KPR Institute of Engineering and Technology
Centre for Academic Courses
Coimbatore

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B.E.–Electrical and Electronics Engineering

Curriculum and Syllabi

Regulations 2019

I. Vision and Mission of the Institute

Vision

To become a premier institute of academic excellence by imparting technical, intellectual and professional skills to students for meeting the diverse needs of the industry, society, the nation and the world at large.

Mission

- Commitment to offer value-based education and enhancement of practical skills
- Continuous assessment of teaching and learning process through scholarly activities
- Enriching research and innovative activities in collaboration with industry and institute of repute
- Ensuring the academic process to uphold culture, ethics and social responsibility

II. Vision and Mission of the Department

Vision

To be the centre of higher learning in the field of Electrical and Electronics Engineering by educating the students to meet the global challenges with professional ethics and social consciousness.

Mission

The Mission of the Department is to

- Providing technical, intellectual and ethical environment to the students through knowledge centric education and research
- Collaborating with industries in the vicinity, nationally and internationally for exposure and innovation
- Enabling the students to serve the society through prolific ideas

III. Program Educational Objectives (PEOs)

The Graduates of Electrical and Electronics Engineering will

PEO1: Possess an adequate knowledge to meet the needs of the stakeholders and excel in their chosen profession with good communication and managerial skills

PEO2: Adapt to emerging technologies and practice their profession confirming to ethical and human values

PEO3: Continuously improve the habit of self-study through professional development activities

IV. Program Outcomes (POs)

Graduates of Electrical and Electronics Engineering will be able to

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

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

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

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

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

PO 6 The engineer and society: Apply reasoning informed by the contextual knowledge to access societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

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

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

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

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

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

V. Program Specific Outcomes (PSOs)

Graduates of Electrical and Electronics Engineering will be

PSO 1: Able to develop skills to the expectations of the dynamic industrial practices in Electrical Engineering and allied areas.

PSO 2: Able to analyse, design and integrate various renewable energy sources to meet the energy demand.

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VII. Mapping of Course Outcomes with Program Outcomes

SEM	Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
SEM I	Language Elective I*	-	-	-	-	-	✓	✓	✓	✓	✓	-	✓	-	-
	Calculus and Differential Equations	✓	✓	✓	-	-	-	-	-	✓	✓	-	✓	-	-
	Engineering Physics	✓	✓	✓	-	-	-	-	✓	✓	✓	-	✓	✓	-
	Engineering Chemistry I	✓	✓	✓	-	-	-	✓	✓	✓	✓	-	✓	✓	-
	Introduction to Electrical Engineering	✓	✓	✓	-	✓	✓	-	✓	-	-	✓	✓	✓	✓
	Engineering Graphics	✓	✓	✓	-	✓	-	-	-	✓	✓	-	✓	✓	-
	Workshop (EEE)	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓
SEM II	Language Elective II**	-	-	-	-	-	✓	✓	✓	✓	✓	-	✓	-	-
	Complex Variables and Laplace Transforms	✓	✓	✓	-	-	-	-	-	✓	✓	-	✓	-	-
	Material Science for Electrical Engineers	✓	✓	✓	-	-	✓	-	-	-	-	-	✓	✓	-
	Chemistry for Electrical Engineers	✓	✓	✓	-	-	-	✓	-	-	-	-	✓	✓	✓
	Problem Solving using Python Programming	✓	✓	✓	-	✓	-	-	✓	✓	✓	-	✓	✓	-
	Computational Thinking	✓	✓	✓	✓	✓	-	-	✓	✓	✓	-	✓	✓	-
	Basics of Electric Circuits	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	✓	✓
	Electric Circuits Laboratory	✓	✓	✓	✓	✓	-	-	✓	✓	✓	-	✓	✓	✓
SEM III	Fourier Analysis and Partial Differential Equations	✓	✓	✓	-	-	-	-	-	✓	✓	-	✓	-	-
	Electromagnetic Theory	✓	✓	✓	✓	✓	-	-	-	✓	✓	-	✓	✓	-
	Electrical Machines – I	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	✓	-
	Electronic Devices and Circuits	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓	✓	-
	Digital Logic Circuits	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓	✓	-
	Data Structures in C	✓	✓	✓	-	-	-	-	✓	✓	✓	-	✓	✓	-
	Electrical Machines - I Laboratory	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓	✓	-
SEM IV	Statistics and Numerical Methods	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓	-
	Linear Integrated Circuits and Applications	✓	✓	✓	✓	-	✓	✓	-	-	-	-	✓	✓	-
	Electrical Machines – II	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓	-

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	Transmission and Distribution	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓
	Measurements and Instrumentation	✓	✓	✓	-	-	✓	✓	-	-	-	-	✓	✓	-
	Object Oriented Programming and Advanced Data Structures	✓	✓	✓	✓	✓	-	-	✓	✓	✓	-	✓	✓	-
	Numerical Aptitude and Verbal Ability – I	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-
	Linear and Digital Integrated Circuits Laboratory	✓	✓	✓	✓	✓	-	-	✓	✓	✓	-	✓	✓	-
	Electrical Machines - II Laboratory	✓	✓	✓	✓	✓	-	-	✓	✓	✓	-	✓	✓	-
SEM V	Power System Analysis	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓	-	✓
	Microprocessors and Microcontrollers	✓	✓	✓	✓	✓	✓	-	-	✓	✓	-	✓	✓	-
	Power Electronics	✓	✓	✓	-	✓	✓	✓	-	-	-	-	✓	✓	-
	Control Systems	✓	✓	✓	✓	✓	-	-	✓	✓	✓	-	✓	✓	-
	Numerical Aptitude and Verbal Ability – II	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-
	Control and Instrumentation Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	-
SEM VI	Solid State Drives	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	✓	✓	-
	Embedded Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
	Power Electronics and Drives Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	-
	Technical Seminar	✓	✓	✓	✓	✓	-	-	-	✓	✓	✓	✓	✓	-
	Mini Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SEM VII	Principles of Management	-	-	-	-	-	✓	✓	✓	-	✓	✓	✓	✓	-
	Power Engineering Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓
SEM VIII	Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
TRACK I	Renewable Energy Sources	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓
	Energy Management and Auditing	✓	✓	✓	✓	-	✓	✓	✓	-	-	✓	✓	-	✓
	Computer Aided Power System Analysis	✓	✓	✓	✓	✓	-	-	✓	✓	-	-	✓	-	✓
	Protection and Switchgear	✓	✓	✓	✓	-	✓	✓	-	-	-	-	✓	-	✓

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	Power System Operation and Control	✓	✓	✓	-	✓	-	-	-	✓	✓	✓	✓	-	✓
	Smart Grid Technologies	✓	✓	✓	✓	✓	✓	-	✓	-	-	-	✓	-	✓
	Artificial Intelligence Applications to Power Systems	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓	-	✓
	Power System Restructuring	✓	✓	✓	-	-	-	-	✓	-	-	✓	✓	-	✓
	Microgrid	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	-	✓
	Power System Security	✓	✓	✓	✓	✓	✓	-	✓	-	-	-	✓	-	✓
	High Voltage Engineering	✓	✓	✓	✓	✓	✓	-	✓	-	-	-	✓	-	✓
	Utilization, Costing and Estimation	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓	✓	-	✓
	EHV AC and DC Transmission	✓	✓	✓	✓	✓	-	-	✓	-	-	-	✓	-	✓
	Power Quality	✓	✓	✓	-	✓	✓	-	✓	-	-	-	✓	-	-
TRACK II	Sensors and its Applications	✓	✓	✓	✓	-	✓	✓	✓	-	-	✓	✓	✓	-
	Energy Storage Systems and Controllers	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	-	✓
	Advanced Electric Motors and Control	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	-
	EV Batteries and Charging Systems	✓	✓	✓	-	✓	-	-	-	-	-	✓	✓	-	✓
	Electric Vehicles and Dynamics	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	✓	-
	Automotive MEMS	✓	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	-
	EV Standard and Testing	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	-	✓
	Hybrid Electric Vehicles	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	✓	-	✓
	Process Dynamics and Control	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	-
	IoT in EV Applications	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	✓	-	✓
	Automotive Transmission	✓	✓	✓	✓	✓	✓	✓	-	✓	-	✓	✓	✓	✓
	Industrial Automation	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓	✓	✓	-
	Embedded Networking and Automation of Electrical Systems	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	-
	Data Acquisition and Robotic Control	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	✓	-
	Data Base Management Systems	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	-	-
	Web Technology	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓	-	-
	System Programming and Operating Systems	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	✓	-
	Application Development Practices	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓	-	-
	Digital Image Processing	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓	✓	-

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TRACK III	Artificial Neural Network and Fuzzy Systems	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	-
	IoT System Design and Security	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	-
	Machine Learning	✓	✓	✓	✓	✓	-	-	✓	-	-	✓	✓	✓	-
	Augmented Reality and Virtual Reality Applications in Engineering	✓	✓	✓	-	✓	-	-	✓	-	-	-	✓	-	-
	Embedded Systems Design	✓	✓	✓	✓	-	✓	✓	-	-	-	-	✓	✓	-
	Data Science	✓	✓	✓	✓	✓	-	-	✓	-	-	✓	✓	✓	-
	Deep Learning	✓	✓	✓	✓	✓	✓	-	✓	-	-	✓	✓	✓	-
	Tensor Flow for Engineering Applications	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓	✓	-
	Big Data Analytics	✓	✓	✓	✓	✓	-	-	✓	-	-	✓	✓	✓	-

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14/7/22

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B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR I - VIII SEMESTERS

SEMESTER I

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1		Language Elective I*	HSM	1	0	2	2
2	U19MA101	Calculus and Differential Equations	BS	3	1	0	4
3	U19PH101	Engineering Physics	BS	2	0	2	3
4	U19CY101	Engineering Chemistry I	BS	2	0	2	3
5	U19EE101	Introduction to Electrical Engineering	ES	3	0	0	3
		PRACTICALS					
6	U19MEG01	Engineering Graphics	ES	1	0	4	3
7	U19EE102	Workshop (EEE)	ES	0	0	4	2
			TOTAL	12	1	14	20

*** U19LE101 - Basic English / U19LE102 - Communicative English**

SEMESTER II

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1		Language Elective II**	HSM	1	0	2	2
2	U19MA201	Complex Variables and Laplace Transforms	BS	3	1	0	4
3	U19PH204	Material Science for Electrical Engineers	BS	3	0	0	3
4	U19CY204	Chemistry for Electrical Engineers	BS	3	0	0	3
5	U19CSG01	Problem Solving using Python Programming	ES	2	0	2	3
6	U19CSG02	Computational Thinking	ES	2	0	2	3
7	U19EE201	Basics of Electric Circuits	ES	3	0	0	3
		PRACTICALS					
8	U19EE202	Electric Circuits Laboratory	ES	0	0	4	2
			TOTAL	17	1	10	23

**** U19LE201 – Advanced Communicative English/ U19LE20* Other languages**

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SEMESTER III

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1	U19MA303	Fourier Analysis and Partial Differential Equations	BS	3	1	0	4
2	U19EE301	Electromagnetic Theory	PC	2	1	0	3
3	U19EE302	Electrical Machines – I	PC	3	0	0	3
4	U19EE303	Electronic Devices and Circuits	PC	3	0	2	4
5	U19EE304	Digital Logic Circuits	PC	3	0	0	3
6	U19EE305	Data Structures in C	ES	2	0	2	3
		PRACTICALS					
7	U19EE306	Electrical Machines - I Laboratory	PC	0	0	4	2
			TOTAL	16	2	8	22

SEMESTER IV

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1	U19MA405	Statistics and Numerical Methods	BS	3	0	0	3
2	U19EE401	Linear Integrated Circuits and Applications	PC	3	0	0	3
3	U19EE402	Electrical Machines - II	PC	3	0	0	3
4	U19EE403	Transmission and Distribution	PC	3	0	0	3
5	U19EE404	Measurements and Instrumentation	PC	3	0	0	3
6	U19EE405	Object Oriented Programming and Advanced Data Structures	ES	2	0	2	3
7	U19CA001	Numerical Aptitude and Verbal Ability I	EEC	1	0	0	1
		PRACTICALS					
8	U19EE406	Linear and Digital Integrated Circuits Laboratory	PC	0	0	2	1
9	U19EE407	Electrical Machines - II Laboratory	PC	0	0	4	2
			TOTAL	18	0	8	22

SEMESTER V

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1	U19EE501	Power System Analysis	PC	3	0	0	3
2	U19EE502	Microprocessors and Microcontrollers	PC	3	0	2	4
3	U19EE503	Power Electronics	PC	3	0	0	3
4	U19EE504	Control Systems	PC	3	1	0	4
5	-	Professional Elective - I	PE	3	0	0	3
6	-	Open Elective – I	OE	3	0	0	3
7	U19CA002	Numerical Aptitude and Verbal Ability – II	EEC	1	0	0	1

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PRACTICALS							
8	U19EE505	Control and Instrumentation Laboratory	PC	0	0	2	1
			TOTAL	**19**	**1**	**4**	**22**

SEMESTER VI

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	U19EE601	Solid State Drives	PC	3	0	0	3
2	U19EE602	Embedded Systems	PC	3	0	2	4
3	-	Professional Elective - II	PE	3	0	0	3
4	-	Professional Elective - III	PE	3	0	0	3
5	-	Open Elective – II	OE	3	0	0	3
6	-	Open Elective – III	OE	3	0	0	3
PRACTICALS							
7	U19EE603	Power Electronics and Drives Laboratory	PC	0	0	2	1
8	U19EE604	Technical Seminar	EEC	0	0	2	1
9	U19EE605	Mini Project	EEC	0	0	2	1
			TOTAL	**18**	**0**	**8**	**22**

SEMESTER VII

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	U19EE701	Principles of Management	HSM	3	0	0	3
2	-	Professional Elective - IV	PE	3	0	0	3
3	-	Professional Elective –V	PE	3	0	0	3
4	-	Professional Elective -VI	PE	3	0	0	3
5	-	Open Elective – IV	OE	3	0	0	3
PRACTICALS							
6	U19EE702	Power Engineering Laboratory	PC	0	0	2	1
			TOTAL	**15**	**0**	**2**	**16**

SEMESTER VIII

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1		Professional Elective - VII	PE	3	0	0	3
2		Professional Elective - VIII	PE	3	0	0	3
PRACTICALS							
3	U19EE801	Project Work	EEC	0	0	20	10
			TOTAL	**6**	**0**	**20**	**16**

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INDUSTRIAL INTERNSHIP

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19EEI01	Industrial Training/Internship* (Four Weeks)	EEC	0	0	0	2
			TOTAL	0	0	0	2

*Four Weeks during any semester vacation from III to VI Semester

TOTAL CREDITS: 165

PROFESSIONAL ELECTIVES (PE)

TRACK I

POWER ENGINEERING						
Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	U19EEP01	Renewable Energy Sources	3	0	0	3
2	U19EEP02	Energy Management and Auditing	3	0	0	3
3	U19EEP03	Computer Aided Power System Analysis	3	0	0	3
4	U19EEP04	Protection and Switchgear	3	0	0	3
5	U19EEP05	Power System Operation and Control	3	0	0	3
6	U19EEP06	Smart Grid Technologies	3	0	0	3
7	U19EEP07	Artificial Intelligence Applications to Power Systems	3	0	0	3
8	U19EEP08	Power System Restructuring	3	0	0	3
9	U19EEP09	Microgrid	3	0	0	3
10	U19EEP10	Power System Security	3	0	0	3
11	U19EEP11	High Voltage Engineering	3	0	0	3
12	U19EEP12	Utilization, Costing and Estimation	3	0	0	3
13	U19EEP13	EHV AC and DC Transmission	3	0	0	3
14	U19EEP14	Power Quality	3	0	0	3

TRACK II

ELECTRIC VEHICLES AND AUTOMATION						
Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	U19EEP15	Sensors and its Applications	3	0	0	3
2	U19EEP16	Energy Storage Systems and Controllers	3	0	0	3
3	U19EEP17	Advanced Electric Motors and Control	3	0	0	3
4	U19EEP18	EV Batteries and Charging Systems	3	0	0	3

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5	U19EEP19	Electric Vehicles and Dynamics	3	0	0	3
6	U19EEP20	Automotive MEMS	3	0	0	3
7	U19EEP21	EV Standard and Testing	3	0	0	3
8	U19EEP22	Hybrid Electric Vehicles	3	0	0	3
9	U19EEP23	Process Dynamics and Control	3	0	0	3
10	U19EEP24	IoT in EV Applications	3	0	0	3
11	U19EEP25	Automotive Transmission	3	0	0	3
12	U19EEP26	Industrial Automation	3	0	0	3
13	U19EEP27	Embedded Networking and Automation of Electrical Systems	3	0	0	3
14	U19EEP28	Data Acquisition and Robotic Control	3	0	0	3

TRACK III

ARTIFICIAL INTELLIGENCE AND EMBEDDED SYSTEMS

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	U19EEP29	Data Base Management Systems	3	0	0	3
2	U19EEP30	Web Technology	3	0	0	3
3	U19EEP31	System Programming and Operating Systems	3	0	0	3
4	U19EEP32	Application Development Practices	2	0	2	3
5	U19EEP33	Digital Image Processing	3	0	0	3
6	U19EEP34	Artificial Neural Network and Fuzzy Systems	3	0	0	3
7	U19EEP35	IoT System Design and Security	3	0	0	3
8	U19EEP36	Machine Learning	3	0	0	3
9	U19EEP37	Augmented Reality and Virtual Reality Applications in Engineering	3	0	0	3
10	U19EEP38	Embedded Systems Design	3	0	0	3
11	U19EEP39	Data Science	3	0	0	3
12	U19EEP40	Deep Learning	3	0	0	3
13	U19EEP41	Tensor Flow for Engineering Applications	3	0	0	3
14	U19EEP42	Big Data Analytics	3	0	0	3

HUMANITIES AND SCIENCES (HSM)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19LE101	Basic English	HSM	1	0	2	2

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2	U19LE102	Communicative English	HSM	1	0	2	2
3	U19LE201	Advanced Communicative English	HSM	1	0	2	2
4	U19EE701	Principles of Management	HSM	3	0	0	3

BASIC SCIENCES (BS)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19MA101	Calculus and Differential Equations	BS	3	1	0	4
2	U19PH101	Engineering Physics	BS	2	0	2	3
3	U19CY101	Engineering Chemistry I	BS	2	0	2	3
4	U19MA201	Complex Variables and Laplace Transforms	BS	3	1	0	4
5	U19PH204	Material Science for Electrical Engineers	BS	3	0	0	3
6	U19CY204	Chemistry for Electrical Engineers	BS	3	0	0	3
7	U19MA303	Fourier Analysis and Partial Differential Equations	BS	3	1	0	4
8	U19MA405	Statistics and Numerical Methods	BS	3	0	0	3

ENGINEERING SCIENCES (ES)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19EE101	Introduction to Electrical Engineering	ES	3	0	0	3
2	U19MEG01	Engineering Graphics	ES	1	0	4	3
3	U19EE102	Workshop (EEE)	ES	0	0	4	2
4	U19CSG01	Problem Solving using Python Programming	ES	2	0	2	3
5	U19CSG02	Computational Thinking	ES	2	0	2	3
6	U19EE201	Basics of Electric Circuits	ES	3	0	0	3
7	U19EE305	Data Structures in C	ES	2	0	2	3
8	U19EE405	Object Oriented Programming and Advanced Data Structures	ES	2	0	2	3

PROFESSIONAL CORE (PC)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19EE301	Electromagnetic Theory	PC	2	1	0	3
2	U19EE302	Electrical Machines – I	PC	3	0	0	3
3	U19EE303	Electronic Devices and Circuits	PC	3	0	2	4
4	U19EE304	Digital Logic Circuits	PC	3	0	0	3
6	U19EE306	Electrical Machines - I Laboratory	PC	0	0	4	2

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7	U19EE401	Linear Integrated Circuits and Applications	PC	3	0	0	3
8	U19EE402	Electrical Machines - II	PC	3	0	0	3
9	U19EE403	Transmission and Distribution	PC	3	0	0	3
10	U19EE404	Measurements and Instrumentation	PC	3	0	0	3
11	U19EE406	Linear and Digital Integrated Circuits Laboratory	PC	0	0	2	1
12	U19EE407	Electrical Machines - II Laboratory	PC	0	0	4	2
13	U19EE501	Power System Analysis	PC	3	0	0	3
14	U19EE502	Microprocessors and Microcontrollers	PC	3	0	2	4
15	U19EE503	Power Electronics	PC	3	0	0	3
16	U19EE504	Control Systems	PC	3	1	0	4
17	U19EE505	Control and Instrumentation Laboratory	PC	0	0	2	1
18	U19EE601	Solid State Drives	PC	3	0	0	3
19	U19EE602	Embedded Systems	PC	3	0	2	4
20	U19EE603	Power Electronics and Drives Laboratory	PC	0	0	2	1

