3	3	3						2			3	2	
C007.4	3	3	3	3									3	2	
C007.5	3	3	2	2						2			3	2	

1	Reasonably Agreed	2	Moderately Agreed	3	Strongly Agreed

20EE008	Big Data Analytics for Smart Grid	3/0/0/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	Power System Analysis, Python Programming	

Course Objectives:

1	To learn the infrastructure and technologies used in Smart Grid.
2	To realize the challenges in Power System and futuristic technologies for improving power system stability.
3	To impart knowledge on Intelligent data collection devices, Machine learning algorithms for Big Data Analytics.
4	To know about the Cloud and Edge Computing for Smart Grid Applications.

Course Outcomes:
Upon completion of the course, students shall have ability to

C008.1	Examine the Challenges and provide Solutions in Power Systems.	[A]
C008.2	Describe the necessity for Smart Grid, its structure, tools and technologies.	[U]
C008.3	Implement the Machine learning algorithms for Big Data Analytics.	[AP]
C008.4	Illustrate the Potential Applications of Big Data Analytics in Smart Grids.	[AP]
C008.5	Investigate the Edge and Cloud computing solutions for the Smart Grid.	[A]

Course Contents:

Module 1: Data Analysis and Data Science in Smart Grid **15 Hrs**

Basics of Smart Grid - Use of Satellite Communication in Modern Power System - Challenges and Solutions in Power Systems - Need for Big Data Analytics in Smart Grid - Role of PMU in Smart Grid - Emerging Trends and Big Data Analytics at Distribution level Grid - D PMUs: Design and Prototyping - Data Science Pertaining to field of Smart Grid - Smart Grid Use Cases - Analytics in Smart Grids Tools and Technologies for Smart Grid.

Module 2: Machine Learning Algorithms for Big Data Analytics **15 Hrs**

Introduction to machine learning - Logistic Regression - Support Vector Machine - Supervised and Unsupervised Learning - Artificial Neural Network and Models - Demonstration of NN implementation of Time Series of Data in the Google Colab using Python - Implementation of CNN of IMDB Data in Google Colab using Python

Module 3: Cloud and Edge Computing for SG Applications **15 Hrs**

Cloud computing and cloud Analytics - Cloud Analytics - Edge Computing for Smart Grid Applications - Application of CC and EC in the field of system optimization, fault detection, intelligent protection, load analysis and forecasting, security and data management.

Total Hours	**45**

Text Books:

1	Shady S. Refaat, Omar Ellabban, Sertac Bayhan, Haitham Abu-Rub, Frede Blaabjerg and Miroslav M. Begovic, “Smart Grid and Enabling Technologies”, Wiley,2021.
2	Bernd M. Buchholz, Zbigniew A. Styczynski “Smart Grids Fundamentals and Technologies in Electric Power Systems of the Future”, Springer Berlin Heidelberg, 2020.
3	Carol L. Stimmel, “Big Data Analytics Strategies for the Smart Grid”,CRC Press, Taylor and Francis,2016.

Reference Books:	
1	Chun Sing Lai, Loi Lei Lai, Qi Hong Lai, “Smart Grids and Big Data Analytics for Smart Cities”, Springer International Publishing, 2021.
2	Yi Wang, Qixin Chen, and Chongqing Kang ‘Smart Meter Data Analytics’, Springer Singapore, 2020.
3	Pethuru Raj, S. Koteeswaran, “Novel Practices and Trends in Grid and Cloud Computing”, IGI Global, 2019.
Web References:	
1	https://onlinecourses.swayam2.ac.in/arp19_ap60/preview
2	https://www.coursera.org/lecture/electric-utilities/5-2-smart-grid-YUPgW
3	https://online.stanford.edu/courses/xeiet137-smart-grid-sensing-data-analytics-and-control
4	https://link.springer.com/chapter/10.1007/978-981-15-0135-7_38

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C008.1	Analyse	Quiz Class Presentation Assignment Simulation Exercise Programming	**20**
C008.2	Understand		
C008.3	Apply		
C008.4	Apply		
C008.5	Analyse		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	20	30	30	30
Analyze	30	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C008.1	3	3	3	3	1	1	1						3		
C008.2	3	3	3	3	2	1	1	1				2	3	1	
C008.3	3	3	3	3	3				2			3		3	3
C008.4	3	3	3	3	3	1	1		2			3	1	3	3
C008.5	3	3	3	3	3	1	1		2			3	1	3	3
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE009	Advanced Processors	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Microcontrollers	

Course Objectives:

1	To understand the Arduino controller with interfacing applications.
2	To analyse the programming concepts of ARM processor and its interfaces.
3	To realise the microcomputer and its peripheral programming.

Course Outcomes:

Upon completion of the course, students shall have ability to

C009.1	Examine the features of Arduino controller.	[A]
C009.2	Apply the Arduino controller for various interfacing applications	[AP]
C009.3	Describe the concepts of embedded C programming.	[U]
C009.4	Develop advance programs using embedded C	[AP]
C009.5	Design the software and hardware structure of Raspberry Piand Jetson Nano.	[A]

Course Contents:

Module 1: Arduino Environment and programming **15 Hrs**

Arduino program - setup and loop functions, main interface of an Arduino through its pins, UART communication protocol to gain controllability and observability, Serial library to communicate with the Arduino through the serial monitor. Transducer Interface - Sensor interface, LCD interface, Servo Control, PWM signal generation concepts, GPS, GSM interface with Arduino Uno.

Module 2: Embedded C Programming **15 Hrs**

Review of data types - scalar types - Primitive types - Enumerated types, Subranges, Structure types - Character strings - Arrays - Functions Introduction to Embedded C -Introduction, Data types Bit manipulation, Interfacing C with Assembly. Embedded programming issues - Reentrancy, Portability, Optimizing and testing embedded C programs. Case Study: Modeling and Analysis of Real Time and Embedded systems.

Module 3: Raspberry Pi and Jetson Nano **15 Hrs**

Introduction about Raspberry Pi and Jetson Nano: OS installation, GPIO, UART, SPI, I2C,C programming, basic computation, Python scripts based accessing of GPIO pins. Case Study: AI based irrigation system, Real time color detection and object tracking, IoT based Applications.

Total Hours	**45**

Text Books:

1	Richard Blum , “Arduino Programming in 24 Hours”, Pearson Education; 1st edition, 2015.
2	Simon Monk , “Programming Arduino: Getting Started with Sketches”, McGraw-Hill Education; 2nd edition, June 2016.
3	Daniel W. Lewis, “Fundamentals of embedded software where C and assembly meet”,Pearson Education, 2002.
4	Jeff Cicolani Beginning Robotics with Raspberry Pi and Arduino Using Python and OpenCV, Apress Publications, First Edition, 2020.

Reference Books:

1	O'Reilly Media , “Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects”, Michael Margolis Publisher, 2nd edition, 2015.
2	J.m Hughes O′Reilly, “Arduino - A Technical Reference”, 1st edition, May 2016.
3	Simon Monk, Shroff/O'Reilly, “Raspberry Pi Cookbook: Software and Hardware Problems and Solutions”, 2nd Edition, 2016.

Web References:	
1	https://www.coursera.org/lecture/arduino-platform/lecture-1-1-arduino-platform-0ozFC
2	https://doc.lagout.org/electronics/Game%20boy%20advance/ARM_BOOKS/ARM_System_Developers_Guide-Designing_and_Optimizing_System_Software.pdf
3	https://people.cs.clemson.edu/~yfeaste/cybersecurity/CPSC424/project/RaspberryPiTutorial.pdf
4	https://www.youtube.com/watch?v=fJWR7dBuc18
5	https://www.youtube.com/watch?v=4gqKu1Rt8yg
6	https://www.youtube.com/watch?v=h0gWfVCSGQQ

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model(Max.Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C009.1	Analyze	Quiz Technical Presentation Group Assignment Class Presentation	**20**
C009.2	Apply		
C009.3	Understand		
C009.4	Apply		
C009.5	Analyze		

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	10	-	10	10
Understand	10	20	20	20
Apply	30	30	20	30
Analyze	50	40	30	20
Evaluate	-	-	10	10
Create	-	10	10	10

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C009.1	2	1			2							1		3	
C009.2	3	2	1	1	3	2	1					2		3	
C009.3	2	1			2							1		3	
C009.4	2	1			2	2	1					2		3	
C009.5	2	1			2	2	1					2		3	
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE010	Internet of Things and its Applications	3/0/0/3

Nature of Course	C (Theory Concept)

Course Objectives:

1	To introduce evolution of internet technology and need of IoT.
2	To discuss about IoT reference layer, various protocols and software.
3	To train the students to build IoT systems using sensors, single bard computers and open source IoT platforms.
4	To make the students to apply IoT data for business solution in various domain in secured manner.

Course Outcomes:

Upon completion of the course, students shall have ability to

C010.1	Identify the IoT networking components with respect to OSI layer.	[U]
C010.2	Design and develop IT based sensor systems.	[AP]
C010.3	Evaluate the wireless technologies for IoT.	[E]
C010.4	Appraise IoT applications in industrial and real world.	[AP]

Course Contents:

Module 1: Evolution of IoT and Components **15 Hrs**

Review of computer communication concepts: OSI layers - Components - Packet communication - Networks - TCP-IP - Subnetting - IPV4 addressing and challenges - IPV6 addressing - IoT architecture reference layer. IoT components: Characteristics IoT sensor nodes - Edge computer - Cloud and peripheral cloud - Single board computers - Open source hardware - Examples of IoT infrastructure.

Module 2: IoT Protocol and Cloud Computation **15 Hrs**

IoT Protocol: MQTT, UDP, MQTT brokers - Publish subscribe modes - HTTP, COAP, XMPP and gateway protocols - IoT Communication Pattern - IoT protocol Architecture - Selection of Wireless technologies - 6LoWPAN, Zigbee, WIFI, BT, BLE, SIG, NFC, LORA, Lifi, Widi. **Cloud Computation:** Evolution of Cloud Computation - Commercial clouds and their features - Open source IoT platforms - Cloud dashboards.

Module 3: IoT Security and Applications **15 Hrs**

Need for encryption - Standard encryption protocol - Lightweight cryptography - Quadruple trust model for IoT A - Threat analysis and model for IoT A - Cloud security **Case studies:** IoT for smart cities - Health care - Agriculture - Smart meters - M2M - Web of things - Cellular IoT - Industrial IoT - Industry 4.0 - IoT standards.

Total Hours	**45**

Text Books:

1	Vijay Madisetti , Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally “Internet of Things A Hands-on-Approach” Arshdeep Bahga & Vijay Madisetti, 2014.
2	Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, “From Machine to Machine to Internet of Things”, Elsevier Publications, 2014.
3	Barrie Sosinsky, “Cloud Computing Bible”, Wiley-India, 2010.

Reference Books:	
1	LuYan, Yan Zhang, Laurence T. Yang, Huansheng Ning, The Internet of Things: From RFID to the Next-Generation Pervasive Network, Aurbach publications, March, 2008.
2	Asoke K Talukder and Roopa R Yavagal, “Mobile Computing,” Tata McGraw Hill, 2010.
3	RonaldL. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley-India, 2010.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc19_cs65/preview
2	https://nptel.ac.in/courses/106105195

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C010.1	Understand	Quiz Class Presentation Assignment Case Study	**20**
C010.2	Apply		
C010.3	Evaluate		
C010.4	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	-	-	-	-
Understand	-	-	-	-
Apply	50	-	50	40
Analyze	-	60	-	30
Evaluate	50	40	50	30
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C010.1	2	1											2		
C010.2	3	2	1	1									2		
C010.3	3	3	2	2									3		
C010.4	3	2	1	1		1							2		

1	Reasonably Agreed	2	Moderately Agreed	3	Strongly Agreed

20EE011	Real Time Systems	3/0/0/3
Nature of Course	D (Theory Application)	
Course Pre-requisites	Nil	

Course Objectives:

1	To study issues related to the design and analysis of systems with real-time constraints.
2	To discuss and analyze different task scheduling algorithms in uniprocessor and multi-processor environments
3	To discuss the features and algorithms for real-time communications to take place in different network structures.