PROFESSIONAL ELECTIVES (PE)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
PROFESSIONAL ELECTIVES I							
1	U19EEP01	Renewable Energy Sources	PE	3	0	0	3
2	U19EEP02	Energy Management and Auditing	PE	3	0	0	3
3	U19EEP15	Sensors and its Applications	PE	3	0	0	3
4	U19EEP16	Energy Storage Systems and Controllers	PE	3	0	0	3
5	U19EEP29	Data Base Management Systems	PE	3	0	0	3
6	U19EEP30	Web Technology	PE	3	0	0	3
PROFESSIONAL ELECTIVES II							
1	U19EEP03	Computer Aided Power System Analysis	PE	3	0	0	3
2	U19EEP04	Protection and Switchgear	PE	3	0	0	3
3	U19EEP17	Advanced Electric Motors and Control	PE	3	0	0	3
4	U19EEP18	EV Batteries and Charging Systems	PE	3	0	0	3
5	U19EEP31	System Programming and Operating Systems	PE	3	0	0	3
6	U19EEP32	Application Development Practices	PE	2	0	2	3
PROFESSIONAL ELECTIVES III							

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1	U19EEP05	Power System Operation and Control	PE	3	0	0	3
2	U19EEP06	Smart Grid Technologies	PE	3	0	0	3
3	U19EEP19	Electric Vehicles and Dynamics	PE	3	0	0	3
4	U19EEP20	Automotive MEMS	PE	3	0	0	3
5	U19EEP33	Digital Image Processing	PE	3	0	0	3
6	U19EEP34	Artificial Neural Network and Fuzzy Systems	PE	3	0	0	3
PROFESSIONAL ELECTIVES IV							
1	U19EEP07	Artificial Intelligence Applications to Power Systems	PE	3	0	0	3
2	U19EEP08	Power System Restructuring	PE	3	0	0	3
3	U19EEP21	EV Standard and Testing	PE	3	0	0	3
4	U19EEP22	Hybrid Electric Vehicles	PE	3	0	0	3
5	U19EEP35	IoT System Design and Security	PE	3	0	0	3
6	U19EEP36	Machine Learning	PE	3	0	0	3
PROFESSIONAL ELECTIVES V							
1	U19EEP09	Microgrid	PE	3	0	0	3
2	U19EEP10	Power System Security	PE	3	0	0	3
3	U19EEP23	Process Dynamics and Control	PE	3	0	0	3
4	U19EEP24	IoT in EV Applications	PE	3	0	0	3
5	U19EEP37	Augmented Reality and Virtual Reality Applications in Engineering	PE	3	0	0	3
6	U19EEP38	Embedded Systems Design	PE	3	0	0	3
PROFESSIONAL ELECTIVES VI							
1	U19EEP11	High Voltage Engineering	PE	3	0	0	3
2	U19EEP25	Automotive Transmission	PE	3	0	0	3
3	U19EEP39	Data Science	PE	3	0	0	3
PROFESSIONAL ELECTIVES VII							
1	U19EEP12	Utilization, Costing and Estimation	PE	3	0	0	3
2	U19EEP13	EHV AC and DC Transmission	PE	3	0	0	3
3	U19EEP26	Industrial Automation	PE	3	0	0	3
4	U19EEP27	Embedded Networking and Automation of Electrical Systems	PE	3	0	0	3
5	U19EEP40	Deep Learning	PE	3	0	0	3
6	U19EEP41	Tensor Flow for Engineering Applications	PE	3	0	0	3
PROFESSIONAL ELECTIVES VIII							
1	U19EEP14	Power Quality	PE	3	0	0	3

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2	U19EEP28	Data Acquisition and Robotic Control	PE	3	0	0	3
3	U19EEP42	Big Data Analytics	PE	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19CA001	Numerical Aptitude and Verbal Ability - I	EEC	1	0	0	1
2	U19CA002	Numerical Aptitude and Verbal Ability - II	EEC	1	0	0	1
3	U19EE604	Technical Seminar	EEC	0	0	2	1
4	U19EE605	Mini Project	EEC	0	0	2	1
5	U19EE801	Project Work	EEC	0	0	20	10
6	U19EEI01	Industrial Training/Internship* (Four Weeks)	EEC	0	0	0	2

MANDATORY NON-CREDIT COURSES (MNC)

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY/ SEMESTER	L	T	P	C
1	U19MYC01	Induction Program	MNC	1	0	0	-
2	U19MYC02	Environmental Sciences	MNC	1	0	0	-
3	U19MYC03	Essence of Indian Traditional Knowledge	MNC	1	0	0	-
4	U19MYC04	Indian Constitution	MNC	1	0	0	-

VIII. Scheme of Credit distribution – Summary

Sl. No.	Stream	Credits/Semester								Credits	%	Suggested by AICTE
		I	II	III	IV	V	VI	VII	VIII			
1	Humanities and Social Sciences including Management (HSM)	2	2	-	-	-	-	3	-	7	4	12
2	Basic Sciences (BS)	10	10	4	3	-	-	-	-	27	16	26
3	Engineering Sciences(ES)	8	11	3	3	-	-	-	-	25	15	20
4	Professional Core (PC)	-	-	15	15	15	8	1	-	54	33	53
5	Professional Elective (PE)	-	-	-	-	3	6	9	6	24	15	18
6	Open Electives(OE)	-	-	-	-	3	6	3	-	12	7	18
7	Employability Enhancement Courses (EEC)	-	-	-	1	1	2	-	10	14	10	11
8	Industrial Training/ Internship	-	-	-	-	-	-	2	-	2		
9	Mandatory Non-Credit Course (MNC)	-	-	-	-	-	-	-	-	-	-	-
	Total	20	23	22	22	22	22	18	16	165	100	158

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SEMESTER I

U19LE101	BASIC ENGLISH	Category: HSM			
		L	T	P	C
		1	0	2	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To read the text, understand and write the meaning under Technical, Business, Social and Academic contexts
- To listen and comprehend monologues, dialogues and discussions
- To speak effectively with appropriate use of words and participate in discussions

UNIT I BASICS FOR COMMUNICATION 9

Regular and Irregular Verbs – Modal Verbs – Prepositions – Tenses – Subject Verb Agreement – Spotting Errors – Homonyms and Homophones – Phrasal Verbs – Single word substitute – Word formation – Reported Speech

UNIT II LISTENING 9

Listening for specific Information – Listening to short texts – Listening to product description and process – Listening to formal and informal Conversations – Listening to announcements – Listening Comprehension

UNIT III SPEAKING 9

Introducing oneself – Seeking and sharing information – JAM – Enquiry – Asking for clarification – Describing a place, person, process, product and experience – Current affairs – Making presentations

UNIT IV READING 9

Reading for information – Skimming – Scanning – Predicting the content – Reading comprehension – Reading short texts – Proof reading(editing)

UNIT V WRITING 9

Memo – Email – Letter writing (formal and informal) – Dialogue writing – Descriptive writing – Instructions – Filling forms of application – Paraphrasing

LIST OF EXPERIMENTS

1. Listening for information
2. Listening to announcements
3. Listening to stories
4. Song based listening
5. Listening to conversations
6. Self Introduction
7. Just a Minute
8. Story narration
9. Picture description
10. Movie review

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Contact Periods:

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

TEXT BOOKS:

1. Mindscapes: "English for Technologist and Engineers", Orient Black Swan, 2014
2. Sudharshana N.P. and Savitha C., "English for Technical Communication", Cambridge University Press, 2016

REFERENCES:

1. Murphy, Raymond, "Intermediate English Grammar", Cambridge University Press, 2009
2. Means, Thomas L., "English and Communication for Colleges", Cengage 2017
3. "Using English: A Coursebook for Undergraduate Engineers and Technologists" Orient Black Swan, 2017

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Use appropriate vocabulary required for spoken and written communication	Remember
CO2	Comprehend and answer questions and take part in conversations	Understand
CO3	Participate in discussions and presentations	Apply
CO4	Understand the meaning of the content present in letters, reports and newspaper	Understand
CO5	Draft letters, e-mails and make notes with appropriate use of words	Apply

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	1	1	3	3	-	1	-	-
CO2	-	-	-	-	-	2	1	1	3	3	-	1	-	-
CO3	-	-	-	-	-	2	1	1	3	3	-	1	-	-
CO4	-	-	-	-	-	2	1	1	3	3	-	1	-	-
CO5	-	-	-	-	-	2	1	1	3	3	-	1	-	-
CO	-	-	-	-	-	2	1	1	3	3	-	1	-	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

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SEMESTER I

U19LE102	COMMUNICATIVE ENGLISH	Category: HSM			
		L	T	P	C
		1	0	2	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop the ability to read, write and comprehend various texts
- To enhance the listening skills to understand conversations and deliberations on diverse contexts
- To make effective presentations and demonstrate concepts within a team

UNIT I BASICS FOR COMMUNICATION 9

Active and Passive – Conditionals – Reported speech – Degrees of comparison – Phrases and clauses – Idioms – Kinds of sentences – Connectives and Discourse markers – Purpose statements

UNIT II LISTENING 9

Listening to TED talks – Listening to product description – Listening to orations – Listening to news – Radio based listening

UNIT III SPEAKING 9

Group discussion – Extempore – Technical seminar – Product and process description – Role play – Conversation and etiquettes – Short group conversation – Narrating a story – Formal and informal discussions

UNIT IV READING 9

Pre-reading and Post-reading – Intensive reading – Extensive reading – Newspaper reading – Reading longer texts – Reviewing company profile – Reading strategies – Interpreting visual graphics

UNIT V WRITING 9

Interpreting charts and graphs – Recommendations – Minutes of meeting – Job application and cover letter – Report writing – Drafting circulars (Business contexts)

LIST OF EXPERIMENTS

1. Listening to TED talks
2. Listening to product description
3. Listening to news
4. Radio based listening
5. Listening to oration
6. Self-Introduction
7. Role play
8. Extempore
9. Presentation
10. Group discussion

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Contact Periods:

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

TEXT BOOKS:

1. "Mindscapes: English for Technologist and Engineers", Orient Black Swan, 2014
2. Sudharshana N.P. and Savitha C., "English for Technical Communication", Cambridge University Press, 2016

REFERENCES:

1. Murphy, Raymond, "Intermediate English Grammar", Cambridge University Press, 2009
2. Means, Thomas L., "English and Communication for Colleges", Cengage 2017
3. "Using English: A Coursebook for Undergraduate Engineers and Technologists", Orient Black Swan, 2017

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Make use of relevant vocabulary in formal and informal contexts	Apply
CO2	Infer and exhibit the ability to listen various professional interactions	Understand
CO3	Express views and perceptions in a technical forum	Understand
CO4	Interpret a given text and relate the content effectively	Understand
CO5	Frame coherent and cohesive sentences in select contexts	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	1	1	3	3	-	1	-	-
CO2	-	-	-	-	-	2	1	1	3	3	-	1	-	-
CO3	-	-	-	-	-	2	1	1	3	3	-	1	-	-
CO4	-	-	-	-	-	2	1	1	3	3	-	1	-	-
CO5	-	-	-	-	-	2	1	1	3	3	-	1	-	-
CO	-	-	-	-	-	2	1	1	3	3	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER I

U19MA101	CALCULUS AND DIFFERENTIAL EQUATIONS	Category: BS			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- Understand the concepts of matrices and calculus which will enable them to model and analyze physical phenomena involving continuous change
- Apply and summarize the methodologies involved in solving problems related to fundamental principles of calculus
- Develop confidence to model mathematical pattern and give appropriate solutions

UNIT I MATRICES **9 + 3**

Eigenvalues and Eigenvectors – Properties (without proof) – Cayley Hamilton theorem (without proof) – Diagonalization using orthogonal transformation – Applications: Elastic membrane

UNIT II DIFFERENTIAL CALCULUS **9 + 3**

Curvature – Radius of curvature (Cartesian form only) – Center of curvature – Circle of curvature – Evolute and Envelope of plane curves

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9 + 3**

Partial derivatives – Total derivative – Jacobians – Taylor's series expansion – Extreme values of functions of two variables – Lagrange multipliers method

UNIT IV INTEGRAL CALCULUS **9 + 3**

Evaluation of definite and improper integrals – Applications of definite integrals – Surface areas – Volume of revolutions

UNIT V ORDINARY DIFFERENTIAL EQUATIONS **9 + 3**

Second and Higher order linear differential equations with constant coefficients – variable coefficients – Euler-Cauchy equation – Legendre's equation – Method of variation of parameters – Applications

Contact Periods:

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

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley India Pvt Ltd, New Delhi, 2018
2. Grewal B.S., "Higher Engineering Mathematics", 44th edition, Khanna Publishers, New Delhi, 2017

REFERENCES:

1. Bali N.P. and Dr Manish Goyal, "A text book of Engineering Mathematics", 12th edition, Laxmi Publications, 2016
2. Thomas G.B. and Finney R.L., "Calculus and Analytic Geometry", 14th edition, Pearson Education India, 2018
3. Maurice D. Weir, Joel Hass, Christopher Heil, "Thomas Calculus", 14th edition, Pearson Education, India, 2018
4. James Stewart, "Calculus: Early Transcendental", 7th Edition, Cengage Learning, New Delhi, 2015

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply the knowledge of matrices with the concepts of eigenvalues to study their problems in core areas	Apply
CO2	Study the behavior of a function at infinity, knowledge on curvature with its properties in Cartesian form	Apply
CO3	Develop competency in applying the idea of Lagrange multipliers to find extreme of functions with constraints	Apply
CO4	Compute area and volume using definite and improper integrals	Apply
CO5	Model the problems, when the particle changes with respect to its velocity, acceleration using higher order differential equations	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	2	1	-	1	-	-
CO2	3	2	1	-	-	-	-	-	2	1	-	1	-	-
CO3	3	2	1	-	-	-	-	-	2	1	-	1	-	-
CO4	3	2	1	-	-	-	-	-	2	1	-	1	-	-
CO5	3	2	1	-	-	-	-	-	2	1	-	1	-	-
CO	3	2	1	-	-	-	-	-	2	1	-	1	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER I

U19PH101	ENGINEERING PHYSICS	Category: BS			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Higher secondary physics

COURSE OBJECTIVES:

- To understand the concepts of surface tension, flow of liquids, heat transfer and thermal conductivity of materials
- To acquire the knowledge of ultrasonic waves and its production methods with its industrial and medical applications
- To understand the fundamental principles of laser and fiber optics with their applications

UNIT I PROPERTIES OF LIQUIDS 6

Surface tension – Determination of surface tension by Jaeger's method – Effect of temperature on surface tension – Viscosity – Coefficient of viscosity – Streamline and turbulent flow – Stokes law and terminal velocity – Poiseuille's equation for the flow of a liquid through a capillary tube and experimental determination

UNIT II HEAT 6

Modes of heat transfer – Thermal properties (solids and liquids) – Specific heat capacity, thermal capacity, thermal diffusivity and coefficient of linear thermal expansion – Lee's disc method for the determination of thermal conductivity – Heat conduction through compound media (series and parallel) – Solar water heater

UNIT III ULTRASONICS 6

Properties of ultrasonic waves – Production of ultrasonic waves – Magnetostrictive generator – Piezoelectric generator – Acoustic grating – Applications – SONAR – Cavitation – Drilling and welding – Nondestructive testing (flaw detection) – Medical applications (fetus heart movement)

UNIT IV LASER 6

Laser characteristics – Spatial and Temporal coherence – Einstein coefficient and its importance – population inversion – optical resonator – Pumping methods – Nd-YAG laser – CO_2 laser – Material processing (drilling, welding) – Medical applications in ophthalmology

UNIT V FIBRE OPTICS 6

Fiber optic cable – Features – Total internal reflection – Numerical aperture and acceptance angle – Classification of optical fibers based on refractive index, modes and materials – Fiber optical communication – Medical endoscopy

LIST OF EXPERIMENTS

1. Determination of viscosity of the given liquid using Poiseuille's flow method
2. Determination of thermal conductivity of a bad conductor using Lee's disc method
3. Determination of velocity of sound and compressibility of a liquid using Ultrasonic interferometer
4. Determination of particle size of lycopodium powder using laser light
5. Determination of wavelength of a given laser source
6. Determination of acceptance angle and numerical aperture of an optical fiber using laser source

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7. Determination of dispersive power of prism using spectrometer
8. Determination of refractive index of a liquid using spectrometer

Contact Periods:

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

TEXT BOOKS:

1. Bhattacharya D.K. and Poonam Tandon, "Engineering Physics", Oxford University Press, 2016
2. Pandey B.K. and Chaturvedi S., "Engineering Physics", Cengage Learning India, 2013

REFERENCES:

1. Arumugam M., "Engineering Physics", Anuradha Publishers, 2014
2. Murugeshan R., "Properties of Matter", S. Chand and Company Ltd, 2012
3. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publishers, 2016
4. https://nptel.ac.in/downloads/104104085/(Laser)
5. https://nptel.ac.in/courses/122107035/8(Ultrasonics)

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the concept of surface tension and viscosity of liquids	Understand
CO2	Interpret the thermal properties of materials and apply to the field of engineering	Understand
CO3	Illustrate the production methods of ultrasonic waves and use it for the field of engineering and medicine	Understand
CO4	Demonstrate the types of laser for various industrial and medical applications	Understand
CO5	Classify the fiber optic cable and study its engineering applications	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	1	2	1	-	1	1	-
CO2	3	2	1	-	-	-	-	1	2	1	-	1	1	-
CO3	3	2	1	-	-	-	-	1	2	1	1	1	1	-
CO4	3	2	1	-	-	-	-	1	2	1	-	1	1	-
CO5	3	2	1	-	-	-	-	1	2	1	-	1	1	-
CO	3	2	1	-	-	-	-	1	2	1	1	1	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER I

U19CY101	ENGINEERING CHEMISTRY I	Category: BS			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To inculcate the fundamentals of water technology and electrochemistry
- To gain basic knowledge of corrosion of metals and change of phases in alloys
- To acquire knowledge about the preparation, properties and applications of nanomaterials

UNIT I WATER 6

Hardness of water – Types – Problems in hardness calculations – Estimation of hardness by EDTA – Boiler feed water – Boiler trouble (scale, sludge, priming, foaming and caustic embrittlement) – Softening methods – Internal treatment (phosphate and calgon) – External treatment (deionization process) – Desalination of water – Reverse osmosis

UNIT II ELECTROCHEMISTRY 6

Electrochemical cells – Types – Galvanic cells – Redox reactions – EMF – Concept of electrode potential – Electrodes (Standard Hydrogen and Calomel electrode) – Nernst equation (derivation only) – Electrochemical series and its Applications – Estimation of iron by potentiometry, Determination of pH by pH metric

UNIT III CORROSION AND ITS CONTROL 6

Types – Chemical corrosion – Electrochemical corrosion (galvanic and differential aeration) – Factors influencing corrosion – Corrosion control methods – Sacrificial anode and impressed current method – Protective coating – Electroplating – Ni plating

UNIT IV PHASE RULE AND ALLOYS 6

Phase rule – Explanation of terms – Advantages and limitations of phase rule – Application of phase rule to one component system (water) – Reduced phase rule – Two component system (simple eutectic system – Lead – silver system) – Alloys – Definition – Purpose of making alloys – Ferrous (stainless steel), heat treatment – Non-ferrous alloys (Brass-Dutch metal, German Silver) – composition, properties and uses

UNIT V NANOCHEMISTRY AND ITS APPLICATIONS 6

Types – Properties of nanomaterials – Size dependent properties – General methods of synthesis – Top down (laser ablation and CVD) – Bottom up (solvothermal and precipitation) – Application of nanotechnology (medicine, electronics, defence and agriculture)

LIST OF EXPERIMENTS

1. Determination of total, permanent and temporary hardness of a given sample water by EDTA method
2. Determination of chloride content in the water sample
3. Estimation of ferrous ion by potentiometric titration
4. Determination of strength of HCl by pH metric method
5. Determination of corrosion rate by weight loss method

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6. Electroplating of Cu and electroless plating of Cu
7. Estimation of Copper in Brass by EDTA method
8. Determination of phase and degrees of freedom in $CuSO_4$. $5H_2O$ / KI and water / $FeCl_3$. $12H_2O$ / phenol-water
9. Preparation of nano ruby (Al_2O_3-Cr) by combustion method
10. Preparation of nano ZnO by co-precipitation method

Contact Periods:

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

TEXT BOOKS:

1. Jain P.C. and Monika Jain, "Engineering Chemistry", 16th edition, Dhanpat Rai Publishing Company, Pvt. Ltd., New Delhi, 2015
2. Vairam S., Kalyani P. and Suba Ramesh, "Engineering Chemistry", 2nd edition, Wiley India Pvt. Ltd, New Delhi, 2013

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", 2nd edition, Scientific International Pvt. Ltd, New Delhi, 2014
2. Prasanta Rath, "Engineering Chemistry", 1st edition, Cengage Learning India, Pvt. Ltd, Delhi, 2015
3. Shikha Agarwal, "Engineering Chemistry, Fundamentals and Applications", 1st edition, Cambridge University Press, 2015

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply the principles of water technology in treatment of industrial and domestic water and estimate the various constituents of industrial water	Apply
CO2	Describe the utilization of electrochemical principles for chemical cells and determine experimentally the EMF of the cells	Understand
CO3	Outline the corrosion process and prevention methods that is adopted in industries	Understand
CO4	Examine the number of phases, components and variants in different heterogeneous systems, construct the phase diagrams and ferrous alloys, composition and applications and relate the change in properties due to heat treatment	Understand
CO5	Classify the different nanomaterials, recall their properties and relate them to applications	Understand

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	2	1	2	1	-	1	1	-
CO2	3	1	1	-	-	-	2	1	2	1	-	1	1	-
CO3	3	1	-	-	-	-	2	1	2	1	-	1	1	-
CO4	3	1	1	-	-	-	2	1	2	1	-	1	1	-
CO5	3	1	1	-	-	-	2	1	2	1	-	1	1	-
CO	3	1	1	-	-	-	2	1	2	1	-	1	1	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER I

U19EE101	INTRODUCTION TO ELECTRICAL ENGINEERING	Category: ES			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire the fundamental knowledge on electricity, power generation, residential and industrial wiring
- To understand the concept of electrical accessories and various tariff
- To apply the concepts of supply utility and tariff calculation in practical applications

UNIT I FUNDAMENTALS OF ELECTRICITY 9

Evolution of electricity – Electrical quantities: DC and AC Current, Voltage, resistance, inductance, capacitance, frequency, impedance triangle – Types of loads – Electrical and mechanical – Electrical Safety measures

UNIT II POWER GENERATION 9

Introduction to energy resources – Conventional and non-conventional energy resources – Layouts of hydro, thermal, nuclear, solar, wind and biomass

UNIT III ELECTRICAL ACCESSORIES 9

Types of Lamps – Incandescent lamp, fluorescent lamp, CFL – Basics of fuses, relays, switches, MCBs, ELCBs and cables

UNIT IV RESIDENTIAL AND INDUSTRIAL WIRING 9

Introduction to electrical wiring layouts: Residential, staircase and industrial wiring – Importance of grounding, neutral and earthing – Types of earthing – Measurement of earth resistance – Field visit

UNIT V UTILITY SUPPLY AND TARIFF 9

Basics of utility supply – Single phase and three phase connection schemes – Electrical tariff and types – Calculation of energy – Introduction to energy audit and importance of energy saving

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Kothari D.P. and Nagrath I.J., "Basic Electrical Engineering", Tata McGraw-Hill Education, 2011
2. Uppal S.L., "Electrical Wiring, Estimating and Costing", 8th reprint, Khanna Publishers, 2018

REFERENCES:

1. Theraja B.L., "Fundamentals of Electrical Engineering and Electronics", S Chand & Company, 2011
2. "General Aspects of Energy Management and Energy Audit", Bureau of Energy Efficiency, Ministry of Power, Government of India

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Interpret the basic electrical quantities and their significance	Understand
CO2	Compare the various sources of power generation	Understand
CO3	Classify the different types of lamps, fuses and circuit breakers	Understand
CO4	Illustrate the residential and industrial wiring	Understand
CO5	Estimate the tariff and energy consumption for a load	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	1	-	-	-	-	-	-	1	1	1
CO2	3	1	-	-	-	-	-	-	-	-	-	1	1	1
CO3	3	1	-	-	-	-	-	-	-	-	-	1	1	1
CO4	3	1	-	-	-	1	-	1	-	-	-	1	1	1
CO5	3	2	1	-	-	1	-	1	-	-	1	1	1	1
CO	3	1.2	1	-	1	1	-	1	-	-	1	1	1	1

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER I

U19MEG01	ENGINEERING GRAPHICS	Category: ES			
		L	T	P	C
		1	0	4	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- The students will be exposed to standards and conventions followed in preparation of engineering drawings
- The students will understand the concepts of orthographic and isometric projections using CAD software
- The students will develop the ability of producing engineering drawings and conveying the information through drawings using CAD software

BASICS OF ENGINEERING DRAWING AND CAD 3

Introduction – Drawing instruments and its uses – Sheet layout, BIS conventions, lines, lettering and dimensioning practices lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. agency, parallelism, inclination and perpendicular

UNIT I CONICS, SPECIAL CURVES AND PROJECTION OF POINTS 3 + 12

Construction of parabola – Ellipse and hyperbola using eccentricity method – Construction of involutes for squares and circles – Construction of Tangent and normal to the above curves – Introduction, method of projection – Planes of projection – Reference line and notations Orthographic Projection of points: Points in all the four quadrants

UNIT II PROJECTION OF STRAIGHT LINES AND SURFACES 3 + 12

Projection of straight lines: Lines inclined to HP/VP plane, inclined to both HP and VP planes (straight lines are assumed to be in first quadrant only) – Projection of planes: Projection of square, rectangle, pentagon, hexagon and circular plane – Inclined to both the plane by change of position method

UNIT III PROJECTION OF SOLIDS 3 + 12

Introduction – Projection of solids: Prisms – Pyramids – Cylinders and cones with axis inclined to both the planes. (Solids resting on HP only)

UNIT IV DEVELOPMENT OF LATERAL SURFACES OF SOLIDS 3 + 12

Introduction – Cutting plane – Sectional views of right regular solids resting with base on HP: Prisms – Pyramids – Cylinder and cone and true shapes of the sections – Development of lateral surfaces of right regular prisms – Pyramids – Cylinders, cones resting with base on HP only – Development of their frustums and truncations

UNIT V ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS 3 + 12

Orthographic projection: Simple machine components using free hand sketching – Isometric projection: Simple solid exercises and combination of solids

Contact Periods:

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

TEXT BOOKS:

1. Bhat N.D. and Panchal V.M., "Engineering Drawing", 51st edition, Charotar Publishing House, Gujarat, 2013

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2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2010

REFERENCES:

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2017
2. Sam Tickoo, "AutoCAD 2013 for Engineers and Designers", Dreamtech Press, 2013
3. Annaiah M.H. and Rajashekar Patil, "Computer Aided Engineering Drawing", 4th edition, New Age International Publishers, 2012
4. Basant Aggarwal, "Engineering Drawing", 1st edition, Tata McGraw Hill Education Private Limited, 2010
5. Kulkarni D.M., Rastogi A.P. and Sarkar A.K., "Engineering Graphics with AutoCAD", Revised edition, PHI Learning Private Limited, New Delhi, 2010

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Sketch curves, orthographic projections of points as per BIS conventions	Apply
CO2	Illustrate the orthographic projections of straight lines and plane surfaces	Apply
CO3	Depict the orthographic projections of solids, lateral surfaces of frustums, truncated solids and its development	Apply
CO4	Translate pictorial and isometric views of simple objects to orthographic views	Apply
CO5	Convert the orthographic views into isometric projections	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	3	-	-	-	1	1	-	1	1	-
CO2	3	2	-	-	3	-	-	-	1	1	-	1	1	-
CO3	3	2	-	-	3	-	-	-	1	1	-	1	1	-
CO4	3	2	1	-	3	-	-	-	1	1	-	1	1	-
CO5	3	2	1	-	3	-	-	-	1	1	-	1	1	-
CO	3	2	1	-	3	-	-	-	1	1	-	1	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER I

U19EE102	WORKSHOP (EEE)	Category: ES			
		L	T	P	C
		0	0	4	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire the knowledge on carpentry, fitting and welding
- To understand the concept of various types of wiring systems, wiring tools, lighting and wiring accessories
- To apply practical knowledge on household electrical appliances

LIST OF EXPERIMENTS

1. Study of joining the wooden materials by dovetail method
2. Preparation of square fitting and vee - fitting models
3. Study of welding methods
4. House wiring
5. Fluorescent lamp and Stair case wiring
6. Measurement of electrical quantities - voltage, current, power and power factor in RLC circuit
7. Measurement of energy using single phase energy meter
8. Measurement of earth resistance using Megger
9. Soldering and de-soldering practices
10. Troubleshooting of ceiling fan
11. Study of Home appliances - iron box, kettle, solar water heater, mixer, grinder, washing machine, air conditioner, refrigerator, LCD Television, radio, vacuum cleaner, induction stove and micro wave oven (Any Two Appliances case study)

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the concept of dovetail method and vee fitting models	Apply
CO2	Apply the welding technique for the given material	Apply
CO3	Build the various types of electrical wiring schemes and measure the electrical quantities	Apply
CO4	Develop the soldering and de-soldering of electronic components	Apply
CO5	Demonstrate the operating principle of home appliances	Apply

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	-	1	1	1	1	1	-	1	1	-
CO2	3	1	1	1	-	1	1	1	1	1	-	1	1	-
CO3	3	1	1	1	-	1	1	1	1	1	1	1	1	-
CO4	3	1	1	1	-	1	1	1	1	1	1	1	1	-
CO5	3	1	1	1	-	1	1	1	1	1	-	1	1	1
CO	3	1	1	1	-	1	1	1	1	1	1	1	1	1
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER II

U19LE201	ADVANCED COMMUNICATIVE ENGLISH	Category: HSM			
		L	T	P	C
		1	0	2	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- Foster their ability to develop communicative strategies and skills
- Strengthen the learners to evocate their listening skills and enhance writing ability
- Exhibit proactive reading strategies and speaking techniques

UNIT I LANGUAGE ADEPTNERS 9

Cloze test – Sentence completion – Relative clause – Transformation of sentences – Common errors – Discourse markers – Formal and Informal expressions – Framing questions – Figures of speech

UNIT II LISTENING 9

Listening to announcements – Interviews – Group discussions – Dialogues – News items – Documentaries – IELTS – GRE – TOEFL based listening

UNIT III SPEAKING 9

Real life situations through role play – Language use – Pronunciation, stress and intonation – Narrating events – Presentation – Group discussion

UNIT IV READING 9

Reading strategies – Reading comprehension – Reading short stories – Journal articles – Inferring editorial column – Cloze reading

UNIT V WRITING 9

Book review – Guided writing – Writing gadget review – Free writing – Rephrasing – Interpreting text – Email writing – Process description

LIST OF EXPERIMENTS

1. Listening for announcements
2. Listening to dialogues
3. Listening to documentaries
4. Listening to interviews
5. IELTS based listening
6. Role play
7. Product description
8. Group discussion
9. Book review
10. General presentation

Contact Periods:

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

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TEXT BOOKS:

1. Shoba K.N. and Lourdes Joavani Rayen. "Communicative English", Cambridge University Press, 2017
2. Sudharshana N.P. and Savitha C., "English for Technical Communication", Cambridge University Press, 2016

REFERENCES:

1. Murphy, Raymond, "Intermediate English Grammar", Cambridge University Press, 2009
2. Means, Thomas L., "English and Communication for Colleges", Cengage 2017
3. "Using English: A Coursebook for Undergraduate Engineers and Technologists", Orient Black Swan, 2017

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Inculcate effective reading strategy	Understand
CO2	Express opinions in real life situations	Understand
CO3	Construct academic and professional writing	Apply
CO4	Impart the listening ability in self-learning	Apply
CO5	Adept to the needs of the second language learner in a grammatical context	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	2	-	2	-	3	-	1	-	-
CO3	-	-	-	-	-	2	-	-	2	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	1	-	-
CO5	-	-	-	-	-	-	2	2	-	3	-	1	-	-
CO	-	-	-	-	-	2	2	2	2	3	-	1	-	-
Correlation levels:	1: Slight (Low)					2: Moderate (Medium)				3: Substantial (High)				

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SEMESTER II

U19MA201	COMPLEX VARIABLES AND LAPLACE TRANSFORMS	Category: BS			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- Understand the vector calculus, which extends the basic concepts of differential calculus to vector functions
- Use the concepts of complex analysis, in the study of heat flow, fluid dynamics and electrostatics
- Apply and summarize the mathematical aspects of time domain to frequency domain using Laplace transform and Inverse Laplace transform vice versa

UNIT I MULTIPLE INTEGRALS **9 + 3**

Double integrals – Change of order of integration – Triple integrals – Applications: Area and volume

UNIT II VECTOR CALCULUS **9 + 3**

Gradient – Divergence and curl – Directional derivative– Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem – Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds

UNIT III LAPLACE TRANSFORM **9 + 3**

Laplace transform – Conditions for existence – Transform of elementary functions – Standard properties (statement only) – Transforms of unit step function – impulse function – Periodic function – Initial and Final value theorems – Convolution theorem (without proof) – Inverse Laplace transform – Standard properties (statement only) – Second order linear differential equations with constant coefficients

UNIT IV COMPLEX DIFFERENTIATION **9 + 3**

Analytic functions: Cauchy-Riemann equations (Cartesian form) and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Construction of analytic functions – Bilinear transformations

UNIT V COMPLEX INTEGRATION **9 + 3**

Complex integration – Statement and applications of Cauchy's Integral theorem and Cauchy's Integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Cauchy's Residue theorem

Contact Periods:

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

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Pvt Ltd, New Delhi, 2018
2. Grewal B.S., "Higher Engineering Mathematics", 44th edition, Khanna Publishers, New Delhi, 2017

REFERENCES:

1. Bali N.P. and Dr Manish Goyal, "A text book of Engineering Mathematics", 12th edition, Laxmi Publications, 2016
2. Thomas G.B. and Finney R.L., "Calculus and Analytic Geometry", 14th edition, Pearson Education India, 2018

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3. James Stewart, "Calculus: Early Transcendental", 7th edition, Cengage Learning, New Delhi, 2015

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Calculate the area and volume of a body on the basis of analysis done with one/two dimensions of a body	Apply
CO2	Apply the theoretical aspects of vector integral calculus in Electro Magnetic Theory and Field	Apply
CO3	Apply the concepts of Laplace transform with their properties in Circuit Theory and Control Systems	Apply
CO4	Identify the complex functions and their mapping in certain complex planes	Apply
CO5	Differentiate and integrate functions represented as power series expansions, including Taylor series, and solve related problems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	2	1	-	1	-	-
CO2	3	2	1	-	-	-	-	-	2	1	-	1	-	-
CO3	3	2	1	-	-	-	-	-	2	1	-	1	-	-
CO4	3	2	1	-	-	-	-	-	2	1	-	1	-	-
CO5	3	3	1	-	-	-	-	-	2	1	-	1	-	-
CO	3	2.2	1	-	-	-	-	-	2	1	-	1	-	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER II

U19PH204	MATERIAL SCIENCE FOR ELECTRICAL ENGINEERS	Category: BS			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Higher Secondary Physics

COURSE OBJECTIVES:

- To gain the knowledge of electrical properties of materials
- To acquire the knowledge of magnetic, dielectric and optical properties of materials
- To gain the fundamentals of advanced materials

UNIT I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory – Expression for electrical conductivity – Wiedemann – Franz law – Success and failures of classical free electron theory – Electrons in metals – Fermi-Dirac statistics – Density of energy states – Metals and insulators – Energy bands in solids

UNIT II MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS 9

Magnetism in materials – Magnetic field and induction – Magnetisation – Magnetic permeability and susceptibility – Types of magnetic materials (dia, para and ferro) – Ferromagnetism: origin and exchange interaction – Domain theory – Soft and hard magnetic materials – Dielectric materials: polarization process (electronic, ionic, orientational and space charge) – Dielectric loss – Dielectric breakdown

UNIT III OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – Carrier generation and recombination processes – Absorption, emission and scattering of light in metals, insulators and semiconductors (concepts only) – Solar cell – I-V characteristics – Efficiency – Solar cell materials – LED – PIN diode

UNIT IV SEMICONDUCTOR MATERIALS 9

Classification of semiconductors based on composition and purity – Carrier concentration in intrinsic semiconductor – Law of mass action – Carrier concentration in n-type semiconductor – P-type semiconductor(qualitative) – Variation of Fermi level with temperature – Hall effect – Experiment – Hall coefficient and its applications

UNIT V ADVANCED MATERIALS 9

Introduction – Electron density in bulk materials – Size dependence of Fermi energy – Quantum confinement – quantum structures (quantum dot, quantum well) – SiC – SMA – Phases – Characteristics – Applications – GaN – Rheological materials

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Wahab M.A., "Solid State Physics: Structure and Properties of Materials", 3rd edition, Narosa Publishing House, 2018
2. Kasap S.O., "Principles of Electronic Materials and Devices", 3rd edition, McGraw-Hill Education, 2017

REFERENCES:

1. Salivahanan S., and Sureshkumar N., "Electronic Devices and Circuits", 4th edition, McGraw Hill Education, 2016

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2. Angusam Sarkar and Chandankumar Sarkar, "Solid State Microelectronic and Optoelectronic Devices", 1st edition, University Press (India) Private Limited, 2012
3. Achuthan M.K. and Bhat K.N., "Fundamentals of Semiconductor Devices", 1st edition, McGraw Hill Education, 2017

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Understand the electrical characteristics of conducting materials	Understand
CO2	Understand the properties and types of magnetic materials and dielectric materials	Understand
CO3	Apply the basic concepts of optical materials to design various optical devices	Apply
CO4	Gain the knowledge of the types of semiconductors and properties used in electronic applications	Understand
CO5	Examine new advanced materials and quantum structures for various applications	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	1	-	-	-	-	-	1	1	-
CO2	3	2	-	-	-	1	-	-	-	-	-	1	1	-
CO3	3	2	1	-	-	1	-	-	-	-	-	1	1	-
CO4	3	2	-	-	-	1	-	-	-	-	-	1	1	-
CO5	3	2	-	-	-	1	-	-	-	-	-	1	1	-
CO	3	2	1	-	-	1	-	-	-	-	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER II

U19CY204	CHEMISTRY FOR ELECTRICAL ENGINEERS	Category: BS			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Engineering Chemistry I

COURSE OBJECTIVES:

- To acquire the basic understanding of adsorption and catalysis for industrial applications.
- To gain adequate knowledge on energy storage sources and batteries.
- To understand the fundamentals of polymers and silicon wafers technology.