Course Outcomes:

Upon completion of the course, students shall have ability to

C011.1	Understand concepts of Real-Time systems	[U]
C011.2	Infer Real-time programming environments.	[U]
C011.3	Apply efficient algorithms for real-time task scheduling in uniprocessor and multi-processor environments.	[AP]
C011.4	Interpret the real time communication Protocols.	[AP]
C011.5	Analyze the design and functioning of existing real-time systems and real-time operating systems.	[A]

Course Contents:

Module 1: Introduction to Real Time Systems **15 Hrs**

Introduction to real time computing - Concepts; Example of real-time applications – Structure of a real time system – Characterization of real time systems and tasks - Hard and Soft timing constraints - Design Challenges - Performance metrics- Prediction of Execution Time : Source code analysis, Micro-architecture level analysis, Cache and Pipeline issues- Programming Languages for Real-Time Systems.

Module 2: Real Time Task Scheduling **15 Hrs**

Real time OS - Threads and Tasks - Scheduling Algorithm - Clock driven scheduling, table driven scheduling, cyclic, schedulers, hybrid schedulers, event driven scheduling, EDF Scheduling, RMA, DMA, resource sharing among RT tasks, Priority inversion, Priority Inheritance Protocol, Highest Locker Protocol, Priority Ceiling Protocol, Scheduling Real-Time tasks in multiprocessor and distributed systems, Fault tolerant scheduling of tasks, clocks in distributed Real-Time systems. Deadlock: Methods for handling deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Module 3: Real Time Communication **15 Hrs**

Real Time Communication - Network topologies and architecture issues - protocols -contention based, token based, polled bus, deadline based protocol, Fault tolerant routing. RTP and RTCP.

Case studies: RTOS for Image Processing - Embedded RTOS for Network communication - RTOS for Control Systems.

Total Hours	**45**

Text Books:

1	J. W. S. Liu, Real-time Systems, Pearson Education, 2018.
2	Raj Kamal, “Embedded Systems- Architecture, Programming and Design”, 3rd Edition, McGraw Hill Education, 2017.
3	R. Mall, Real-Time Systems, Pearson, 2007.
4	C.M. Krishna, Kang G. Shin “ Real Time Systems”, International Edition, McGraw Hill Companies, Inc., New York, 2004.

Reference Books:	
1	Philip A. Laplante and Seppo J. Ovaska, “Real-Time Systems Design and Analysis: Tools for the Practitioner’’ IV Edition IEEE Press, Wiley. 2011.
2	D.M.Dhamdhere,” Operating Systems,A Concept-Based Approch,TMH,2008.
3	Kopetz H. Real-time Systems: Design Principles for Distributed Embedded Applications. Springer Science & Business Media; 2011 Apr 15.
Web References:	
1	https://nptel.ac.in/courses/106105172
2	https://www.udemy.com/course/introduction-to-rtos/
3	https://www.coursera.org/learn/real-time-systems
4	https://www.udemy.com/course/mastering-rtos-hands-on-with-freertos-arduino-and-stm32fx/

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C011.1	Understand	Quiz Class Presentation Group Assignment Case Study	**20**
C011.2	Understand		
C011.3	Apply		
C011.4	Apply		
C011.5	Analyze		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	-	-	-	-
Understand	60	-	30	30
Apply	40	60	50	50
Analyze	-	40	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C011.1	3	3	2	2										3	
C011.2	3	2	2	2	2		2				1	2		3	
C011.3	3	3	2	2	2		2				1	2		3	
C011.4	3	2	2	2	1		2				1	2		3	
C011.5	3	3	3	2	2		2				2	2		3	2
1	**Reasonably Agreed**				**2**	**Moderately Agreed**					**3**	**Strongly Agreed**			

20EE012	Modern Power Converters	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Power Electronics	

Course Objectives:

1	To impart the knowledge on switched mode power supplies and the characteristics of Power Semiconductor devices.
2	To provide adequate knowledge of isolated converters and design constraints of reactive elements.

Course Outcomes:

Upon completion of the course, students shall have ability to

C012.1	Analyze the operation of Switched Mode DC Power Supplies with and without isolation.	[A]
C012.2	Implement switching technique for switched mode AC-DC converters.	[AP]
C012.3	Examine the operation of push-pull and fly back converter.	[A]
C012.4	Illustrate the working principle of Matrix Converter.	[U]
C012.5	Acquire the design constraints of reactive elements in power electronic systems.	[AP]

Course Contents:

Module 1: Switched Mode Power Supplies **15 Hrs**

DC Power supplies and Classification: Switched mode DC power supplies - with and without isolation, single and multiple outputs, closed loop control and regulation - Design examples on converter and closed loop performance. Switched mode AC-DC converters: Synchronous rectification - single and three phase topologies - switching techniques - high input power factor reduced input current harmonic distortion. Improved efficiency - with and without input-output isolation - Performance indices design examples.

Module 2: Single-phase AC-DC single-switch Bidirectional boost converter **15 Hrs**

Forward converter, Push-pull converter, Fly back converter - Matrix converters - Basic topology - Commutation - current path - Modulation techniques - Scalar modulation - Indirect modulation - Matrix converter AC-DC application. AC-AC converter with DC link - topologies and operation - with and without resonance link.