UNIT I SURFACE CHEMISTRY 9

Adsorption – Types of adsorption – Adsorption of gases on solids – Adsorption isotherms – Freundlich adsorption isotherm – Langmuir adsorption isotherm – Applications of adsorption on pollution abatement. Catalyst – Definition – Characteristics – Types of catalysis – Criteria – autocatalysis – Catalytic poisoning and catalytic promoters – Applications (catalytic convertor) – enzyme catalysis – Michaelis – Menten equation

Estimation of adsorbed sodium in a substrate by flame photometry (Demonstration only)

UNIT II ENERGY SOURCES 9

Energy – Classification, energy demand, conventional – Coal, hydroelectric, limitations of conventional energy – Non-conventional energy resources – Solar energy conversion – Solar cells – Wind energy – Ocean energy (tidal, OTEC) – Geothermal energy, biofuels – Biogas

UNIT III BATTERIES 9

Batteries – Types – Merits and demerits – Applications – Primary battery (dry cell), secondary battery (lead acid battery, lithium-ion-battery) – H_2-O_2 Fuel cell and supercapacitors

Components of various batteries (Demonstration only)

UNIT IV POLYMERS 9

Introduction – Monomer, dimers, functionality, degree of polymerisation, transition glass temperature, classification of polymers – Source, structure, tacticity, thermoplastics (PVC, Nylon 6, Nylon 66, Nylon 11, Teflon), thermosetting plastics (Bakelite, urea formaldehyde) – Preparation, properties and applications, compounding – Conducting polymers – Polypyrrole, polyacetylene, polyaniline (structures only) composites – FRP – Properties and applications

Determination of molecular weight and degree of polymerization of a polymer by viscosity measurements (Ostwald's viscometer) (Demonstration only)

UNIT V SILICON WAFER TECHNOLOGY 9

Silicon for chips – Single crystal – Preparation by Czechralski and float zone processes – Wafer preparation – P-N junction formation (by diffusion technique only) – Insulator layer by oxidation – Photolithography – Chemical etching method – Planar technology

Chemical Etching (Demonstration only)

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Jain P.C. and Monika Jain, "Engineering Chemistry", 16th edition, Dhanpat Rai Publishing Company, Pvt. Ltd., New Delhi, 2015

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2. Vairam S., Kalyani P. and Suba Ramesh, "Engineering Chemistry", 2nd edition, Wiley India Pvt. Ltd., New Delhi, 2013

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", 2nd edition, Scientific International Pvt. Ltd., New Delhi, 2014
2. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", 1st edition, Cambridge University Press, Delhi, 2015
3. Tyagi MS., "Introduction to semiconductor materials and devices", 7th edition, Wiley India, 2012

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Illustrate the concept of adsorption, its types, isotherms and adsorption of solid in solutions and principle of catalysis, its process, classification and applications	Understand
CO2	Appreciate the utility of different energy sources its types, process and its applications in electrical energy generation.	Understand
CO3	Explain the construction, working and applications of different kinds of batteries for electrical applications	Understand
CO4	Classify different types of polymers, synthesize practically and apply them in mechanical machinery	Understand
CO5	Discuss the various steps involved in IC Chip manufacturing process	Understand

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	2	-	-	-	-	1	1	-
CO2	3	1	-	-	-	-	2	-	-	-	-	1	1	1
CO3	3	1	1	-	-	-	2	-	-	-	-	1	1	-
CO4	3	1	-	-	-	-	2	-	-	-	-	1	1	-
CO5	3	1	-	-	-	-	2	-	-	-	-	1	1	-
CO	3	1	1	-	-	-	2	-	-	-	-	1	1	1
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER II

U19CSG01	PROBLEM SOLVING USING PYTHON PROGRAMMING	Category: ES			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To learn basics of computers and problem-solving techniques
- To understand syntax and semantics of python programming
- To develop simple python programs

UNIT I COMPUTER BASICS AND PROBLEM-SOLVING STRATEGIES 6

Introduction to Computers: Characteristics – Classification – Applications – Components – Hardware and Software – Algorithms – Algorithmic building blocks – Notations: Pseudo code – Flow chart – Programming language – Programming paradigms – Computational thinking

UNIT II LANGUAGE BASICS 6

Python interpreter and interactive mode – Tokens – Data types – Numbers and math functions – Input and Output operations – Comments – Reserved words – Indentation – Operators and expressions – Precedence and associativity – Type conversion – Debugging – Common errors in Python – Classes and objects

UNIT III CONTROL STATEMENTS, FUNCTIONS AND MODULES 6

Selection/Conditional branching statements: if – if-else – Nested-if – Elif statements – Iterative statements: while – for loop – break – continue and pass statements – Functions: Function Definition and Function call – Variable scope and Lifetime – Return statement – Lambda functions or Anonymous functions – Recursion – Modules and Packages

UNIT IV PYTHON DATA STRUCTURES 6

Strings: Slicing – Immutability – Built-in string methods and functions – Concatenating – Appending and Multiplying strings – String modules – Regular expressions – List: Creation – Accessing values – Slicing – List methods – In-built functions for Lists – Tuples: Creation – Operations on tuples – Traversing – Indexing and Slicing – Tuple assignment – In-built functions for tuples – Sets: Creation – Operations – Dictionaries: operations and methods

UNIT V EXCEPTION AND FILE HANDLING 6

Exceptions: Errors and Exceptions – Handling exception – Built-in and User-defined exceptions – Files: Types – Operations: Open – Read – Write – Close

LIST OF EXPERIMENTS

1. Algorithms, flowchart and pseudo code
2. Language basics
3. Input and output statements
4. Looping and decision-making statements
5. String operations
6. Recursive functions
7. Python data structures
8. Searching and Sorting

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9. Generating histogram
10. File and exception handling

Contact Periods:

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

TEXT BOOKS:

1. Reema Thareja, "Python programming: Using problem solving approach" 1st edition, Oxford University Press, 2017
2. Roland Backhouse, "Algorithmic Problem Solving", 1st edition, John Wiley & Sons, 2011

REFERENCES:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, O'Reilly Publishers, 2016
2. Ashok Namdev Kamthane and Amit Ashok Kamthane, "Programming and Problem Solving with Python", 1st edition, McGraw Hill Education, 2018
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", 1st edition, Pearson India Education Services Pvt. Ltd., 2016

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Interpret computer basics and algorithmic solutions for a given problem	Understand
CO2	Demonstrate the usage of data types, operators and expressions in python programming	Apply
CO3	Design python programs using functions, modules and packages	Apply
CO4	Develop programs using python data structures	Apply
CO5	Demonstrate the usage of exceptions and file handling	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	2	2	2	-	2	1	-
CO2	3	3	2	-	1	-	-	2	2	2	-	2	1	-
CO3	3	3	3	-	1	-	-	2	2	2	-	2	1	-
CO4	3	3	2	-	1	-	-	2	2	2	-	2	1	-
CO5	3	3	2	-	1	-	-	2	2	2	-	2	1	-
CO	3	2.8	2	-	1	-	-	2	2	2	-	2	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER II

U19CSG02	COMPUTATIONAL THINKING	Category: ES			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Problem Solving using Python Programming

COURSE OBJECTIVES:

- To formulate problems in a way that enables the use of a computer to solve them
- To logically organize and analyze data
- To identify, analyze and implement possible solutions with the goal of achieving the most efficient and effective combination of steps and resources

UNIT I PRINCIPLES OF COMPUTATIONAL THINKING 6

Programming – Algorithmic thinking – Bitwise and Boolean algebra – Compiler vs interpreter – Pseudo coding – Problem definition – Data collection – Problem decomposition – Abstraction – Flowcharting – Name binding – Selection – Repetition – Modularization – Sample exercise problems and deriving solutions.

UNIT II DATA ORGANIZATION & PROCESSING USING PYTHON 6

Operators – Variables and Data types – Loops and conditions – Nested loop – Strings – Euclid's algorithm – Arrays – Functions – Recursion

UNIT III REVERSE ENGINEERING & SOLUTIONS 6

Algorithm Tracing Technique (simulating execution) – Best practices – keeping it simple – documentation style – idioms – DRY code – naming conventions – and comments – Debugging Anticipating output from pseudo code

UNIT IV APPLIED COMPUTATIONAL THINKING 6

Operating systems basics – Networking basics – Database Management System (DBMS) – SQL – No SQL – JSON – API – XML

UNIT V EFFICIENCY ANALYSIS AND BENCHMARKING 6

Algorithm efficiency – Time complexity in programs – Mathematical preliminaries – Asymptotic analysis – Recurrence relations – Algorithm design paradigms – Divide and conquer algorithms – Dynamic programming – Greedy algorithms

LIST OF EXPERIMENTS

1. Print the difference of indices of largest and smallest number in an array
2. Length of the longest substring without repeating characters
3. Prime factors of a given number
4. Product of the sum of diagonals of an array
5. The greatest common divisor (GCD) of two numbers – with & without Euclid's algorithm
6. Finding output of sequencing and looping puzzles
7. Finding output of pattern matching puzzles
8. Using only indexing technique- storing and retrieving Array elements (without library functions)
9. Add, subtract, multiply, and check for equality in the two given matrices (without library functions)

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10. Utilize the Pythagorean Theorem to calculate a third side of a right triangle, given the other two sides
11. Time complexity analysis – Tower of Hanoi (using Recursion) – 3 rods and n disks
12. Time complexity analysis – Tower of Hanoi (using Recursion) – 4 rods and n disks

Contact Periods:

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

TEXT BOOKS:

1. David Riley and Kenny Hunt, "Computational thinking for modern solver", Kindle Edition, Chapman & Hall/CRC, 2014
2. Karl Beecher, "Computational Thinking: A beginner's guide to problem solving and programming", Kindle Edition, BCS, The Chartered Institute for IT, 2017

REFERENCES:

1. Paul Curzon and Peter William Mcowan, "Power of Computational Thinking, the: Games, Magic and Puzzles to Help You Become A Computational Thinker", Kindle Edition, World Scientific Publishing Europe Ltd, 2017
2. Fabrizio Luccio, Paolo Ferragina, "Computational Thinking: First Algorithms, Then Code", Kindle Edition, Springer, 2018
3. Jane Krauss, Kiki Prottsman, "Computational Thinking and Coding for Every Student: The Teacher's Getting-Started Guide" Kindle edition, SAGE publications, 2016
4. GUVI Technical Learning Platform, Certifications, Assessments and FDP/FEM for KPRIET

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Understand the basic principles of Computational thinking	Understand
CO2	Examine the data organization and processing using Python	Apply
CO3	Understand the basic algorithm tracing techniques	Understand
CO4	Explore the basics of operating system, networking, database management system, API and XML	Analyze
CO5	Determine efficiency of algorithms	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	-	-	1	2	1	-	2	1	-
CO2	3	2	2	-	-	-	-	1	2	1	-	2	1	-
CO3	3	2	2	2	2	-	-	1	2	1	-	2	1	-
CO4	3	-	-	2	2	-	-	1	2	1	-	2	1	-
CO5	3	3	3	2	-	-	-	1	2	1	-	3	1	-
CO	3	2.5	2.25	2	2	-	-	1	2	1	-	2.2	1	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

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SEMESTER II

U19EE201	BASICS OF ELECTRIC CIRCUITS	Category: ES			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce electric circuits and its analysis
- To identify the major parameters of two port networks
- To introduce the phenomenon of resonance and coupled circuits

UNIT I BASIC CONCEPTS OF ELECTRIC CIRCUITS 9

Active and passive elements – Elements in series and parallel connections – Ohm's law and Kirchhoff's laws – Complex impedance – Phasor diagram – Voltage and current division – Star and delta conversions – Source transformation – Mesh and nodal analysis – Power, power factor and energy

UNIT II NETWORK THEOREMS 9

DC and AC circuits: Superposition theorem – Thevenin's and Norton's theorem – Maximum power transfer theorem – Millman's theorem – Applications

UNIT III THREE PHASE CIRCUITS 9

Three phase system – Phasor diagram – Three phase three wire – Three phase four wire – Balanced star and delta load – Unbalance star and delta load – Power measurement in three phase system

UNIT IV TRANSIENT RESPONSE AND TWO PORT NETWORKS 9

Transient response of RL, RC and RLC circuits with DC and sinusoidal excitations – Two port networks – Z and Y parameters

UNIT V RESONANCE AND COUPLED CIRCUITS 9

Series and parallel resonance circuits – Frequency response, quality factor bandwidth and half power frequencies – Coupled circuits – Self and mutual inductance – Coupling coefficient – Dot rule – Single tuned circuits – Applications

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Sudhakar A and Shyammohan S. Palli, "Circuits and Network Analysis", 5th edition, McGraw-Hill Education, New Delhi, 2019
2. William H. Hayt, Jr., Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", 8th edition, McGraw-Hill Education, New Delhi, 2013

REFERENCES:

1. Joseph A. Edminister, Mahmood Nahvi, "Electric Circuits", 5th edition, Schaum's outline series, McGraw Hill Education, New Delhi, 2017
2. Allan H. Robbins, Wilhelm C. Miller, "Circuits Analysis Theory and Practice", 5th edition, Cengage Learning, India, 2013

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3. Charles K. Alexander and Matthew N. O. Sadiku, "Electric Circuits", 6th edition, McGraw Hill Education, New Delhi, 2019

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Solve an electric network by applying basic laws and reduction methods	Apply
CO2	Apply the concept of network theorems for electric circuits	Apply
CO3	Explain the concepts of three phase circuits and its power measurement	Understand
CO4	Analyze the transient response of electric circuits and to infer two port network parameters	Analyze
CO5	Interpret the resonance phenomenon and coupled circuits	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO	3	2	1	-	-	-	-	-	-	-	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER II

U19EE202	ELECTRIC CIRCUITS LABORATORY	Category: ES			
		L	T	P	C
		0	0	4	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To verify an electric circuit using network theorems
- To compute the transient response of an electric circuit
- To design a resonance circuit and sketch its frequency response

LIST OF EXPERIMENTS

1. Determination of an equivalent resistance for an electric circuit
2. Experimental verification of an electric circuit using Ohm's and Kirchhoff's laws
3. Experimental verification of an electric circuit using mesh and nodal analysis
4. Experimental verification of an electric circuit using Thevenin's theorem
5. Experimental verification of an electric circuit using Norton's theorem
6. Experimental verification of an electric circuit using superposition theorem
7. Experimental verification of an electric circuit using maximum power transfer theorem
8. Measurement of three phase power using two wattmeter method
9. Experimental validation of RL, RC and RLC transients
10. Determination of resonance frequency, half power frequencies, bandwidth and quality factor of a series and parallel resonance circuit

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Verify an electric circuit using basic circuit laws	Analyze
CO2	Verify an electric circuit by applying network theorems	Analyze
CO3	Calculate the three-phase power using two wattmeter method	Apply
CO4	Compute the transient response of an electric circuit	Analyze
CO5	Design a series and parallel resonance circuit	Analyze

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	1	1	1	-	1	1	1
CO2	3	2	1	1	1	-	-	1	1	1	-	1	1	-
CO3	3	2	1	1	1	-	-	1	1	1	-	1	1	-
CO4	3	2	1	1	1	-	-	1	1	1	-	1	1	-
CO5	3	2	1	1	1	-	-	1	1	1	-	1	1	-
CO	3	2	1	1	1	-	-	1	1	1	-	1	1	1
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER III

U19MA303	FOURIER ANALYSIS AND PARTIAL DIFFERENTIAL EQUATIONS	Category: BS			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- Apply Fourier series for periodic signals
- Apply and summarize the mathematical aspects that contribute to the solution of One-Dimensional Wave and Heat equation
- Understand the concept of transform techniques in the field of engineering

UNIT I PARTIAL DIFFERENTIAL EQUATIONS **9 + 3**

Formation of Partial Differential Equations – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Solution methods for second order homogeneous equations with constant coefficients

UNIT II FOURIER SERIES **9 + 3**

Dirichlet's conditions – Full range Fourier series – Odd and Even functions – Half range series – Parseval's Identity – Harmonic analysis

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9 + 3**

Fourier series solution – Vibrations of strings – one dimensional wave equation – one dimensional equation of heat conduction

UNIT IV FOURIER TRANSFORM **9 + 3**

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's Identity

UNIT V Z – TRANSFORM **9 + 3**

Z-transforms – Elementary properties – Inverse Z- transform – Initial and Final value theorems (statement only) – Convolution theorem – Formation of difference equations – Solution of difference equations using Z - transform

Contact Periods:

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

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44th edition, Khanna Publishers, New Delhi, 2017
2. Srimanta Pal and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, New Delhi, 2015
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, John Wiley & Sons, New Delhi, 2018

REFERENCES:

1. Bali N.P. and Manish Goyal, "A Textbook of Engineering Mathematics", 9th edition, Laxmi Publications Pvt. Ltd, 2014
2. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage, New Delhi, 2016
3. James G, "Advanced Modern Engineering Mathematics", 3rd edition, Pearson Education, 2011

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Use Partial Differential Equation through mathematical models	Apply
CO2	Identify the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series	Apply
CO3	Apply Fourier series as a tool for One Dimensional Wave and Heat equations	Apply
CO4	Analyze the spectral characteristics of signals using Fourier Transforms	Apply
CO5	Apply Z- transform for analyze of discrete-time signals and systems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	2	1	-	1	-	-
CO2	3	2	1	-	-	-	-	-	2	1	-	1	-	-
CO3	3	2	1	-	-	-	-	-	2	1	-	1	-	-
CO4	2	2	1	-	-	-	-	-	2	1	-	1	-	-
CO5	3	3	1	-	-	-	-	-	2	1	-	1	-	-
CO	2.8	2.2	1	-	-	-	-	-	2	1	-	1	-	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER III

U19EE301	ELECTROMAGNETIC THEORY	Category: PC			
		L	T	P	C
		2	1	0	3

PRE–REQUISITES:

- Material Science for Electrical Engineers, Complex Variables and Laplace Transforms

COURSE OBJECTIVES:

- To acquire the fundamental knowledge on coordinate system, electrostatics and magnetostatics
- To understand the concept of electric fields in material space and magnetostatics
- To apply the concept of electromagnetics to develop the EMF and Maxwell's equations

UNIT I CO-ORDINATE SYSTEMS **6 + 3**

Introduction to Co-ordinate system: Rectangular, cylindrical, spherical – Differential elements – Point and vector transformation – Nabla operator – Gradient, divergence and curl – Divergence theorem and Stoke's theorem

UNIT II ELECTROSTATICS FIELDS **6 + 3**

Coulomb's Law – Principle of superposition – Electric field intensity – Electric field intensity due to continuous uniform charge distribution: infinite and finite line, circular disc – Electric flux density – Gauss's Law and its proof – Electric potential – Potential due to infinite line charge – Potential due to circular disc

UNIT III ELECTRIC FIELDS IN MATERIAL SPACE **6 + 3**

Dipole moment – Electric potential due to dipole moment – Electric polarization – Potential gradient – Current and current density – Integral and point form of continuity equation – Resistance of conductor – Point form of Ohm's law – Poisson's and Laplace's equation – Boundary conditions for electric fields: between dielectrics, conductor and dielectric, conductor and free space – Dielectric strength – Capacitance: parallel plate, sphere – Electrostatic energy and energy density

UNIT IV MAGNETOSTATICS **6+ 3**

Lorentz force equation – Force on current element – Biot-Savart Law – Magnetic Field intensity due to finite and infinite wire carrying current I – Magnetic Field intensity due to circular loop carrying a current I – Ampere's circuital law – Magnetic flux density – Magnetic dipole moment – Magnetization – Magnetic Torque – Boundary conditions for magnetic fields – Magnetic circuits – Self and mutual inductance – Inductance of solenoid and Toroid – Energy and energy density

UNIT V APPLICATION OF ELECTROMAGNETICS **6+ 3**

Faraday's law – Transformer EMF and Motional EMF – Maxwell's equations derived from Ampere's Circuital Law – Maxwell's equations derived from Faradays Law – Maxwell's equations derived from Guess's Law – Poynting theorem – Poynting vector – Power flow in a co-axial cable – Relationship between circuit theory and field theory

Contact Periods:

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

TEXT BOOKS:

1. Mathew N.O. Sadiku, "Principles of Electromagnetic Fields", 4th edition, Oxford University Press, 2010
2. William Hayt Jr. and John A. Buck, "Engineering Electromagnetics", 8th edition, TMH Publishing Co. Ltd., 2014

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REFERENCES:

1. Gangadhar K.A., "Electromagnetic Field Theory", 8th reprint, Khanna Publishers, 2015
2. Joseph. A. Edminister, "Schaum's Outline Series Theory and Problems of Electromagnetics", 3rd edition, Tata McGraw Hill, 2010
3. Tewari J.P., "Engineering Electromagnetics- Theory, Problems and Applications", Latest edition, Khanna Publishers, 2018

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply the concept of vector calculus for different coordinate systems	Apply
CO2	Describe the electric field intensity in various geometric by using appropriate law	Understand
CO3	Apply the concept of electric potential for different geometries	Apply
CO4	Describe the basic concepts on magneto-statics and its applications	Understand
CO5	Describe the concepts of Maxwell's Equations	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	1	1	-	1	1	-
CO2	3	2	1	-	-	-	-	-	1	1	-	1	1	-
CO3	3	2	2	1	-	-	-	-	1	1	-	1	1	-
CO4	3	2	1	-	-	-	-	-	1	1	-	1	1	-
CO5	3	2	1	-	-	-	-	-	1	1	-	1	1	-
CO	3	2	1.4	1	1	-	-	-	1	1	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER III

U19EE302	ELECTRICAL MACHINES – I	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Basics of Electric Circuits

COURSE OBJECTIVES:

- To acquire the knowledge in construction, working principle and classification of electrical machines
- To understand the concept of testing and performance characteristics of generators, motors and transformers
- To select the various DC machines and transformers for field applications

UNIT I DC GENERATORS 9

Basics of electromechanical energy conversion system – Operating principle – Construction – Types of winding – EMF equation – Methods of excitation – Types – Armature reaction – Commutation – Methods of improving commutation – Open circuit and Load Characteristics – Parallel operation – Applications

UNIT II DC MOTORS 9

Principle of operation – Back EMF – Torque and power developed equations – Types – Characteristics – Starting and speed control – Plugging, dynamic and regenerative braking – Applications

UNIT III TESTING OF DC MACHINES 9

Specifications – Losses and efficiency – Testing of DC machines – Open circuit and load test on generator, Brake test, Swinburne's test on motor and Hopkinson's test

UNIT IV TRANSFORMERS 9

Construction – Principle of operation – No load and load condition – Equivalent circuit parameters – Losses and efficiency – Voltage regulation – Parallel operation – Autotransformer – Field visit

UNIT V TESTING OF TRANSFORMERS AND THREE PHASE TRANSFORMERS 9

Specifications – All day efficiency – Testing – Load test, OC and SC test, Sumpner's test, polarity test – Three phase transformers – Connections – Scott connection – Applications

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Kothari D.P. and Nagrath I.J., "Electric Machines", 5th edition, McGraw-Hill Education Pvt. Ltd, 2017
2. Bimbhra P.S., "Electrical Machinery", 7th edition, Khanna Publishers, 2011

REFERENCES:

1. Gupta B.R., "Fundamental of Electric Machines", 3rd edition, New age International Publishers, Reprint 2015
2. Rajput R.K., "Electrical Machines", 6th edition, Laxmi Publications, 2016

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the construction, operating principle and characteristics of DC generators	Understand
CO2	Acquire the knowledge on operating principle, starting and speed control of DC motors	Understand
CO3	Apply various testing methods for the assessment of the performance characteristics of DC machines	Apply
CO4	Explain the construction, operating principle and equivalent circuit of transformers	Understand
CO5	Identify various testing methods of singe phase transformer and types of connections in three phase transformers	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	2	3	-
CO2	3	2	1	-	-	-	-	-	-	-	-	2	3	-
CO3	3	3	2	1	-	-	-	-	-	-	-	2	3	-
CO4	3	2	1	-	-	-	-	-	-	-	-	2	3	-
CO5	3	3	2	1	-	-	-	-	-	-	-	2	3	-
CO	3	2.4	1.4	1	-	-	-	-	-	-	-	2	3	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER III

U19EE303	ELECTRONIC DEVICES AND CIRCUITS	Category: PC			
		L	T	P	C
		3	0	2	4

PRE–REQUISITES:

- Material Science for Electrical Engineers

COURSE OBJECTIVES:

- To acquire the knowledge on semiconductor devices and its characteristics
- To understand the operation of transistors, oscillators and special devices
- To apply semiconductor devices for rectifiers, regulators, amplifiers and oscillators concept of mitigation techniques for solving power quality issues

UNIT I PN JUNCTION DIODE 9

Semiconductor devices – PN junction diode – Structure, operation and I – V characteristics – Diffusion and transition capacitance – Rectifiers – Half wave and full wave rectifier – Zener diode – Structure – Operation and I – V characteristics – Zener diode as voltage regulator – UJT – structure and characteristics

UNIT II BIPOLAR JUNCTION TRANSISTOR 9

BJT– Structure – Operation – Characteristics – Biasing – Small signal model – Analysis of CE, CB, CC amplifiers – Gain and frequency response – Differential amplifier – Common mode and difference mode analysis – High frequency analysis

UNIT III FIELD EFFECT TRANSISTOR 9

CMOS – FET – Structure – Operation – Characteristics – FET small signal model – Analysis of CS and source follower – Gain and frequency response – High frequency analysis

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Power amplifiers (Qualitative analysis) – Advantages of negative feedback – Voltage / current series, shunt feedback – positive feedback – Condition for oscillations – Phase–shift, Wien bridge, Hartley, Colpitts and Crystal oscillators

UNIT V SPECIAL DIODES AND OPTO ELECTRONIC DEVICES 9

Display devices – LED – LASER diodes – Solar Cells – Photo diode – Photo transistor – Optocoupler – Charge coupled devices – Special diodes – Varactor diodes – Tunnel diodes – Schottky diodes – PIN diode

LIST OF EXPERIMENTS

1. Characteristics of Semiconductor diode and Zener diode
2. Single Phase half-wave and full-wave rectifiers with inductive and capacitive filters
3. Characteristics of photo diode and phototransistor
4. Characteristics of NPN Transistor under Common Emitter, Common Collector and Common Base configurations
5. Characteristics of JFET and draw the equivalent circuit
6. Characteristics of UJT and generation of saw tooth waveforms
7. Design and frequency response characteristics of a common emitter amplifier
8. Differential amplifiers using FET

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9. Design and testing of RC phase shift and LC oscillators
10. Design and implementation of clipper and clamper circuits using diodes
11. Characteristics of BJT and FET using PSpice
12. Mini Project

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: 30 Periods Total: 75 Periods

TEXT BOOKS:

1. Robert Boylestad and Lowis Nashelsky, "Electronic Devices and Circuit Theory", 11th edition, Pearson Education, 2015
2. David A. Bell, "Electronic Devices and Circuits", 5th edition, Prentice Hall India, 2010

REFERENCES:

1. Floyd T.L., "Electronic Devices", Pearson Education, 10th edition, New Delhi, 2018
2. Sedra and Smith, "Microelectronic Circuits", 7th edition, Oxford University Press, 2014

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Infer the characteristics and applications of PN junction diode, Zener diode and UJT	Understand
CO2	Design an amplifier using BJT	Apply
CO3	Interpret the response of FET amplifiers	Understand
CO4	Design feedback amplifiers and oscillators using transistors	Apply
CO5	Identify the applications of optoelectronic devices	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	1	1	1	1	1	2	-
CO2	3	2	2	1	1	-	-	1	1	1	1	1	2	-
CO3	3	2	1	1	-	-	-	1	1	1	1	1	2	-
CO4	3	2	2	1	1	-	-	1	1	1	1	1	2	-
CO5	3	1	1	1	-	-	-	1	1	1	1	1	2	-
CO	3	1.8	1.4	1	1	-	-	1	1	1	1	1	2	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

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SEMESTER III

U19EE304	DIGITAL LOGIC CIRCUITS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Material Science for Electrical Engineers

COURSE OBJECTIVES:

- To acquire the knowledge on combinational, synchronous and asynchronous sequential logic circuits
- To understand the concept of various memory devices, programmable logic devices and digital logic families
- To apply the programming language to the digital logic circuits using VERILOG

UNIT I BOOLEAN ALGEBRA AND COMBINATIONAL CIRCUITS 9

Basic logic gates – Boolean algebra: De-Morgan's theorem – Switching functions and simplification using K-maps – Design of adder, subtractor, comparators, code converters, multiplexers and demultiplexers – Applications

UNIT II SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Flipflops: SR, D, JK and T – Analysis of synchronous sequential circuits – Design of synchronous sequential circuits – Moore and Melay models – Counters – State diagram, state reduction, state assignment, asynchronous and synchronous type – Modulo counters

UNIT III ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Analysis of asynchronous sequential logic circuit – Fundamental and pulse mode, state reduction, state assignment – Asynchronous design problem, transition table, flow table – Race conditions, hazards and errors in digital circuits

UNIT IV PROGRAMMABLE LOGIC DEVICES, MEMORY AND LOGIC FAMILIES 9

X Memories: ROM, PROM, PLA, PAL, PLD, CPLD, FPGA – Digital logic families: RTL, DTL, TTL, ECL, MOS families

UNIT V VERILOG 9

Introduction to VERILOG – RTL design – Combinational logic – Types – Operators – Packages – Test benches (Adders, Counters, Flipflops, FSM, Multiplexers / Demultiplexers)

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Morris Mano M, Michael D. Ciletti, "Digital Design with an Introduction to the Verilog HDL, VHDL and System Verilog", 6th edition, Pearson Education, 2018
2. David J. Comer, "Digital Logic and State Machine Design", 3rd edition, Oxford University Press, 2012

REFERENCES:

1. Soumitra Kumar Mandal, "Digital Electronics Principles and Application", 1st edition, McGraw-Hill Education, 2017
2. William Keitz, "Digital Electronics - A Practical Approach with VHDL", 1st edition, Pearson Education, 2013

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Simplify the mathematical expressions using Boolean postulates and implement combinational logic circuits using K-map	Understand
CO2	Explain the various types of flipflops, counters and design synchronous sequential logic circuits	Analyze
CO3	Analyze the behavior of asynchronous sequential logic circuits	Analyze
CO4	Interpret different memory devices, programmable logic devices and digital logic families	Understand
CO5	Apply verilog programming to various digital logic circuit applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	-	-	-	-	-	-	-	1	2	-
CO2	3	2	2	1	-	-	-	-	-	-	-	1	2	-
CO3	3	2	2	1	-	-	-	-	-	-	-	1	2	-
CO4	3	1	1	1	-	-	-	-	-	-	-	1	2	-
CO5	3	2	2	1	1	-	-	-	-	-	-	1	2	-
CO	3	1.6	1.6	1	1	-	-	-	-	-	-	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER III

U19EE305	DATA STRUCTURES IN C	Category: ES			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Problem Solving using Python Programming

COURSE OBJECTIVES:

- To learn C programming constructs and write simple programs
- To understand the concepts of functions, pointers, structures and unions
- To learn and explore the applications of linear and non-linear data structures

UNIT I BASICS OF C PROGRAMMING 6

Structure of C program – Pre-processor directives – Compilation and Linking processes – Data Types – Storage classes – Constants – Variables – Operators – Expressions – Input / Output statements – Assignment statements – Decision making statements – Switch statement – Looping statements – Arrays: declaration, initialization, one-dimensional and two-dimensional arrays – Strings: declaration – Initialization and operations on strings

UNIT II FUNCTIONS, POINTERS, STRUCTURES AND UNIONS 6

Functions: Pass by value – Pass by reference and Recursion – Pointers definition – Initialization-Pointers arithmetic – Structures and Unions – Definition – Structure within a structure – Programs using structures and unions

UNIT III LINEAR DATA STRCUTURES 6

Stacks and Queues – Array-based implementation – Linked lists – Linked list-based implementation of Stacks and Queues – Evaluation of Expressions – Linked list based polynomial addition

UNIT IV NON-LINEAR DATA STRCUTURES 6

Trees – Binary Trees – Binary tree representation and traversals – Binary Search Trees – Applications of trees – Set representations – Union – Find operations – Graph and its representations – Graph Traversals

UNIT V SEARCHING AND SORING ALGORITHMS 6

Linear Search – Binary Search – Bubble Sort – Insertion sort – Merge sort – Quick sort – Hash tables – Overflow handling

LIST OF EXPERIMENTS

1. Input and Output statements
2. Looping and decision-making statements
3. String Operations
4. Matrix operations
5. Functions and Pointers
6. Structures and Unions
7. Stack: array-based and linked list-based implementation
8. Queue: array-based and linked list-based implementation
9. Polynomial addition
10. Searching and Sorting

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Contact Periods:

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

TEXT BOOKS:

1. Reema Thareja, "Programming in C", 1st edition, Oxford University Press, 2018
2. Reema Thareja, "Data structures using C", 2nd edition, Oxford University Press, 2014

REFERENCES:

1. Pradip Dey and Manas Gosh, "Programming in C", 1st edition, Oxford University Press, 2018
2. Herbert Schildt, "C: The Complete Reference", 4th edition, McGraw Hill Education, 2017
3. Seymour Lipschutz, "Data structures with C", 4th edition, McGraw Hill Education, 2017

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Understand the basic of C Programming language constructs	Understand
CO2	Learn the concepts of arrays and strings	Understand
CO3	Applying functions, pointers, structures and unions to write programs	Apply
CO4	Understand the Linear and Non-Linear Data Structures	Understand
CO5	Learn the various searching and sorting algorithms	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	2	2	2	-	1	1	-
CO2	3	2	2	-	-	-	-	2	2	2	-	1	1	-
CO3	3	2	2	-	-	-	-	2	2	2	-	1	1	-
CO4	3	2	2	-	-	-	-	2	2	2	-	1	1	-
CO5	3	2	2	-	-	-	-	2	2	2	-	1	1	-
CO	3	2	2	-	-	-	-	2	2	2	-	1	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER III

U19EE306	ELECTRICAL MACHINES – I LABORATORY	Category: PC			
		L	T	P	C
		0	0	4	2

PRE–REQUISITES:

- Basics of Electric Circuits

COURSE OBJECTIVES:

- To acquire the knowledge on testing of various DC machines and transformers
- To understand the working principle of DC motors and transformers
- To test DC machines and transformers under various loading conditions

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of DC shunt generator
2. Load characteristics of DC compound generator with differential and cumulative connections
3. Load test on DC shunt and compound motor
4. Load test on DC series motor
5. Swinburne's test and Speed control of DC motor
6. Hopkinson's test
7. Load test on single phase transformer
8. Open circuit and short circuit test on single phase transformer
9. Sumpner's test on single phase transformers
10. Connections of three phase transformers
11. Mini Project

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Analyze the characteristics of DC shunt and compound generators	Apply
CO2	Compare the load characteristics of DC shunt, series and compound motors	Apply
CO3	Estimate the efficiency of DC machines using indirect methods	Apply
CO4	Choose the different speed control methods for various applications	Apply
CO5	Asses the performance characteristics and equivalent circuit parameters of single-phase transformers	Apply

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	1	1	1	1	1	3	-
CO2	3	2	2	1	1	-	-	1	1	1	1	1	3	-
CO3	3	2	2	1	1	-	-	1	1	1	1	1	3	-
CO4	3	2	2	1	1	-	-	1	1	1	1	1	3	-
CO5	3	2	2	1	1	-	-	1	1	1	1	1	3	-
CO	3	2	2	1	1	-	-	1	1	1	1	1	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

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SEMESTER IV

U19MA405	STATISTICS AND NUMERICAL METHODS	Category: BS			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- Understand the concepts of Probability and Statistics in the field of engineering
- Apply the concepts of testing of hypothesis for small and large samples
- Apply design of experiments in the field of engineering

UNIT I PROBABILITY 9

Probability – Axioms of probability – Conditional probability – Total probability – Baye's theorem – Discrete and continuous random variables

UNIT II TESTING OF HYPOTHESIS 9

Large sample test for single mean and difference of means – Small sample test: t, Chi-square and F distributions

UNIT III DESIGN OF EXPERIMENTS 9

One way and Two-way classifications – Completely randomized design – Randomized block Design – Latin square design

UNIT IV SYSTEM OF EQUATIONS 9

Newton-Raphson method – Gauss elimination method – Gauss-Jordan method – Iterative methods of Gauss-Jacobi and Gauss-Seidel

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9

Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Johnson R.A., Miller I. and Freund J., "Miller and Freund's Probability and Statistics for Engineers", 8th edition, Pearson Education, Asia, 2015
2. Grewal B.S., "Numerical Methods in Science and Engineering", 9th edition, Khanna Publishers, 2015
3. Gupta S.C., Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand Publishers, 2014

REFERENCES:

1. Bali N.P. and Manish Goyal, "A Textbook of Engineering Mathematics", 9th edition, Laxmi Publications Pvt. Ltd, 2014
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage, New Delhi, 2016
3. James G., "Advanced Modern Engineering Mathematics, 3rd edition, Pearson Education, 2011

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply probability axioms and the moments of discrete and continuous random variables	Apply
CO2	Analyze small and large samples in industry by using testing of hypothesis	Apply
CO3	Compute and interpret the results of real time applications by performing ANOVA and F-test	Analyze
CO4	Apply numerical techniques to obtain solution of algebraic equations	Apply
CO5	Use numerical methods to solve ordinary differential equations	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO	3	2	1	-	-	-	-	-	-	-	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER IV

U19EE401	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Electronic Devices and Circuits

COURSE OBJECTIVES:

- To acquire knowledge in IC fabrication, operational amplifiers and special ICs
- To understand the characteristics of operational amplifiers
- To apply special ICs and regulator ICs for various applications

UNIT I IC FABRICATION 9

IC classifications – Fundamentals of monolithic IC technology – Realization of monolithic ICs – Recent trends in IC technology – Fabrication of diodes, capacitor, resistor and FETs

UNIT II CHARACTERISTICS OF OP AMP 9

Ideal characteristics of Op-Amp – Functional blocks of Op-Amp – Inverting and Non-inverting amplifiers – DC characteristics – AC characteristics – Differential amplifier

UNIT III APPLICATIONS OF OP AMP 9

V/I and I/V converters – Summer – Differentiator – Integrator – Instrumentation amplifier – First order low pass and high pass active filters – Waveform generators – Clippers – Clampers – Peak detector – Sample and Hold circuit – D/A converters – A/D converters

UNIT IV SPECIAL ICs 9

555 Timer IC – Monostable mode – Astable mode – Applications – 566 Voltage controlled oscillator – 565 Phase lock loop – BQ76PL536-Q1 battery monitoring and protection – Applications

UNIT V VOLTAGE REGULATORS 9

IC voltage regulators – LM78XX, 79XX – Fixed voltage regulators – Low Drop Out (LDO) linear regulator – Switching regulator – SMPS – TPS61170

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Roy Choudhary D. and Sheil B. Jani, "Linear Integrated Circuits", New Age Publisher, 2018
2. David A. Bell, "Op-amp & Linear ICs", Oxford University Press, 2013

REFERENCES:

1. Robert F. Coughlin and Fredrick F. Driscoll, "Op-amp and Linear ICs", 6th edition, PHI Learning Pvt. Ltd., New Delhi, 2012
2. Jacob Millman and Christos C. Halkias, "Integrated Electronics - Analog and Digital Circuits System", Tata McGraw Hill, 2003.
3. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", McGraw Hill, 2016

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the fabrication techniques of monolithic ICs	Understand
CO2	Summarize the characteristics of operational amplifier	Understand
CO3	Apply the operational amplifiers for various applications	Apply
CO4	Describe the functional blocks of Special ICs	Understand
CO5	Design the voltage regulators using integrated circuits	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	1	2	-
CO2	3	1	1	-	-	-	-	-	-	-	-	1	2	-
CO3	3	2	2	1	-	1	1	-	-	-	-	1	2	-
CO4	3	1	1	-	-	-	-	-	-	-	-	1	2	-
CO5	3	2	2	1	-	1	1	-	-	-	-	1	2	-
CO	3	1.4	1.4	1	-	1	1	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER IV

U19EE402	ELECTRICAL MACHINES – II	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Electrical Machines – I

COURSE OBJECTIVES:

- To acquire the knowledge on construction and operating principles of various AC machines
- To understand the starting and speed control of AC motors
- To apply AC motors, generators and special electrical machines for various practical applications

UNIT I SYNCHRONOUS GENERATOR 9

Construction and types – EMF equation – Armature reaction – Voltage regulation – EMF and MMF methods – Parallel operation – Two reaction theory for salient pole alternator – Slip test

UNIT II SYNCHRONOUS MOTOR 9

Principle of operation – Starting methods – Torque equation – Effect of varying field current and load – V and Inverted V curves – Synchronous condenser – Hunting – Damper winding

UNIT III THREE PHASE INDUCTION MOTOR 9

Construction – Types – Principle of operation – Slip – Torque Equation – Torque-Slip characteristics – Cogging and crawling – Equivalent circuit – Power flow diagram – Losses and efficiency – No load and blocked rotor tests – Double cage induction motors – Induction generator – Submersible motor

UNIT IV STARTING AND SPEED CONTROL OF INDUCTION MOTOR 9

Starters – Types – DOL, star-delta, auto transformer and rotor resistance starter – Soft starters – Speed control – Number of poles, cascaded connection and V/f Control – Braking

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Construction – Double field revolving theory – Starting methods – Capacitor start – Capacitor run induction motor – Shaded pole induction motor – Equivalent circuit – Servo motor – Stepper motor – Linear induction motor – Applications

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Stephen J. Chapman, "Electric Machinery Fundamentals", 4th edition, McGraw - Hill Education Pvt. Ltd, 2010
2. Kothari D.P. and Nagrath I.J., "Electric Machines", 5th edition, McGraw - Hill Publishing Company Ltd, 2017

REFERENCES:

1. Gupta B.R., "Fundamental of Electric Machines" 3rd edition, New Age International Publishers, Reprint 2015
2. Bhimbhra P.S., "Electrical Machinery", 2nd edition, Khanna Publishers, 2017
3. Gupta J.B., "Theory and Performance of Electrical Machines", S. K. Kataria & Sons Publishers, 2016

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Interpret the constructional details, principle and performance of alternators	Understand
CO2	Acquire the knowledge of synchronous motors and its applications	Understand
CO3	Infer the operation and performance of three phase induction motors	Understand
CO4	Analyze the performance characteristics of AC motors by various testing methods	Apply
CO5	Explain the construction and operating principles of single-phase induction motors and special machines	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	2	3	-
CO2	3	2	1	-	-	-	-	-	-	-	-	2	3	-
CO3	3	2	1	-	-	-	-	-	-	-	-	2	3	-
CO4	3	2	1	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	1	-	-	-	-	-	-	-	-	2	3	-
CO	3	2	1	-	-	-	-	-	-	-	-	2	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER IV

U19EE403	TRANSMISSION AND DISTRIBUTION	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Basics of Electric Circuits, Electromagnetic Theory

COURSE OBJECTIVES:

- To acquire the knowledge on electrical supply systems and performance of transmission lines
- To understand the concept of insulators, cables and its performance parameters
- To apply the concepts of electrical and mechanical design for overhead lines

UNIT I ELECTRICAL SUPPLY SYSTEMS 9

Structure of power system – Operating level voltages – Generation, transmission and distribution – AC and DC distributors – Interconnection – Indian grids – Electricity de-regulation – DISCOMs

UNIT II ELECTRICAL DESIGN OF OVERHEAD LINES 9

Parameters of single and three phase transmission lines with single and double circuits – Resistance, inductance and capacitance of solid, stranded and bundled conductors – Symmetrical and unsymmetrical spacing – Transposition of lines – Skin and proximity effects

UNIT III PERFORMANCE OF TRANSMISSION LINES 9

Performance of transmission lines – Short line, medium line and long line – Equivalent circuits, phasor diagram, transmission efficiency and voltage regulation – Surge impedance loading – Ferranti effect

UNIT IV MECHANICAL DESIGN OF OVERHEAD LINES 9

Line supports – Dampers – Spacers – Types of towers, tower spotting and conductor types – Corona – Critical voltages – Stress and sag calculation – Effects of wind and ice loading – Field visit

UNIT V INSULATORS AND CABLES 9

Types of insulators – String efficiency – Construction of cables – Power factor and heating of cables – DC cables – Fault identification

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Kothari D.P. and Nagarath I.J., "Power System Engineering", 3rd edition, McGraw-Hill Publishing Company Ltd., New Delhi, 2019
2. Mehta V.K. and Rohit Mehta, "Principles of Power System", 6th edition, S. Chand, New Delhi, 2014

REFERENCES:

1. Gupta B.R., "Power System Analysis and Design", 7th revised edition, S. Chand, New Delhi, 2014
2. Gupta J.B., "Transmission and Distribution", 10th edition, S. K. Kataria & Sons, New Delhi, 2015
3. Singh S.N., "Electric Power Generation, Transmission and Distribution", 2nd edition, PHI Learning Pvt. Ltd., 2011

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Interpret the structure of electric supply and distribution systems	Understand
CO2	Determine the line parameters in overhead transmission lines	Apply
CO3	Identify the performance of short, medium and long transmission lines	Apply
CO4	Solve sag and tension of overhead lines for different weather conditions	Apply
CO5	Summarize the types of insulators and cables	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	2	-	2
CO2	3	2	2	1	2	1	1	-	-	-	-	2	-	2
CO3	3	2	2	1	2	1	1	-	-	-	-	2	-	2
CO4	3	2	2	1	-	1	1	-	-	-	-	2	-	2
CO5	3	1	1	-	-	-	-	-	-	-	-	2	-	2
CO	3	1.6	1.6	1	2	1	1	-	-	-	-	2	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER IV

U19EE404	MEASUREMENTS AND INSTRUMENTATION	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Material Science for Electrical Engineers

COURSE OBJECTIVES:

- To acquire the knowledge on measurements and instrumentation systems
- To understand the working of various electrical and electronic instruments, storage and display devices
- To apply the concept of instrumentation in sensors and transducers

UNIT I INSTRUMENTS AND MEASUREMENT SYSTEMS 9

Functional elements of instrument – Units and standards of measurements – Static and dynamic characteristics – Errors in measurement – Calibration methodology – Construction and working principle of moving coil and moving iron instruments

UNIT II ELECTRICAL AND ELECTRONIC INSTRUMENTS 9

Digital voltmeters – Integrating type, successive approximation type DVM – Digital multimeters – Frequency meter – Power factor meter – CT and PT – Dynamometer type wattmeter – Single phase induction type energy meter – Phantom loading

UNIT III COMPARATIVE METHOD OF MEASUREMENTS 9

Determination of B-H curve – Measurement of iron losses – AC potentiometers – DC potentiometers – Crompton's and Duo Range type – DC bridges – AC bridges – Maxwell, Schering and Anderson bridges – Interference types – Screening methods

UNIT IV STORAGE AND DISPLAY DEVICES 9

X-Y recorder – Digital plotters and printers – CRT display, cathode ray oscilloscope, digital storage oscilloscope – Data loggers – HDD – SSD

UNIT V SENSORS AND TRANSDUCERS 9

Hall effect sensors – Proximity Sensors – Temperature sensors – Soil and moisture sensors – Classification of transducers – Resistive, capacitive and inductive transducer – Thermoelectric and piezoelectric transducer – LVDT

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Sawhney A.K., "A Course in Electrical and Electronic Measurement and Instrumentation", 18th edition, Dhanpat Rai & Co., 2015
2. Albert D. Halfride and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Pearson India Education, 2016

REFERENCES:

1. Stout M.B., "Basic Electrical Measurements", Prentice Hall of India Pvt Ltd., 2012
2. Gupta J.B., "A Course in Electronics and Electrical Measurements and Instrumentation", S. K. Kataria & Sons, Delhi, 2013
3. Patranabis D., "Sensors and Transducers", 2nd edition, PHI Learning, 2013

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the functional elements and types of instruments	Understand
CO2	Summarize the concept of electrical and electronic instruments	Understand
CO3	Apply various comparative methods to measure the electrical parameters	Apply
CO4	Illustrate the construction and working principle of various storage and display devices	Understand
CO5	Infer the concept of sensors and transducers for various applications	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	1	2	-
CO2	3	1	1	-	-	-	-	-	-	-	-	1	2	-
CO3	3	2	2	-	-	1	1	-	-	-	-	1	2	-
CO4	3	1	1	-	-	-	-	-	-	-	-	1	2	-
CO5	3	2	2	-	-	1	1	-	-	-	-	1	2	-
CO	3	1.4	1.4	-	-	1	1	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER IV

U19EE405	OBJECT ORIENTED PROGRAMMING AND ADVANCED DATA STRUCTURES	Category: ES			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Data Structures in C

COURSE OBJECTIVES:

- To learn basics of Object-Oriented Programming concepts and characteristics of Java
- To understand the Exceptions and use I/O streams
- To learn the usage of hierarchical data structures, Graphs and its applications.

UNIT I OOP AND JAVA FUNDAMENTALS 6

Object oriented programming – Abstraction – Objects and classes – Encapsulation– Inheritance – Polymorphism – OOP in Java – Characteristics of Java – The Java environment – Java source file – Structure – Compilation – Fundamental programming structures in Java – Defining classes in Java – Constructors – Methods – Access specifiers – Static members – Comments – Data types – Variables – Operators – Control flow – Arrays – Packages – Java doc comments

UNIT II INHERITANCE AND INTERFACES 6

Inheritance – Super classes – Sub classes – Protected members – Constructors in sub classes – The object class – Abstract classes and methods – Final methods and classes – Interfaces – Defining an interface – Implementing interface – Differences between classes and interfaces and extending interfaces – Object cloning – Inner classes – Array lists – Strings

UNIT III EXCEPTION HANDLING AND I/O 6

Exceptions – Exception hierarchy – Throwing and catching exceptions – Built in exceptions – Creating own exception – Stack trace elements – Input / Output basics – Streams – Byte streams and character streams – Reading and writing console – Reading and writing files

UNIT IV HIERARCHICAL DATA STRUCTURES 6

AVL trees – AVL tree rotation – B tree – B+ tree – Heap – Applications of heap

UNIT V GRAPHS 6

Graphs – Introduction – Representation of graphs – BFS – DFS –Topological sort – Bi-connectivity Dijkstra's algorithm – The Floyd Warshall algorithm – Minimum spanning trees – Cut vertex – Euler circuits – Applications of graphs including electric circuit designing

LIST OF EXPERIMENTS

1. Program to implement Operators, Flow Controls concepts
2. Program to implement Classes, Constructors, Overloading and access control
3. Program using Nested & Inner Classes, Static and Final
4. Program using File Streams and IO Streams
5. Program to implement Strings, String Buffer Concept
6. Program using Interfaces, Abstract Classes
7. Develop a Java application to generate telephone bill
8. Develop a java application to implement currency converter, distance converter, time converter using packages

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9. Develop a java application for an employee payroll system
10. Program to implement AVL-Tree
11. Program to implement B-Tree
12. Program to implement Topological sort
13. Shortest path algorithm using Dijkstra

Contact Periods:

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

TEXT BOOKS:

1. Herbert Schildt, "Java The complete reference", 11th edition, McGraw Hill Education, 2018
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in JAVA", 3rd edition, Pearson Publication, 2012

REFERENCES:

1. Cay S. Horstmann and Gary Cornell, "Core Java Volume –I Fundamentals", 9th edition, Prentice Hall, 2013
2. Paul Deitel and Harvey Deitel, "Java SE 8 for programmers", 3rd edition, Pearson, 2015
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint, 2006.
4. Sridhar S., "Design and Analysis of Algorithms", 1st edition, Oxford University Press, 2014

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Develop Java programs using OOP principles	Apply
CO2	Design Java programs using the concepts inheritance and interfaces	Apply
CO3	Build Java applications using exceptions and I/O streams	Apply
CO4	Understand the various algorithms using tree to solve computing problems	Understand
CO5	Design algorithms using graph structure to solve real-life problems.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	1	-	-	2	2	2	-	-	1	-
CO2	3	3	2	-	1	-	-	2	2	2	-	-	1	-
CO3	3	3	2	-	1	-	-	2	2	2	-	-	1	-
CO4	3	3	2	1	1	-	-	1	1	1	-	-	1	-
CO5	3	3	2	1	1	-	-	1	1	1	-	1	1	-
CO	3	3	2	1	1	-	-	1.6	1.6	1.6	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER IV

U19CA001	NUMERICAL APTITUDE AND VERBAL ABILITY - I	Category: EEC			
		L	T	P	C
		1	0	0	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of coding, decoding, interpreting and applying
- To comprehend the basic concepts of logical reasoning and verbal reasoning

UNIT I CODING AND DECODING 3

Clocks and calendars – Alpha numeric series – Coding and decoding – Blood relations – Odd man out – Direction

UNIT II DATA INTERPRETATION 3

Syllogism – Order and ranking – Puzzles – Cubes and dices – Statements – Assumptions and conclusions – Seating arrangements – Data sufficiency – Data interpretation

UNIT III GRAMMAR 3

Parts of speech: (Nouns – Pronouns – Verbs – Adjectives – Adverbs – Preposition – Conjunctions – Interjections) – Gerunds – Phrases and clauses

UNIT IV WRITING 3

Tenses – Active and passive voice (tense usage) – Reported speech – Verbal ability (vocabulary and reasoning)

UNIT V READING 3

Closet test - Sentence formation – Para jumbles – Passage formation – Spotting errors – Verbal analogies

Contact Periods:

Lecture: 15 Periods Tutorial: – Periods Practical: – Periods Total: 15 Periods

TEXT BOOKS:

1. Aggarwal R.S., "Quantitative Aptitude for Competitive Examinations", 17th edition, S. Chand Publishing, New Delhi, 2017
2. Aggarwal R.S., "Objective General English", S. Chand Publishing, New Delhi, 2017

REFERENCES:

1. Abhijit Guha, "Quantitative Aptitude for Competitive Examination", 5th edition, McGraw Hill Education (India) Private Limited, 2015
2. Aggarwal R.S., "A Modern Approach to Verbal & Non-Verbal Reasoning", S. Chand Publishing, New Delhi, 2017

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply the concept of coding and decoding for numerical reasoning and data interpretation through graphs and charts	Apply
CO2	Choose appropriate words / phrases for the sentences and present comprehensively	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO	3	-	-	-	-	-	-	-	-	3	-	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER IV

U19EE406	LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Electronic Devices and Circuits and Digital Logic Circuits

COURSE OBJECTIVES:

- To acquire knowledge on linear ICs
- To implement the design procedure for analog and digital logic circuits
- To apply the simplification techniques for digital circuits

LIST OF EXPERIMENTS

1. Implementation of arithmetic circuits
2. Parking system using multiplexer and decoder.
3. BCD to 7 segment converters
4. Digital counters
5. Pulse generation using operational amplifier.
6. Design of filters using operational amplifier
7. Wave shaping circuits.
8. Design of power supply unit

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Construct the combinational logic circuits using ICs	Apply
CO2	Demonstrate the code converter for various applications	Apply
CO3	Design and implement counters using ICs	Apply
CO4	Apply the concepts of operational amplifiers for various applications	Apply
CO5	Develop the power supply unit for real time applications	Apply

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	1	1	1	-	1	2	-
CO2	3	2	2	2	1	-	-	1	1	1	-	1	2	-
CO3	3	2	2	2	1	-	-	1	1	1	-	1	2	-
CO4	3	2	2	2	-	-	-	1	1	1	-	1	2	-
CO5	3	2	2	2	-	-	-	1	1	1	-	1	2	-
CO	3	2	2	2	1	-	-	1	1	1	-	1	2	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER IV

U19EE407	ELECTRICAL MACHINES – II LABORATORY	Category: PC			
		L	T	P	C
		0	0	4	2

PRE–REQUISITES:

- Electrical Machines – I, Electrical Machines – I Laboratory

COURSE OBJECTIVES:

- To acquire the knowledge on performance characteristics of various AC machines
- To understand the various losses in AC machines
- To analyze the equivalent circuit parameters of AC machines

LIST OF EXPERIMENTS

1. Regulation of three phase alternator by EMF, MMF methods and slip test
2. Measurements of negative sequence and zero sequence impedance of alternators
3. V and Inverted V curves of three phase synchronous Motor
4. Load test on three-phase induction motor
5. No load and blocked rotor tests on three-phase induction motor
6. Separation of No-load losses of three-phase induction motor
7. Load test on single-phase induction motor
8. No load and blocked rotor test on single-phase induction motor
9. Parallel operation of alternators
10. Simulation on performance characteristics of AC machines

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply the indirect testing methods to determine the voltage regulation of three phase alternator	Apply
CO2	Develop the positive, negative and zero sequence impedance of alternators	Apply
CO3	Analyze the performance of synchronous motor on infinite bus for various excitation	Analyze
CO4	Experiment with single phase and three phase induction motor by direct and indirect testing methods	Apply
CO5	Identify the performance characteristics of various AC machines using simulation tools	Apply

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	1	2	1	-	2	3	-
CO2	3	2	1	1	1	-	-	1	2	1	-	2	3	-
CO3	3	2	1	1	1	-	-	1	2	1	-	2	3	-
CO4	3	2	1	1	1	-	-	1	2	1	-	2	3	-
CO5	3	2	1	1	1	-	-	1	2	1	-	2	3	-
CO	3	2	1	1	1	-	-	1	2	1	-	2	3	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER V

U19EE501	POWER SYSTEM ANALYSIS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Transmission and Distribution

COURSE OBJECTIVES:

- To acquire the knowledge on power systems components, power flow analysis and faults
- To understand the concept of various faults and stability analysis
- To apply the concept of fault and stability analysis for power system structures

UNIT I MODELING OF POWER SYSTEMS 9

Need for system planning and operational studies – Power system components – Per unit quantities – p.u. impedance and reactance diagram – Primitive network – Construction of Y-bus and Z-bus using inspection method

UNIT II POWER FLOW ANALYSIS 9

Classification of buses – Development of power flow model – Iterative solution using Gauss-Seidel method – Q-limit check for voltage-controlled buses

UNIT III SYMMETRICAL FAULT ANALYSIS 9

Importance of short circuit analysis – Assumptions in fault analysis – Analysis using Thevenin's theorem – Z-bus building algorithm – Fault analysis using Z-bus

UNIT IV UNSYMMETRICAL FAULT ANALYSIS 9

Symmetrical components – Sequence impedances – Sequence network analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem and Z-bus matrix

UNIT V STABILITY ANALYSIS 9

Classification of power system stability – Swing equation – Swing curve – Power angle equation – Equal area criterion – Critical clearing angle and time – Classical step-by-step solution of swing equation

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Nagarath I.J. and Kothari D.P., "Modern Power System Analysis", 4th edition, Tata McGraw-Hill Education, 2011.
2. John J. Grainger and Stevenson Jr. W.D., "Power System Analysis", 6th reprint, McGraw-Hill Education, 2010.

REFERENCES:

1. Hadi Saadat, "Power System Analysis", 21st reprint, Tata McGraw-Hill Education, 2010
2. Kundur P., "Power System Stability and Control", 10th reprint, Tata McGraw-Hill Education, 2010
3. Murty P.S.R., "Power System Analysis", 2nd edition, 2017, BSP Books Pvt, Ltd, Elsevier

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Model the single line diagram with per unit quantities	Apply
CO2	Illustrate the load flow analysis using numerical methods	Understand
CO3	Calculate the fault in the power system under balanced condition	Apply
CO4	Determine the fault in the power system under unbalanced condition	Apply
CO5	Explain the power system stability using swing equation and equal area criteria	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	-	2	-	2
CO2	3	2	1	-	1	-	-	-	-	-	-	2	-	2
CO3	3	2	2	1	1	-	-	-	-	-	-	2	-	2
CO4	3	2	2	1	1	-	-	-	-	-	-	2	-	2
CO5	3	2	1	-	1	-	-	-	-	-	-	2	-	2
CO	3	2	1.6	1	1	-	-	-	-	-	-	2	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER V

U19EE502	MICROPROCESSORS AND MICROCONTROLLERS	Category: PC			
		L	T	P	C
		3	0	2	4

PRE–REQUISITES:

- Linear integrated circuits and applications

COURSE OBJECTIVES:

- To acquire the knowledge on digital processor 8085 and controller 8051
- To understand the assembly language programming, memory and peripheral interfacing with processors and controllers
- To apply the controllers and processors for various practical applications

UNIT I 8085 PROCESSOR 9

Evolution, Selection of a microprocessor – Architecture of 8085 – Pin details – I/O and memory interfacing – Interrupts – Machine cycles and timing diagrams

UNIT II PROGRAMMING WITH8085 PROCESSOR 9

Addressing modes – Instruction formats – Instruction set – Assembly language programs – Applications: Water level control – Wiper control

UNIT III PERIPHERAL INTERFACING OF 8085 MICROPROCESSOR 9

Architecture, configuration and interfacing ICs: 8255, 8259, 8254, 8279, A/D and D/A converters with 8085 microprocessor

UNIT IV 8051 MICRO CONTROLLER 9

Architecture of 8051, Pin details – Memory organization – I/O ports – Timers – Serial port – Interrupts – Timing diagrams

UNIT V PROGRAMMING WITH 8051CONTROLLER 9

Addressing modes – Instruction set – Assembly language programming – Interfacing of relay and sensors – Application: Automation of irrigation system – Introduction to KEIL programming

LIST OF EXPERIMENTS

1. Assembly language programs using 8085
2. Assembly language programs using 8051
3. Assembly language programs using KEIL
4. Traffic Light Control using 8085
5. ADC Interfacing with 8085
6. DAC Interfacing with 8085
7. I/O Interfacing with 8051
8. Stepper Motor Control using 8051

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: 30 Periods Total: 75 Periods

TEXT BOOKS:

1. Ramesh S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, Prentice Hall of India, New Delhi, 2011

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2. Muhammed Ali Mazidi, Janice Gillispie Mazidi and Rolin D. Mckinlay, "The 8051 Microcontroller and Embedded Systems", 2nd edition, Pearson Education India, New Delhi, 2011

REFERENCES:

1. Douglas V Hall, "Microprocessors and Interfacing: Programming and Hardware", 2nd edition, Tata McGraw Hill, New Delhi, 2010
2. Subrata Ghoshal, "8051 Microcontroller: Internals, Instructions, Programming and Interfacing", 2nd edition, Pearson Education India, New Delhi, 2014
3. Kenneth J Ayala, "The 8051 Microcontroller Architecture Programming and Application ", 3rd edition, Penram International Publishers

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Describe the architecture, memory organization, interrupts and timing diagram of 8085microprocessor	Understand
CO2	Develop the assembly language program using mnemonics of 8085 microprocessor	Apply
CO3	Illustrate the interfacing of 8085 with various peripheral devices	Understand
CO4	Explain the architecture, memory organization of 8051microcontroller	Understand
CO5	Utilize 8051 microcontroller for real time applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	-	-	-	-	1	1	-	3	2	-
CO2	3	2	2	1	1	1	-	-	1	1	-	3	2	-
CO3	3	1	1	1	-	-	-	-	1	1	-	3	2	-
CO4	3	1	1	1	-	-	-	-	1	1	-	3	2	-
CO5	3	2	1	1	1	1	-	-	1	1	-	3	2	-
CO	3	1.4	1.2	1	1	1	-	-	1	1	-	3	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER V

U19EE503	POWER ELECTRONICS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Electronic Devices and Circuits

COURSE OBJECTIVES:

- To acquire the knowledge of power semiconductor switches and its characteristics
- To understand the concept of control and working of various power converters
- To apply the concept of various power conversion and control techniques for practical applications

UNIT I POWER SEMICONDUCTOR SWITCHES 9

Power semiconductor devices – Power diode – Power transistor, SCR, Power MOSFET, IGBT – Principle of operation, characteristics, ratings, protection and gate drive circuits – IR 2110 – TRIAC and GTO – Comparison of semiconductor devices.