Module 3: Design of Reactive Elements in Power Electronic Systems **15 Hrs**

Design of inductor- Transformer and capacitors for power electronic applications - Input filter requirement. State space averaging of converters - Transfer function of converters - Design of feedback compensators - Voltage and current loop.

Total Hours	**45**

Text Books:

1	Fang Lin Luo, “Advanced DC/DC Converters” , CRC Press, NewYork, 2016.
2	Simon Ang, Alejandro Oliva, “Power Switching Converters”, Taylor & Francis, 3rd Edition, 2010.
3	Ned Mohan, Tore M. Undeland and William P. Robbins, “Power Electronics - Converters, Applications and Design”, John Wiley & Sons edition 2011.
4	M.H. Rashid, “Power Electronics Circuits, devices and applications”, Pearson Education, Inc. Edition 2014.

Reference Books:	
1	P.S. Bhimbra, “Power Electronics”, Khanna Publishers edition 2018.
2	Agarwal, “Power Electronics: Converters, Applications, and Design”, 3rd edition, Jai P, Prentice Hall, 2000.
3	Andrzej M. Trzynadlowski, “Introduction to Modern Power Electronics”, 3rd Edition, Wiley Publication, 2015.
Web References:	
1	https://nptel.ac.in/courses/108107128
2	https://www.tutorialspoint.com/power_electronics/index.htm
3	https://in.mathworks.com/videos/developing-dc-dc-converter-control-with-simulink.html
4	https://in.mathworks.com/videos/series/developing-dc-dc-converter-control-with simulink.html

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C012.1	Analyze	Quiz Simulation exercises Class Presentation Group Assignment	**20**
C012.2	Apply		
C012.3	Analyze		
C012.4	Understand		
C012.5	Apply		

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	
Remember	-	-	-	10
Understand	20	30	20	20
Apply	30	50	30	30
Analyze	50	20	50	40
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	**30**	**50**	**100**

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C012.1	3	3	2	2			1						3	2	
C012.2	3	2	1	1	2		2				1	2	3	3	
C012.3	3	3	2	2	2		2				1	2	3	3	
C012.4	2	1	1	1			1				1	2	3	3	
C012.5	3	2	1	1	2		2				1	2	3	3	

1	Reasonably Agreed	2	Moderately Agreed	3	Strongly Agreed

MANDATORY COURSES

20MC101	Induction Programme (FOR ALL BRANCHES OF B.E / B.TECH PROGRAMMES)	2/0/0/0
Nature of Course	Induction Programme	
Pre requisites	Nil	
Course Objectives:		
1	To have broad understanding of society and relationships	
2	To nurture the character and fulfil one's responsibility as an engineer, a citizenand a human being	
3	To incorporate meta skills and values	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C101.1	Explore academic interest and activities	[AP]
C101.2	Work for excellence	[AP]
C101.3	Promote bonding and give a broader view of life and character	[AP]
Course Contents:		

PHYSICAL ACTIVITY

Yoga

CREATIVE ARTS (students can select any one of their choice)

Painting, sculpture, pottery, music, dance, craft making and so on

UNIVERSAL HUMAN VALUES

Enhancing soft skills

LITERARY AND PROFICIENCY MODULES

Reading, writing, speaking – debate, role play etc.Communication and computer skills

LECTURES BY EMINENT PEOPLE

Guest lecture by subject experts

VISIT TO LOCAL AREAS

Meditation centre/orphanage/Hospital

FAMILIARIZATION TO DEPARTMENT/BRANCH INNOVATION

Lectures by Department's Head and senior faculty members

20MC102	Environmental Sciences	2 /0 /0 /0

Nature of Course	Theory Concept
Pre requisites	Basics in Environmental Studies

Course Objectives:

1	To learn the integrated themes on various natural resources.
2	To gain knowledge on the type of pollution and its control methods.
3	To have an awareness about the current environmental issues and the social problems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C102.1	Recall and play an important role in transferring a healthy environment for future generation.	[R]
C102.2	Understand the importance of natural resources and conservation of biodiversity.	[U]
C102.3	Understand and analyze the impact of engineering solutions in a global and societal context.	[U]
C102.4	Apply the gained knowledge to overcome pollution problems.	[AP]
C102.5	Apply the gained knowledge in various environmental issues and sustainable development.	[AP]

Course Contents:

Module 1: Natural Resources **10 Hrs**

Introduction-Forest resources: Use and abuse, case study-Major activities in forest-Water resources-over utilization of water, dams-benefits and problems. Mineral resources-Use and exploitation, environmental effects of mining- case study–Food resources- World food problems, case study. Energy resources -Renewable and non-renewable energy sources Land resources- Soil erosion and desertification — Role of an individual in conservation of natural resources.

Module 2: Environmental Pollutions **10 Hrs**

Definition – causes, effects and control measures of: a. Air pollution-Acid rain - Greenhouse effect-Global warming- Ozone layer depletion — case study- Bhopal gas tragedy. Water pollution c. Solid waste management-Recycling of plastics-Pyrolysis method- causes, effects and control measures of municipal solid wastes d. Noise pollution. e. Nuclear hazards-case study-Chernobyl nuclear disaster-Role of an individual in prevention of pollution.

Module 3: Social issues and the Environment **10 Hrs**

Sustainable development-water conservation, rain water harvesting, E-Waste Management – Environmental ethics: 12 Principles of green chemistry-Scheme of labelling of environmental friendly products (Eco mark) – Emission standards – ISO 14001 standard. HIV AIDS.

Total Hours	**30**

Text Books:

1	AnubhaKaushik and C P Kaushik “Perspectives in Environmental Studies”4th Edition, Newage International (P) Limited, Publisher Reprint 2014. New Delhi
2	Rajagopalan, R, “Environmental Studies-From Crisis to Cure”, Oxford University Press2015.

Reference Books:

1	Tyler Miller, Jr., “Environmental Science”, Brooks/Cole a part of Cengage Learning, 2014.
2	William Cunningham and Mary Cunningham, “Environmental Science”, 13th Edition,McGraw Hill,2015.
3	Gilbert M. Masters, “Introduction to Environmental Engineering and Science”, Third Edition, Pearson Education, 2014.

Web References:

1	http://nptel.ac.in/courses/104103020/20

2	http://nptel.ac.in/courses/120108002
3	http://nptel.ac.in/courses/122106030
4	http://nptel.ac.in/courses/120108004/
5	http://nptel.ac.in/courses/122102006/20
Online Resources:	
1	https://www.edx.org/course/subject/environmental-studies
2	www.environmentalscience.org

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:100)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C102.1	Remember	Quiz	**30**
C102.2	Understand	Mini project based on environmental aspect	**30**
C102.3	Understand	Class Presentation	**20**
C102.4 C102.5	Apply	Group Assignment	**20**

20MC103	Soft Skills	2/0/0/0
Nature of Course	Theory Concept	
Pre requisites	Technical Communication Skills	

Course Objectives:

1.	To develop the students competency level and their capabilities.
2.	To teach the students to be effective in workplace and social environments.
3.	To create self confidence among the students and to resolve stress and conflictwithin themselves.
4.	To help the students to enhance their career skills by increasing their productivity and performances.
5.	To concentrate more on conversation skills, presentation skills, verbal ability,critical and creative thinking.

Course Outcomes:
Upon completion of the course, students shall have ability to

C103.1	Remember the principles of soft skills required for their profession.	[R]
C103.2	Understand the importance of Interpersonal communication Skills among individuals, groups and cultures.	[U]
C103.3	Apply verbal and non-verbal communication skills in corporate environment.	[AP]
C103.4	Analyze and apply creativity skills, critical thinking skills and problem solving skills.	[A]
C103.5	Articulate oral and written messages in an appropriate and persuasive manner to suit specific purposes, audiences and contextsat work place.	[AP]
C103.6	Apply good teamwork skills and Leadership Skills	[AP]

Course Contents:

Module 1: Professional Communication Skills **10 Hrs**

Introduction to the Soft Skills, Performance Evaluation 1 –Significance of Soft Skills- Understanding the basic Communication Principles –Listening Skills- Listening Exercises- Speaking Skills- How to start and Sustain a Conversation- Speaking in Groups- Understanding self and Personal Branding, attitude, types of attitude, Positive Attitude, Self Confidence and Self-Motivation - Personal Application/Action Taken.

Advanced Writing Skills-Principles of Business Writing- E mails- Writing Reports- Types of Reports- Strategies for Report Writing- Personal Application/Action Taken.

Verbal Ability- Analogy- Classification- Odd One Out- Idioms and Phrases- Sentence Correction- Empathy and its importance in career -Personal Application/Action Taken.

Module 2: Interpersonal Communication **10 Hrs**

Nonverbal Communication- Individual, Groups and Cultures- Body Language- Attire and Etiquettes- Interpersonal Skills- dealing with diverse People- Networking- Emotional Intelligence and its importance. Personal Application/Action Taken. Developing Creativity- Critical Thinking and Problem Solving Skills- Making the Right Choice- Never Give Up- Begin to Grow- Personal Application/Action Taken.

Interviews- Facing Job Interviews - Planning and Preparing- Effective Resume along with Covering Letter- Planning and Preparing- Personal Application/Action Taken.

Self-Discipline - Self Presentation - Personal Application/Action Taken.

Module 3: Teamwork and Leadership Skills **10 Hrs**

Industry Expectations- Universal Hiring Rule- Personal Application/Action Taken.

Importance of Human Values-Importance of Team Work- Developing Key Traits in Motivation, Persuasion, Negotiation and Leadership Skills- Being an Effective Team Player- Personal Application/Action Taken.

Planning- Prioritization – Delegation - Conflict Management - Decision and its necessity in crucial

situations- Group Discussion - Personal Application/Action Taken. Essential Skills in working Strategies- Presentation and Interaction Skills- What to Present and How- Being Assertive- Multimedia Presentation-Making Effective Presentations. Interview Skills - Do's and Don'ts - Body Language - Answering the Common Questions of Interview- Performance Evaluation 2 - Mock Interview

Total Hours	**30**

Text Books:	
1.	Business Communication for managers: An advanced approach, by Penrose, Cengage learning.
2.	Professional Communication in Engineering. by H.E. Sales. Palgrave Macmillan 2009.
3.	Communication for professional engineers by W. P. Scott, Bertil Billing. Thomas Telford, 1998.
Reference Books:	
1.	Reason and professional ethics by Peter Davson-Galle. Ashgate Publishing, Ltd., 2009.
2.	Cross Cultural and Inter Cultural Communication. by William B. Gudykunst. Sage Publications India Pvt Ltd, New Delhi.2003.
3.	Corporate Communications: Theory and Practice. ByJoepCornelissen. Sage Publications India Pvt Ltd, New Delhi.2004.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc16_hs15/preview
2	https://www.getinternship.switchidea.com/NTAT/syllabus/Interpersonal-Communication.
3	https://smude.edu.in/smude/programs/bca/soft-skills.html
Online Resources:	
1	https://swayam.gov.in/course/4047-developing-soft-skills-and-personality
2	https://www.clearias.com/interpersonal-skills-including-communication-skills-for-csat/
3	https://www.bizlibrary.com/soft-skills-training/

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Revised Bloom's Level	Assessment Component	Marks
C103.1	Remember	Group Discussion	30
C103.2 & C103.3	Understand	Listening Skills	20
C103.4	Apply	Interview	20
C103.5 & C103.6	Apply	Formal Presentation	30

20MC104	Management Organizational Behaviour	2/0/0/0
Nature of Course	Theory Concept	
Pre requisites	Nil	

Course Objectives:

1.	The objective of the course is to provide basic knowledge about management to familiarize the students with the management principles and organizational behavior.
2.	The course is designed to enable the students to adapt & apply theoretical concepts in business
3.	To know about the role of manager in the area of management.
4.	To create and implement team building strategies for organization building.