UNIT II PHASE CONTROLLED CONVERTERS 9

Single phase, three phase semi and full converters – Effect of source inductance for single phase converters – Single phase dual converter – Single phase fully controlled converter fed DC drive (Continuous and Discontinuous mode)

UNIT III DC TO DC CONVERTERS 9

Step-down and step-up chopper – Control strategy – Switched mode regulators – Buck, Boost - Resonant converters – High step-up DC-DC converters – Applications.

UNIT IV DC TO AC CONVERTERS 9

Single phase and three phase voltage source inverters (120° and 180° modes) – Voltage and harmonic control – Multiple PWM, sinusoidal PWM, selective harmonic elimination – Space vector modulation – Multilevel inverter – Cascaded H bridge – Single phase current source inverter – Field visit.

UNIT V AC TO AC CONVERTERS 9

Single phase and three phase AC voltage controllers – Multistage sequence control – Single phase and three phase cycloconverters – Matrix converters – Applications.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Rashid M.H., "Power Electronics: Circuits, Devices and Applications", 4th edition, Pearson Education, New Delhi, 2017
2. Daniel W. Hart, "Power Electronics" McGraw-Hill Education, 2017

REFERENCES:

1. Singh M.D. and Khanchandani K.B., "Power Electronics", 2nd edition, McGraw Hill India, 2013
2. Joseph Vithayathil, "Power Electronics, Principles and Applications", McGraw-Hill Series, 2013
3. Bimbhra P.S., "Power Electronics", 6th reprint edition, Khanna Publishers, 2018

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Describe the construction of switching devices and its characteristics	Understand
CO2	Explain the working of single phase, three phase power converter circuits and its applications	Understand
CO3	Apply the concept of DC-DC power conversion techniques	Apply
CO4	Describe the operation of single phase and three phase inverters with different switching techniques	Understand
CO5	Illustrate the operation of AC-AC power converters	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	-	2	3	-
CO2	3	2	1	-	2	1	1	-	-	-	-	2	3	-
CO3	3	2	2	-	2	1	1	-	-	-	-	2	3	-
CO4	3	2	1	-	2	1	1	-	-	-	-	2	3	-
CO5	3	2	1	-	1	1	1	-	-	-	-	2	3	-
CO	3	2	1.2	-	1.6	1	1	-	-	-	-	2	3	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER V

U19EE504	CONTROL SYSTEMS	Category: PC			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

- Fourier Analysis and Partial Differential Equations, Electrical Machines-I

COURSE OBJECTIVES:

- To acquire the fundamental knowledge on system modeling and response
- To understand the behavior of the system in time domain and frequency domain
- To apply the concept of compensators and controllers for closed loop system

UNIT I SYSTEM MODELING 9+3

Elements – open and closed loop systems – Transfer function – Mechanical systems: Translational and rotational system – Electrical analogy – Transfer function of armature and field – controlled DC motor – Block diagram reduction – Signal flow graph

UNIT II TIME RESPONSE ANALYSIS 9+3

Time response – Standard test signals – Order and type – Time response of first order systems – Step response of second order system – Time domain specifications – Steady state errors and error constants – Generalized error series

UNIT III FREQUENCY RESPONSE ANALYSIS 9+3

Frequency Response – Bode plot – Polar plot – Determination of closed loop response from open loop response – Frequency domain specifications – Correlation between time domain and frequency domain specification

UNIT IV STABILITY ANALYSIS 9+3

Stability – Characteristics equation – Routh Hurwitz's criterion – Construction of root locus – Nyquist stability criterion

UNIT V COMPENSATOR DESIGN AND CONTROLLERS 9+3

Need of compensator – Design procedure – Lag network – Lead network – Compensator design using bode plots: Lag, lead – P, PI, PID controller

Contact Periods:

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

TEXT BOOKS:

1. Nagrath I.J. and Gopal M., "Control Systems Engineering", 6th edition, Wiley Eastern Limited, 2014
2. Ogata K., "Modern Control Engineering", 7th edition, Prentice Hall of India, 2013

REFERENCES:

1. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Pearson Prentice Hall, 2012
2. Norman S. Nise, "Control Systems Engineering", 6th edition, Wiley, 2010
3. Benjamin C. Kuo and Farid Golnaraghi, "Automatic Control System", 9th edition, Wiley, 2014

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Determine the transfer function of electrical and mechanical system	Understand
CO2	Solve the LTI systems in time domain	Apply
CO3	Analyze frequency response of the LTI systems using various plots	Apply
CO4	Interpret the stability of LTI systems using Routh Hurwitz criterion and Nyquist stability criterion	Apply
CO5	Implement the compensators and controllers for closed loop systems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	1	1	1	-	2	3	-
CO2	3	2	2	1	2	-	-	1	1	1	-	2	3	-
CO3	3	2	2	1	2	-	-	1	1	1	-	2	3	-
CO4	3	2	2	1	2	-	-	1	1	1	-	2	3	-
CO5	3	2	2	1	2	-	-	1	1	1	-	2	3	-
CO	3	2	1.8	1	2	-	-	1	1	1	-	2	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER V

U19CA002	NUMERICAL APTITUDE AND VERBAL ABILITY - II	Category: EEC			
		L	T	P	C
		1	0	0	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of number system, profit and loss and infer time, speed, distance
- To write sentence with appropriate grammatical structure in professional context

UNIT I NUMBER SYSTEMS 3

Divisibility tests (Divisibility factor – Prime factor – Divisibility rules – Finding unit digit) – LCM & HCF (Listing multiples, Prime Factorization, Division method, etc.) – Number System (Numbers, Prime, Composite, Co-prime, numbers) – Percentage (Percentage – Fractions of percentages– Expenditure – Price – Consumption – Population – Depreciation)

UNIT II PROFIT AND LOSS 3

Profit, Loss and Discounts – (CP, SP, MP, Profit, Loss, Discount) – Ratio & Proportion (Compounded Ratio – Mean – Proportional – Componendo – Dividendo – Directly proportional – Inversely proportional), Age problems (Various techniques to solve age problems)

UNIT III AVERAGES AND ALLIGATIONS 3

Averages (simple average, weighted average) – Mixture and Alligations (various techniques to solve mixtures and alligations) – Boats and streams (downstream, upstream, average speed)

UNIT IV PERMUTATION AND COMBINATION 3

Time and work (problems on time, work and effectively) – Permutations and combinations (arrangements and selections, together and not together problems) – Probability (coins, card, dice) Logarithms (log function, common log, natural log, binary log, laws of logarithms) – Areas and volumes

UNIT V WRITING 3

Reading comprehension – Letter writing – Email writing – Creative writing – Resume building

Contact Periods:

Lecture: 15 Periods Tutorial: – Periods Practical: – Periods Total: 15 Periods

TEXT BOOKS:

1. Aggarwal R.S., "Quantitative Aptitude for Competitive Examinations", 17th edition, S. Chand Publishing, New Delhi, 2017
2. Aggarwal R.S., "Objective General English", S. Chand Publishing, New Delhi, 2017

REFERENCES:

1. Aggarwal R.S., "A Modern Approach to Verbal & Non-Verbal Reasoning", S. Chand Publishing, New Delhi, 2017
2. Abhijit Guha., "Quantitative Aptitude for Competitive Examination", 5th edition, McGraw Hill Education (India)Private Limited, 2015
3. Arun Sharma, "How to prepare for Quantitative Aptitude for CAT", 8th edition, McGraw Hill Education, Chennai, 2018

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Use basics of counting through permutation and combination for arrangement kind of tasks	Apply
CO2	Draft letters, emails and make notes with appropriate use of words	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO	3	-	-	-	-	-	-	-	-	3	-	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER V

U19EE505	CONTROL AND INSTRUMENTATION LABORATORY	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Measurements and Instrumentation

COURSE OBJECTIVES:

- To acquire the knowledge in system modeling
- To understand the concept of bridges, transducers, controllers and compensators
- To simulate the system using modern tools

LIST OF EXPERIMENTS

1. Position control systems
2. Determination of transfer function of servomotor
3. Determination of transfer function of DC motor and DC generator
4. Stability analysis (Simulation)
5. P, PI and PID controllers (Simulation)
6. Design of Lag and Lead compensators (Simulation)
7. Bridge networks - AC and DC Bridges
8. Dynamics of Sensors/Transducers: Pressure and Displacement

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply control theory concept for electrical engineering problems	Apply
CO2	Analyze the system response in time and frequency domain	Analyze
CO3	Simulate the different types of controllers and compensators	Apply
CO4	Examine the electrical parameters using bridge circuits	Analyze
CO5	Demonstrate the concept of sensors/transducers	Apply

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	1	1	2	2	1	2	3	-
CO2	3	2	1	1	2	1	1	1	2	2	1	2	3	-
CO3	3	2	1	1	2	-	-	1	2	2	1	2	3	-
CO4	3	2	1	1	-	1	1	1	2	2	1	2	3	-
CO5	3	2	1	1	-	1	1	1	2	2	1	2	3	-
CO	3	2	1	1	2	1	1	1	2	2	1	2	3	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER VI

U19EE601	SOLID STATE DRIVES	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Electrical Machines – II, Power Electronics

COURSE OBJECTIVES:

- To acquire the knowledge in the characteristics of electric motor drives
- To understand the control strategies of Induction, Synchronous and Special electric motor drives
- To apply various electric motor drives for industrial applications

UNIT I DRIVE CHARACTERISTICS 9

Electric drive – Components – Classifications – Equations governing motor load dynamics – Mathematical condition for steady state stability – Modes of operation – Types of braking – Selection of motor drives – Thermal aspects – Multi quadrant dynamics – Speed torque characteristics

UNIT II INDUCTION MOTOR DRIVES 9

Stator voltage control – V/F control – Constant air-gap flux – Field weakening mode – Voltage/Current source inverter – Closed loop control – Vector control of induction motor – Rotor resistance control and slip power recovery schemes

UNIT III SYNCHRONOUS MOTOR DRIVES 9

Open loop V/F control – Self-controlled synchronous motor – Margin angle control – Power factor control – Vector control of synchronous motor drive

UNIT IV SRM AND PMBLDC MOTOR DRIVES 9

SRM: Constructional features – Modes of excitation – Torque prediction – Characteristics – Steady state performance prediction – Power controllers – Control of SRM drive – Sensorless operation of SRM PMBLDC: Constructional features – Types – Principle of operation – Drive schemes – Converter topologies – Characteristics

UNIT V DRIVE APPLICATIONS 9

Digital technique in speed control – Microcontroller based control of drives – Selection of drives – Control schemes – Traction, Steel rolling mills and Electric vehicles – Simulation of electric drive system

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Gopal K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, 2018
2. Bimal K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, 2015

REFERENCES:

1. John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System", Elsevier, 2012
2. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis), 2013
3. Krishnan R., "Switched Reluctance Motor Drives-Modeling, Simulation, Analysis, Design and Application", CRC Press, New York, 2014

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the motor load dynamics and steady state operation of electric motor-load system	Understand
CO2	Infer the control schemes and characteristics of Induction motor drives	Understand
CO3	Illustrate the operation and control schemes of synchronous motor drives	Understand
CO4	Describe the constructional features, types, control schemes of Switched Reluctance and Brushless DC motor drives	Understand
CO5	Select the power converters, controllers and motor drives for industrial applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO5	3	2	2	1	1	1	1	-	-	-	1	1	3	-
CO	3	2	1.2	1	1	1	1	-	-	-	1	1	2.2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

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SEMESTER VI

U19EE602	EMBEDDED SYSTEMS	Category: PC			
		L	T	P	C
		3	0	2	4

PRE–REQUISITES:

- Microprocessors and Microcontrollers

COURSE OBJECTIVES:

- To acquire knowledge on the building blocks of embedded systems and ARM processor
- To understand the bus communication protocols in embedded systems
- To apply embedded systems concepts for real time applications

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Overview – Characteristics of embedded system – Challenges in embedded system design – Structural units in an embedded processor – Selection of processor and memory devices – DMA – Memory management – Timer and counting devices – Watchdog timer – Real time clock – In circuit emulator – Target hardware debugging

UNIT II EMBEDDED NETWORKING 9

Introduction – I/O devices – Ports and buses – Serial bus communication protocols – RS 232 standard, RS 422 and RS 485 – CAN bus – Serial peripheral interface – Inter integrated circuits bus – LIN bus – Need for device drivers

UNIT III RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction – Task, process and threads– Interrupt routines in RTOS – Multiprocessing and multitasking – Pre-emptive and non-pre-emptive scheduling algorithms – Task communication – Shared memory – Message passing – Inter process communication – Micro C OS-II – RT Linux – VxWorks

UNIT IV ARM PROCESSOR AND PERIPHERALS 9

ARM Architecture – Instruction Set – Stacks and subroutines – Peripherals – Timer unit – Pulse width modulation unit – UART – Block diagram of ARM9 and ARM Cortex M3 MCU

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 9

Applications: Washing machine – Automotive application – Smart card system application – ATM machine – Elevator control and digital camera

LIST OF EXPERIMENTS

1. Study of ARM evaluation system
2. Interfacing ADC and DAC
3. Interfacing LED and PWM
4. Interfacing real time clock and serial port
5. Interfacing EPROM and interrupt
6. Flashing of LED's
7. Interfacing stepper motor and temperature sensor
8. Implementing ZIGBEE protocol with ARM

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: 30 Periods Total: 75 Periods

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TEXT BOOKS:

1. Rajkamal, "Embedded System – Architecture, Programming and Design", 2nd edition, McGraw Hill, 2013
2. James K. Peckol, "Embedded System Design", 2nd edition, John Wiley and Sons, 2010

REFERENCES:

1. Sriram J., Iyer V. and Pankaj Gupta, "Embedded Real-time Systems Programming", Tata McGraw-Hill, New Delhi, 2012
2. David E. Simon, "An Embedded Software Primer", Pearson Education India, New Delhi, 2013
3. Elicia White, "Making Embedded Systems", O Reilly Series SPD, 2011

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Describe the functional blocks of embedded systems.	Understand
CO2	Explain the bus communication involved in processors and input/output interfacing.	Understand
CO3	Summarize the various RTOS concepts and processor scheduling algorithms implemented in embedded systems.	Understand
CO4	Develop the assembly language programs using ARM Instruction Set.	Apply
CO5	Utilize ARM processor for real time applications.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	1	1	-	2	3	-
CO2	3	2	1	1	-	-	-	1	1	1	-	2	3	-
CO3	3	2	1	1	1	-	-	1	1	1	-	2	3	-
CO4	3	2	2	1	1	1	1	1	1	1	-	2	3	-
CO5	3	2	2	1	1	-	-	1	1	1	1	2	3	-
CO	3	2	1.4	1	1	1	1	1	1	1	1	2	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER VI

U19EE603	POWER ELECTRONICS AND DRIVES LABORATORY	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Electronic Devices and Circuits, Power Electronics

COURSE OBJECTIVES:

- To acquire the knowledge on semiconductor devices and characteristics
- To understand the topologies of power converters for electric drives
- To apply the power converters for industrial applications

LIST OF EXPERIMENTS

1. Gate pulse generation using R, RC and UJT
2. Characteristics of semiconductor devices
3. Single phase and three phase-controlled rectifiers
4. DC-DC, DC-AC converters and AC voltage controllers
5. DSP based control of induction motor drives
6. DSP based control of switched reluctance and DC motor drives
7. Speed control of brushless DC motor drives
8. Simulation of power electronic circuits (1ϕ and 3ϕ semi converters, 1ϕ and 3ϕ full converters, DC-DC converters, DC-AC converter, AC voltage controller)

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

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

Cos	Statements	K-Level
CO1	Analyze the static and dynamic characteristics of power semiconductor devices	Analyze
CO2	Demonstrate the working of power converters	Apply
CO3	Examine the performance of converter fed DC and AC drives	Analyze
CO4	Analyze the performance of converter fed Switched Reluctance and Brushless DC motor drives	Analyze
CO5	Simulate the topologies of converter fed electric drives for various applications	Apply

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	1	1	1	1	1	-	2	3	-
CO2	3	2	2	1	-	1	1	1	1	1	-	2	3	-
CO3	3	2	2	2	-	1	1	1	1	1	-	2	3	-
CO4	3	2	2	2	-	1	1	1	1	1	-	2	3	-
CO5	3	2	2	2	2	1	1	1	1	1	-	2	3	-
CO	3	2	2	1.6	2	1	1	1	1	1	-	2	3	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER VI

U19EE604	TECHNICAL SEMINAR	Category: PEC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

Nil

COURSE OBJECTIVES:

- To acquire the knowledge and understand specific technical topic
- To outline the technical and communication skills related to the topic
- To summarize the latest information, trends and best practices in a particular field to the audience.

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the excellent technical knowledge of their selected topic	Understand
CO2	Show the strategic approach to solve real-world problems	Understand
CO3	Illustrate the problem solving, critical thinking and communication skills of their selected topic	Understand
CO4	Summarize the latest information in their selected topic	Understand
CO5	Extend the professional networks, connection with experts and peers	Understand

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	2	2	1	1	2	2
CO2	3	2	1	1	1	-	-	-	2	2	1	1	2	2
CO3	3	2	1	1	1	-	-	-	2	2	1	1	2	2
CO4	3	2	1	1	1	-	-	-	2	2	1	1	2	2
CO5	3	2	1	1	1	-	-	-	2	2	1	1	2	2
CO	3	2	1	1	1	-	-	-	2	2	1	1	2	2
Correlation levels:		1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)						

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SEMESTER VI

U19EE605	MINI PROJECT	Category: EEC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire the problem identification and problem-solving skill
- To understand the basics of literature review and developing the solution to the problem identified form the literature review.