Course Outcomes:
Upon completion of the course, students shall have ability to

C104.1	Identify and understand different management principles techniques in business environment.	[U]
C104.2	Apply management fundamentals and planning to solve organization problems and make effective decisions.	[AP]
C104.3	Understand and analyze the changes within an individual will changethe group as well as the organization	[AN]
C104.4	Understand and analyze the leadership style and organization theoriesto create a productive environment to workforce.	[AN]
C104.5	Analyze the organizational climate and change management strategiesand tactics	[AN]
C104.6	Apply the empowerment strategy and tactics for productivity	[AP]

Course Contents:

Module 1: Fundamentals of Management, Planning and Decision Making 10 Hrs

Introduction to Management- Concept and functions- Thought Managerial roles and styles- Principles of Management - Levels of Management- Theories of Management - Classical, Scientific, Administrative, Behavioral, Management Sciences Theories. Organizational planning - Vision, Mission and goals, Types of plans, steps in planning process, Approaches to planning, Planning in Dynamic Environment. Decision making process, types of decisions, decision making styles, Behavioural influences on decision making - Group decision making - Vroom's Participative decision-making model.

Module 2: Individual, interpersonal and group behavior 10 Hrs

Definition, need and importance of Organizational behavior –Learning-Nature -Importance of Learning- Introduction and theories Motivation: Content and process theories-Leadership: Styles and Theories - Perception-Personality — Attitudes- Definition, need and importance - Nature and scope-Importance of Groups and Teams- Role relationships and conflict-Group dynamics- Work values. Organization Theories: Maslow's needs hierarchy theory, two factor theory of motivation, McGregor's theory, ERG theory, McClelland's needs theory, Valance Theory.

Module 3: Organizational Development 10 Hrs

Organizational culture: Elements - Organizational climate– Factors affecting organizational climate- Organizational Commitment, Organizational change- Importance- Stability Vs Change- Proactive Vs Reaction change- Change process– Resistance to change- Managing changes- Managing International Workforce - Productivity- Alternative change management approaches and cultural contingencies - power to manage effectively; Empowerment and Participation strategies and tactics.

Total Hours: 30 Hrs

Text Books:

1	Nelson, Quick, Khandelwal, "Organizational Behavior", 2nd edition, Cengage Learning,2016.
2	Williams, Tripathy, "Principles of Management", Cengage Learning, 2016.
3	Aswathappa, K, "Organizational Behavior", 12th Edition, Himalaya Publication, 2016.

4	Stephen Robbins, Timothy A. Judge, “Organizational Behavior”, 16th edition, PrenticeHall India Pvt. Ltd, 2014.
Reference Books:	
1	Chandrani Singh, Aditi Khatri, “Principles and Practices of Management andOrganizational Behavior”, Sage Publications, 2016.
2	Richard L. Daft, “Understanding the Theory and Design of Organizations”, 11th edition, Cengage Learning, 2013.
3	John M Ivancevich and Robert Konopaske, “Organizational Behavior and Management”, McGraw-Hill Education, 2013.
4	UdaiPareek, Sushama Khanna, “Organization Behavior”, 3rd edition, Oxford Publishing, 2012.
Web References:	
1	https://iedunote.com/fundamental-concepts-of-organizational-behavior
2	https://nscpolteksby.ac.id/ebook/
3	https://ebooks.lpude.in/management/mba/term_1/DMGT402_MANAGEMENT PRACTICES_AND_ORGANIZATIONAL_BEHAVIOUR.pdf
4	https://www.studocu.com/in/document/vellore-institute-of-technology/organizational-behaviour/lecture-notes/ob-notes/3208134/view
Online Resources:	
1	https://nptel.ac.in/syllabus/110105034/
2	https://nptel.ac.in/courses/110/105/110105033/
3	https://freevideolectures.com/course/3502/organizational-behaviour-i
4	https://nptel.ac.in/courses/110/106/110106145/

Tentative Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Revised Bloom’s Level	Assessment Component	Marks
C104.1	Understand	Quiz	30
C104.2 C104.6	Apply	Listening Skills	20
C104.3	Analyze	Group Discussion	20
C104.4 C104.5	Apply	Formal Presentation	30

20MC105	General Aptitude	2 /0 /0 /0

Nature of Course	Theory Concept
Pre requisites	NIL

Course Objectives:

1	To improve the verbal ability.
2	To improve the mathematical skills.
3	To develop problem solving skills.
4	To equip them to face interview & Group Discussion.
5	To inculcate critical thinking process.

Course Outcomes:

Upon completion of the course, students shall have ability to

C105.1	To teach the basics of Quantitative Techniques in a graded manner	[R]
C105.2	Understand the verbal and non-verbal nature of problems in reality and now the shortcut methods of solving it.	[U]
C105.3	Solve problems using their general mental ability	[AP]
C105.4	To give intense focus on improving and increasing the ability of solving real problems	[AP]
C105.5	Think critically about mathematical models for relating different quantities to reach conclusion	[AP]
C105.6	Enable effective use of data interpretation, formulas, graphs and assumptions	[AP]

Course Contents:

Module 1: Number Theory and Statistics **14 Hrs**

Number Systems– HCF and LCM of Numbers – Decimal Fractions – Simplification – SquareRoot and Cube Root of a number – Surds and Indices – Problems on numbers – Percentage– Ratio and Proportion – Divisibility – Mixtures – Averages- Polynomials – Solving Equations and Inequalities – Discard's rule of signs – Problems on ages – Chain rule – Time and Work – Time and Distance – Problems on Trains – Problems on Boats and Streams- Measures of central tendency – Mean, Median and Mode – Variance and Standard deviation Logarithms – Profit and Loss – Simple Interest – Compound Interest.

Module 2: Logic and Decision Making **8 Hrs**

Analogy – Classification – Series completion – Coding and Decoding – Blood Relations – Puzzle Test – Direction Sense test – Logical Venn Diagrams - Number Ranking and Time Sequence Test – Decision Making – Assertion and Reason– Inserting the missing one – Logical Sequence of words – Syllogisms.

Module 3: Reasoning **8 Hrs**

Logic – Statement and Arguments – Statements and Assumptions – Statements and Course of Action – Statements and Conclusions – Deriving conclusions from passages – Functions – Different kinds of functions — Miscellaneous sets- Series — Analogy — Classifications — Analytical Reasoning – Problems on Cubes and Dice – Mirror Images – Water Images – Rule Detection.

Total Hours: 30

Text Books:

1	Aggarwal R. S. "Quantitative Aptitude" Revised Edition, S. Chand Publication.
2	Abhijit Guha "Quantitative Aptitude" 5th Edition, McGraw Hill Education.

Reference Books:

1	Edgar Thorpe "Mental Ability & Quantitative Aptitude" 3rd Edition, McGraw HillEducation.

Web References:

1	https://www.wiziq.com/tutorial/815468-quantitative-aptitude-reasoning-data- interpretation-video-lectures
2	https://learningpundits.com/contest?referrer=harsh.cse15@nituk.ac.in
3	https://nptel.ac.in/courses/114106041/8
4	https://nptel.ac.in/courses/111103020/2

Online Resources:

1	http://aptitudetraining.in/home/index.php

2	https://www.udemy.com/vedicmaths/
3	https://www.youtube.com/channel/UCtmn-DsF4BhPug- ff9LiDAA?disable_polymer=true

Reference Books:	
1	R.S. Aggarwal,"Quantitative Aptitude", S.Chand Publishers
2	R.S. Aggarwal,"A Modern Approach to Verbal & Non-verbal reasoning", S.ChandPublishers
3	Face Aptipedia - Aptitude Encyclopedia - Wiley
4	Dinesh Khattar, "The pearson guide to Quantitative Aptitude for Competitive examinations, Pearson Education
Web References:	
1	https://www.geeksforgeeks.org/placements-gq/
2	https://www.indiabix.com/aptitude/questions-and-answers/

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Bloom's Level	Assessment Component	Marks
C105.1	Remember	Quiz	30
C105.2 & C105.3	Understand	Formal presentation	20
C105.4, C105.5 & C105.6	Apply	Formal interview tests	50

20MC106	Life Skills and Ethics	2 /0 /0 /0

Nature of Course	Theory Concept
Pre requisites	NIL

Course Objectives:

1	To develop communication competence in prospective engineers.
2	To enable them to convey thoughts and ideas with clarity and focus.
3	To develop report writing skills.
4	To equip them to face interview & Group Discussion.
5	To inculcate critical thinking process.
6	To prepare them on problem solving skills.
7	To provide symbolic, verbal, and graphical interpretations of statements in a problem description.

Course Outcomes:

Upon completion of the course, students shall have ability to

C106.1	Define and Identify different life skills required in personal and professionallife.	[U]
C106.2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.	[AP]
C106.3	Explain the basic mechanics of effective communication and demonstratethese through presentations.	[AN]
C106.4	Use appropriate thinking and problem solving techniques to solve new problems.	[AP]
C106.5	Understand the basics of teamwork and leadership	[U]

Course Contents:

Module 1 **10 Hrs**

Communication Skill: Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication.

Module 2 **10 Hrs**

Critical Thinking & Problem Solving: Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats Mind Mapping & Analytical Thinking. Teamwork: Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

Module 3 **10 Hrs**

Ethics, Moral & Professional Values: Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE. **Leadership Skills:** Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation

Total Hours	**30**

Reference Books:

1	Barun K. Mitra; (2011), “Personality Development & Soft Skills”, First Edition; OxfordPublishers.
2	Kalyana; (2015) “Soft Skill for Managers”; First Edition; Wiley Publishing Ltd.
3	Larry James (2016); “The First Book of Life Skills”; First Edition; Embassy Books.
4	ShaliniVerma (2014); “Development of Life Skills and Professional Practice”; First Edition; Sultan Chand (G/L) & Company
5	John C. Maxwell (2014); “The 5 Levels of Leadership”, Centre Street, A division ofHachette Book Group Inc

Web References:

1	https://www.coursera.org/courses?query=ethics

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:100)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C106.1	Remember	Quiz	**20**
C106.2	Understand	Assignment	**20**
C106.3	Understand	Presentation	**30**
C106.4 C106.5	Apply	Group Discussion	**30**

20MC107	Stress Management	2 /0 /0 /0

Nature of Course	Theory Concept
Pre requisites	NIL

Course Objectives:

1	Understand the basic principles of stress management
2	Recognize your stress triggers and how to manage them
3	Develop proactive responses to stressful situations
4	Use coping tips for managing stress both on and off the job
5	Learn to manage stress through diet, sleep and other lifestyle factors
6	Develop a long term action plan to minimize and better manage stress
7	Understand the basic principles of stress management

Course Outcomes:

Upon completion of the course, students shall have ability to

C107.1	Understand the basic principles of stress management	[U]
C107.2	Apply the concept of recognizing your stress triggers and find was tomanage them.	[AP]
C107.3	Develop proactive responses to stressful situations	[AN]
C107.4	Develop a long term action plan to minimize and better manage stress	[AP]

Course Contents:

Module 1 **10 Hrs**

Scientific Foundations of Stress: What is stress? – Sources of Stress – Types of Stress – Personality Factors and stress – Stress and the college student. Stress Psychophysiology:Stress and nervous system – Hypothalamic – Pituitary – Adrenal (HPA) Axis – Effect of Stresson Immune system – Health risk associated with chronic stress – Stress and Major Psychiatric disorders.

Module 2 **10 Hrs**

Developing Resilience to Stress: Understanding you stress level – Role of personality pattern, Self-esteem, Locus of control – Role of Thoughts Beliefs and Emotions – I & II – Life situation Intrapersonal: (Assertiveness, Time Management).

Module 3 **10 Hrs**

Strategies for Relieving Stress: Developing cognitive coping skills – Autogenic training, imagery and progressive relaxation – Other relaxation techniques – Exercise and Health – DIY strategies stress management.

Total Hours	**30**

Reference Books:

1	Jonathan C. Smith; (2011), “Stress Management: A Comprehensive Handbook of Techniques and Strategies”, First Edition; Springer Publishing Company.
2	Bob Stahl, Elisha Goldstein, Jon Kabat-Zinn (2019); “A mindfulness–based stress reduction workbook”; Second Edition; New Harbinger Publications.
3	Ryan M. Niemiec (2019), “ The Strengths-based workbook for stress relief”, First edition, New Harbinger Publications.

Web References:	
1	https://thiswayup.org.au/courses/coping-with-stress-course/
2	https://www.classcentral.com/course/swayam-stress-management-14309

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:100)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C107.1	Remember	Quiz	**20**
C107.2	Apply	Group Discussion	**30**
C107.3	Apply	Class Presentation	**30**
C107.4	Understand	Assignment	**20**

20MC108	Constitution of India	2/0/0/0
Nature of Course	Theory	
Pre Requisites	NIL	

Course Objectives:

1	To familiarize with basic information about Indian constitution
2	To understand the fundamental rights and duties as citizens of India

Course Outcomes:
Upon completion of the course, students shall have ability to

C108.1	Explain the objectives of the Constitution of India and its formation	[U]
C108.2	Recall state and central policies (Union and State Executive), fundamental Rights and their duties.	[R]
C108.3	Make use of legal directions in developing solutions to societal issues	[AP]
C108.4	Utilized for competitive exams that requires knowledge of Indian Constitution	[AP]

Course Contents:

Module 1 **10 Hrs**

Historical perspective, The making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Citizenship Article 5-11.

Module 2 **10 Hrs**

Federal structure, Powers of the Union and the states, Centre-State Relations, Union Executive - President, Prime Minister, Union Cabinet, Parliament, Supreme Court of India, State Executives - Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Elections, Electoral Process, and Election Commission of India, Election Laws. Powers and Functions of Municipalities and Panchayat

Module 3 **10 Hrs**

Amendments - Methods, Emergency Provisions, National Emergency, President Rule, Financial Emergency, Provisions for SC & ST, OBC, women, children and backward classes, Right to Property, Freedom of Trade and Commerce. Agricultural Law

Total Hours: 30

Text Books:

1	Dr.D.D.Basu, "Introduction to the Constitution of India", LexisNexis, New Delhi, 22nd Edition, 2016.
2	"Bare act-constitution of India", The universal Publications, LexisNexis 2020, New Delhi,India.

Reference Books:

1	Subhash.C.Kashyap, "Our Constitution: An Introduction to India's Constitution and Constitutional Law", National Book Trust, India, 5th edition, 2019.
2	M. Laxmikanth, "Constitution of India", Cengage Learning India. 1st edition 2018.

Web References:

1	https://unacademy.com/course/the-indian-constitution/NSKQ8XXQ
2	https://unacademy.com/goal/upsc-civil-services-examination-ias-preparation/KSCGY

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Bloom'sLevel	Assessment Component	Marks
C108.1	Remember	Test	**20**
C108.4	Understand	Quiz	**40**
C108.3	Apply	Presentation	**20**
C108.2	Apply	Group Assignment	**20**

20MC109	Essence of Indian Traditional Knowledge	2/0/0/0
Nature of Course	Theory Concept	
Pre Requisites	NIL	

Course Objectives:

1	To make understand the contribution of Indian mind in various fields.
2	To cultivate critical appreciation of the thought content and provide insightsrelevant for promoting cognitive ability, health, good governance, aesthetic appreciation and right values.

Course Outcomes:
Upon completion of the course, students shall have ability to

C109.1	Relate classical Indian traditions with contemporary traditions and culture.	[R]
C109.2	Outline the thoughts of Indians in different disciplines.	[U]
C109.3	Apply the knowledge to the present context.	[AP]
C109.4	Develop a better appreciation and understanding of Indian traditions.	[C]

Course Contents:

Module 1 **10 Hrs**

Indian Ethics: Individual and Social – Society state and Polity (Survey) - Education systems – Agriculture (Survey) – Early & Classical Architecture – Medieval & Colonial Architecture.

Module 2 **10 Hrs**

Astronomy in India — Martial Arts Traditions (Survey) - Indian Literatures - Indian Philosophical Systems - Indian Traditional Knowledge on Environmental Conservation

Module 3 **10 Hrs**

Ayurveda for Life, Health and Well-being - The Historical Evolution of Medical Tradition inAncient India- Music in India - Classical & Folk

Total hours **30**

Text Books:

1	Kapil Kapoor and Michel Danino, Textbook of “Knowledge Traditions and Practicesof India”, Central Board of Secondary Education, 2017.
2	Yogesh Atal, “Indian Society: Continuity and Change”, Pearson EducationIndia, 2016.

Reference Books:

1	Douglas Osto, “An Indian Tantric Tradition and Its Modern Global Revival”, Routledge publications, 2020.
2	Rao C.N. Shankar, “Sociology: Principles of Sociology with an Introduction toSocial Thoughts”, S Chand Publisher, 2019.

Web References:

1	http://nopr.niscair.res.in/handle/123456789/43
2	https://nptel.ac.in/courses/109/104/109104102/

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C109.1	Remember	Quiz	**20**
C109.2	Understand	Group Assignment	**20**
C109.3	Apply	Presentation	**20**
C109.4	Create	Survey	**40**