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply fundamental concepts and demonstrate technological tools in the professional field of study.	Apply
CO2	Analyze the technical elements of the chosen project with a thorough and systematic approach.	Analyze
CO3	Demonstrate the ethical and sustainable development in professional field of study.	Apply
CO4	Create a prototype model as a team to provide a solution for social needs.	Analyze
CO5	Utilize effective oral, written, and visual communication to proficiently convey and report project-related activities.	Apply

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	3	-	-	-	-	-	3	-	3	3
CO2	3	3	3	3	-	-	-	-	3	-	3	2	3	3
CO3	-	-	-	-	-	3	3	3	-	3	3	3	3	3
CO4	-	-	3	-	-	3	3	2	3	-	3	2	3	3
CO5	-	-	-	-	3	2	-	2	3	3	3	3	3	3
CO	3	3	3	3	3	2.6	3	2.3	3	3	3	2.3	3	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER VII

U19EE701	PRINCIPLES OF MANAGEMENT	Category: HSM			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire the knowledge on management and its organizations
- To understand the concept of planning and organizing
- To implement the various principles of management strategies in directing and controlling the organization

UNIT I MANAGEMENT AND ORGANIZATIONS 9

Management – Science or Art-Manager Vs Entrepreneur – Types of managers – Managerial roles and skills – Evolution of management – Scientific, human relations, system and contingency approaches – Types of business organization – Sole proprietorship, partnership, company – Public and private sector enterprises – Organization culture and environment – Current trends and issues in management

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic management – Planning tools and techniques – Decision making steps and process

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – Delegation of authority – Centralization and decentralization – Job design – Human Resource Management (HRM) – HR Planning, recruitment, selection – Training and development – Performance management – Career planning and management

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – Motivation theories, motivational techniques – Job satisfaction – Job enrichment – Leadership – Types and theories of leadership – Communication - Process of communication – Barrier in communication – Effective communication – Communication and IT

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non-budgetary control techniques – Use of computers and IT in management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Stephen P. Robbins and Mary Coulter, "Management", 14th edition, Pearson Education, 2017
2. Harold Koontz, Heinz Welhrich and Ramachandra Aryasri, "Principles of Management", 2nd edition, McGraw-Hill Education Pvt. Ltd, 2015

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REFERENCES:

1. Mitra J.K., "Principles of Management", 1st edition, Oxford University Press, 2017
2. Stephen A. Robbins, David A. Decenzo and Mary Coulter, "Fundamentals of Management", 7th edition, Pearson Education, 2011
3. Tripathi P.C. and Reddy P.N., "Principles of Management", 6th edition, McGraw-Hill Education Pvt. Ltd, 2017

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Discuss the fundamental principles of management and types of organizations	Understand
CO2	Illustrate the planning process and strategic management of decision making	Understand
CO3	Interpret the organizational structure and human resource management	Understand
CO4	Describe the various motivational techniques and leadership qualities for effective management	Understand
CO5	Compare various controlling techniques used for efficient management	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	2	3	-	2	2	2	1	-
CO2	-	-	-	-	-	2	2	3	-	2	2	2	1	-
CO3	-	-	-	-	-	2	2	3	-	2	2	2	1	-
CO4	-	-	-	-	-	2	2	3	-	2	2	2	1	-
CO5	-	-	-	-	-	2	2	3	-	2	2	2	1	-
CO	-	-	-	-	-	2	2	3	-	2	2	2	1	-
Correlation levels:	1: Slight (Low)					2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER VII

U19EE702	POWER ENGINEERING LABORATORY	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Power Electronics, Power System Analysis

COURSE OBJECTIVES:

- To provide the necessary inputs on harnessing the renewable energy sources
- To recognize current and possible future role of renewable energy system
- To provide the knowledge of power system through simulation

LIST OF EXPERIMENTS

1. Simulation of 1 kW solar PV system
2. Simulation of wind energy generator
3. Simulation of hybrid (Solar – Wind) system
4. Performance assessment of 1 kWp solar PV system
5. Performance assessment of micro wind energy generator
6. Formation of bus admittance and impedance matrices
7. Analysis of Gauss-Seidal and Newton Raphson methods for solving nonlinear power flow equation
8. Symmetrical and unsymmetrical fault analysis in power system
9. Economic dispatch in power systems
10. Electromagnetic transients in power systems: Transmission Line Energization

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Simulate and analyze the performance behavior of solar PV and wind energy system	Analyze
CO2	Categorize the performance characteristics of renewable energy system	Analyze
CO3	Analyze the computational performance of power flow problems in power system	Analyze
CO4	Compute the optimal dispatch of the given power system	Analyze
CO5	Analyze the transient stability for various faults in power system	Analyze

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	3	1	-	1	1	2	-	1	-	3
CO2	3	2	1	1	3	1	1	1	1	2	-	1	-	3
CO3	3	2	2	1	3	1	-	1	1	2	-	1	-	2
CO4	3	2	2	1	3	1	1	1	1	2	-	1	-	2
CO5	3	2	2	1	3	1	1	1	1	2	-	1	-	2
CO	3	2	1.6	1	3	1	1	1	1	2	-	1	-	2.4
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER VIII

U19EE801	PROJECT WORK	Category: EEC			
		L	T	P	C
		0	0	20	10

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To apply and adapt a diversified problem-solving strategy to solve real time challenges.
- To develop collaborative and communication skills.
- To acquire skills to utilize the modern tools effectively for report preparation.
- To inculcate the lifelong learning.

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study.	Apply
CO2	Demonstrate skill and knowledge of current information and technological tools and techniques specific to the professional field of study	Analyze
CO3	Identify, analyze, and solve problems creatively through sustained critical investigation for personal, societal, and ethical standards.	Evaluate
CO4	Apply the theoretical concepts to solve industrial problems with teamwork and practice the skills needed to engage in lifelong learning.	Apply
CO5	Utilize effective oral, written, and visual communication to proficiently convey and report project-related activities.	Apply

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	3	3	-	2	-	-	3	3	3
CO2	-	3	3	3	3	2	2	-	2	-	-	3	3	3
CO3	-	-	3	3	3	3	3	3	2	-	-	3	3	3
CO4	-	-	-	-	-	-	-	-	3	2	2	3	3	3
CO5	-	-	-	-	3	2	-	2	3	3	3	3	3	3
CO	3	3	3	3	3	2.5	2.6	2.5	2.4	2.5	2.5	3	3	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP01	RENEWABLE ENERGY SOURCES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Electrical Machines – II

COURSE OBJECTIVES:

- To acquire the basic concepts of renewable energy sources
- To understand the characteristics and operation of renewable energy sources and energy storage systems
- To apply the concepts of renewable energy sources for various applications

UNIT I SOLAR ENERGY SYSTEM 9

Solar radiation – Evolution of solar cells – Series and parallel operations – Maximum power point tracking – Flat plate collectors – Concentrating collectors – Solar water heater – Solar street lighting – Grid connected solar system

UNIT II WIND ENERGY CONVERSION SYSTEMS 9

Wind data and energy estimation – Site selection considerations – Environmental aspects – Wind energy conversion systems – Classification – Interconnected systems – Applications

UNIT III BIOENERGY SYSTEM 9

Biomass conversion technologies – Direct combustion – Gasification – Pyrolysis – Biochemical conversion – Alcohol production from biomass – Anaerobic digestion – Biomass cogeneration

UNIT IV OCEAN AND GEOTHERMAL ENERGY SYSTEM 9

Ocean energy resources – Ocean wave energy conversion and tidal energy conversion – Geothermal energy –Site selection and geothermal power plants

UNIT V ENERGY STORAGE SYSTEMS 9

Mechanical energy storage – Thermal energy storage – Sensible and latent heat storage – Electrical energy storage – Batteries – Ultra capacitors

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Kothari, "Renewable Energy Sources and Emerging Technologies", PHI learning Pvt. Ltd., 2013
2. KhanB.H., "Non-Conventional Energy Resources", Tata McGraw-Hill Education, 2017

REFERENCES:

1. Sukhatme S.P. and Nayak J.K., "Solar Energy", Tata McGraw Hill, 2017
2. Burton T., "Wind Energy Handbook", 2nd edition, John Wiley and Sons, 2011
3. Ibrahim Dincer and Mark A. Rosen, "Thermal Energy Storage Systems and Applications", John Wiley and Sons, 2010

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Apply the concept of energy conversion techniques for solar power applications	Apply
CO2	Interpret the operation of wind energy conversion systems	Understand
CO3	Summarize the bio-energy conversion systems	Understand
CO4	Describe the ocean thermal energy and Geothermal energy conversion process	Understand
CO5	Explain the energy storage technologies	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	1	-	-	-	-	1	-	3
CO2	3	2	1	-	1	-	-	-	-	-	-	1	-	3
CO3	3	2	1	-	-	-	-	-	-	-	-	1	-	3
CO4	3	2	1	-	-	-	-	-	-	-	-	1	-	3
CO5	3	2	1	-	1	-	-	-	-	-	-	1	-	3
CO	3	2	1	1	1	1	1	-	-	-	-	1	-	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP02	ENERGY MANAGEMENT AND AUDITING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Transmission and Distribution

COURSE OBJECTIVES:

- To acquire the knowledge on energy scenario and its policies
- To understand the concepts of energy management, energy conservation and audit procedures
- To apply the financial and project planning techniques for real time applications

UNIT I ENERGY SCENARIO 9

Primary and secondary energy – Commercial and non-commercial energy – Global primary energy reserves – Energy consumption – Indian energy scenario – Sector wise energy consumption in India – Energy needs of growing economy – Integrated energy policy – Purchasing power parity

UNIT II ENERGY AUDIT 9

Need for energy audit – Types – Costs – Benchmarking – Energy performance – Instruments and metering for audit – Audit procedures and time intervals – Case study

UNIT III FINANCIAL AND PROJECT MANAGEMENT 9

Financial analysis techniques – Cash flow – Sensitivity and risk analysis – Financing options – ESCOs – Project development cycle – Project planning techniques

UNIT IV ENERGY EFFICIENCY AND CLIMATE CHANGE 9

Energy and environment – Global environmental issues – Ozone layer depletion – Global warming and climate change – UNFCCC – IPCC – COP – Kyoto Protocol – Sustainable development

UNIT V ENERGY CONSERVATION ACTS AND POLICIES 9

Features of energy conservation act – Schemes of BEE – Electricity acts – Integrated energy policy – UNSDG 13 – National action plan on climate change

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. "General Aspects of Energy Management and Energy Audit", 4th edition, Bureau of Energy Efficiency, New Delhi, India, 2015
2. Wayne C. Turner, Steve Doty, "Energy Management Handbook", 6th edition, CRC Press, 2006

REFERENCES:

1. Albert Thumann, William J. Younger, "Handbook of Energy Audits", CRC press, 2003
2. Rajiv Shankar, "Energy Auditing in Electrical Utilities", Viva Books, 2014
3. Rajan, G.G., "Optimizing Energy Efficiencies in Industry", Tata McGraw Hill Publication Company, 2001

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the basics of energy scenario	Understand
CO2	Summarize the energy audit process	Understand
CO3	Apply the financial analysis and project planning techniques for energy management	Apply
CO4	Explain the concept of energy efficiency and climate change	Understand
CO5	Infer the energy conservation act and its policies	Understand

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	1	-	2
CO2	3	1	1	-	-	-	-	1	-	-	1	1	-	1
CO3	3	2	1	1	-	1	1	1	-	-	1	1	-	1
CO4	3	1	1	-	-	-	-	-	-	-	-	1	-	1
CO5	3	1	1	-	-	-	-	1	-	-	-	1	-	1
CO	3	1.2	1	1	-	1	1	1	-	-	1	1	-	1.2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP03	COMPUTER AIDED POWER SYSTEM ANALYSIS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Transmission and Distribution, Power System Analysis

COURSE OBJECTIVES:

- To acquire the knowledge on power flow analysis in power system networks
- To understand the various types of faults occurring in power system
- To apply the algorithms for obtaining security and stability performance of power system

UNIT I POWER FLOW ANALYSIS 9

Modeling of power system components – Power flow equations – Formation of Y bus matrix – Power flow solution algorithms – Newton Raphson, Fast decoupled and DC load flow methods – AC-DC system power flow analysis – Sequential and simultaneous solution algorithms

UNIT II SPARSE MATRICES 9

Sparsity directed optimal ordering schemes – Solution algorithms – LU factorization, bi-factorization and iterative methods

UNIT III FAULT ANALYSIS 9

Symmetrical and asymmetrical faults – Z bus formulation – Short circuit analysis of large power systems using Z bus – Analysis of open circuit faults

UNIT IV SECURITY ANALYSIS 9

Basic concepts – Static security analysis at control centers – Contingency analysis – Contingency selection

UNIT V STABILITY ANALYSIS 9

Classification of stability – Classical model of synchronous machines and excitation system – Transient stability analysis of multi-machine systems – Eigen analysis of dynamical systems – Small signal stability analysis using classical model

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Kothari D.P. and Nagrath I.J., "Power System Engineering", 3rd edition, Tata McGraw-Hill Education, 2019
2. Grainger J.J. and Stevenson W.D., "Power System Analysis", 1st edition, Tata McGraw-Hill Education, 2017

REFERENCES:

1. Arrillaga J. and Arnold C.P., "Computer Analysis of Power Systems", John Wiley, 2016
2. Uma Rao K., "Computer Techniques and Models in Power Systems", I.K. International Publishing House Pvt. Limited, 2008
3. Ramasamy Natarajan, "Computer-Aided Power System Analysis", Marcel Dekkallnc, 2002

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COURSE OUTCOMES:

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

Cos	Statements	K-Level
CO1	Organize the power system network using power flow algorithms	Apply
CO2	Develop the suitable method for optimal scheduling	Apply
CO3	Identify the symmetrical and asymmetrical faults in power system	Apply
CO4	Interpret the impact on power system during abnormal conditions	Understand
CO5	Select the various power system components for ensuring its stability	Apply

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	-	-	-	1	-	-	1	-	2
CO2	3	2	2	1	2	-	-	-	1	-	-	1	-	2
CO3	3	2	2	1	2	-	-	1	1	-	-	1	-	2
CO4	3	2	2	-	1	-	-	1	1	-	-	1	-	2
CO5	3	2	2	1	2	-	-	-	1	-	-	1	-	2
CO	3	2	2	1	1.8	-	-	1	1	-	-	1	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP04	PROTECTION AND SWITCHGEAR	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Transmission and Distribution, Power System Analysis

COURSE OBJECTIVES:

- To acquire the characteristics and functions of protective devices
- To understand the protection of apparatus using relays and circuit breakers
- To apply the relays and circuit breakers for power system protection

UNIT I PROTECTION SCHEMES AND STANDARDS 9

Principles and need for protective schemes – Zones of protection – Primary and backup protection – Essential qualities of protection – Classification of protection schemes – Introduction to IEC standards for earthing (TT, TN, IT) – IEC standards for MCB and MCCB

UNIT II PROTECTIVE RELAYS 9

Requirement of relays – Universal relay – Torque equation – IDMT relays – Non-directional and directional over current IDMT relays – Earth fault relays – Distance relays – Differential Relays – Negative sequence relay – Under frequency relay – Introduction to static relays

UNIT III APPARATUS AND LINE PROTECTION 9

Alternator, Transformer, Bus bar, Substation and Motor protection schemes – Feeder protection – Radial and ring main system

UNIT IV THEORY OF CIRCUIT INTERRUPTION AND INSULATION COORDINATION 9

Principles of arc extinction – Arc control devices – Recovery voltage and restriking voltage – Current chopping – Capacitance current breaking – Arc suppression coil – Insulation coordination – Determination of line insulation – Insulation levels of substation

UNIT V CIRCUIT BREAKERS 9

Oil – Air break – Air blast – Sulphur hexafluoride – Vacuum circuit breaker – Fuses – Types – Selection – Discrimination – HVDC breakers – Rating – Testing of circuit breakers

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Sunil S. Rao, "Switchgear and Protection", 13th edition, Khanna Publishers, New Delhi, 2014
2. Anderson P.M., "Power System Protection", 1st edition, A John Wiley and Sons Inc., Publication, 2014

REFERENCES:

1. Badri Ram and Vishwakarma B.H., "Power System Protection and Switchgear", 2nd edition, New Age International Pvt. Ltd., 2011
2. Paithankar Y.G. and Bhide S.R., "Fundamentals of power system protection", 2nd edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010
3. Wadhwa C.L., "Electrical Power Systems", 6th edition, New Age International Pvt. Ltd., 2010

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Illustrate the protection schemes and its standards	Understand
CO2	Classify the types of protective relays	Understand
CO3	Select different types of protective schemes for alternator, transformer, bus bar, substation and motor protection	Apply
CO4	Explain the theory of arc interruption	Understand
CO5	Select the circuit breaker for various applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	1	-	2
CO2	3	1	1	-	-	-	-	-	-	-	-	1	-	2
CO3	3	2	2	1	-	1	1	-	-	-	-	1	-	2
CO4	3	2	1	-	-	-	-	-	-	-	-	1	-	2
CO5	3	1	2	1	-	1	1	-	-	-	-	1	-	2
CO	3	1.4	1.4	1	-	1	1	-	-	-	-	1	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP05	POWER SYSTEM OPERATION AND CONTROL	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Transmission and Distribution, Power System Analysis

COURSE OBJECTIVES:

- To acquire the knowledge on operation of power systems and its control methods
- To understand the concept of real and reactive power control in power system
- To apply the computer control methods to power system

UNIT I ECONOMIC ASPECTS 9

Power scenario in Indian grid – National and Regional load dispatching centers – Requirements of good power system – Necessity of voltage and frequency regulation – System load variation – Load curves – Basic concepts of load dispatching and load forecasting

UNIT II LOAD FREQUENCY CONTROL 9

Speed governing mechanisms and modeling – Speed load characteristics – Parallel operation of generators – Load frequency control of single area system and two area system – Static and dynamic analysis

UNIT III REACTIVE POWER CONTROL 9

Generation and absorption of reactive power – Basics of reactive power control – Automatic voltage regulator – Static and dynamic analysis of AVR loop – Methods of reactive power control – Voltage control methods: SVC, STATCOM and UPFC

UNIT IV ECONOMIC OPERATION OF POWER SYSTEM 9

Input and output characteristics of thermal plant – Incremental cost curve – Optimal operation of thermal units without and with transmission losses – Unit commitment (UC) problem – Constraints on UC problem – Solution of UC problem using priority list

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

Need of computer control – Energy control centers and its functions – Phasor measurement unit – Data acquisition and controls – System hardware configurations – SCADA – Energy management system and its functions – State estimation problem – Various operating states – State transition diagram

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Olle I.Elgerd, "Electric Energy Systems Theory – An Introduction", 34th reprint, McGraw Hill Education Pvt. Ltd., New Delhi, 2010
2. AbhijitChakrabarti and SunitaHalder, "Power System Analysis Operation and Control",3rd edition, PHI learning Pvt. Ltd., New Delhi, 2010

REFERENCES:

1. Wadhwa C.L., "Electrical Power Systems", 7th edition, New Academic Science Limited, 2016
2. Allen J. Wood and Bruce F.Wollen berg, "Power Generation, Operation and Control", 3rd edition, John Wiley & Sons, Inc., 2013
3. Kundur P., "Power System Stability and Control", 10th reprint, McGraw Hill Education Pvt. Ltd., New Delhi, 2010

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Relate the basic concepts of load dispatching and load forecasting techniques	Understand
CO2	Interpret the concept of load frequency control in power systems	Understand
CO3	Outline the principle of reactive power control in power systems	Understand
CO4	Illustrate the economic operation of power systems	Understand
CO5	Extend the knowledge on computer control of power systems	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	1	1	-	2
CO2	3	2	1	-	1	-	-	-	1	1	1	1	-	2
CO3	3	2	1	-	1	-	-	-	1	1	1	1	-	2
CO4	3	2	1	-	1	-	-	-	1	1	1	1	-	2
CO5	3	2	1	-	1	-	-	-	-	-	1	1	-	2
CO	3	1.8	1	-	1	-	-	-	1	1	1	1	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP06	SMART GRID TECHNOLOGIES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Power Electronics

COURSE OBJECTIVES:

- To acquire the knowledge on smart grid infrastructure and its composition
- To understand the operation of converters and energy storage systems for smart grid
- To apply the computational techniques for optimizing the smart grid

UNIT I SMART POWER GRID 9

Grid challenges – Evolution – Characteristics and benefits of smart grid – Vision and roadmap for India – Examples of SG projects in India, US effort, Europe effort and China effort – Cyber controlled smart power grids – Comparison of microgrid and smart grid

UNIT II COMMUNICATION AND MEASUREMENT 9

Functions of smart grid components – Communication and measurement – Monitoring, PMU and smart meters – Demand side integration –Synchrophasor measurement – IEEE Standards, Multi agent systems technology

UNIT III COMPUTATIONAL TOOLS 9

Decision support tools – Optimization techniques – Classical optimization method – Heuristic optimization – Evolutionary computational techniques – Adaptive Dynamic Programming (ADP) techniques – Pareto methods – Hybridizing optimization techniques

UNIT IV POWER ELECTRONICS AND ENERGY STORAGE SYSTEMS 9

Current source and voltage source converters – Fault current limiting – Shunt and series compensators with energy storage – Energy storage technologies – Batteries, flow battery, fuel cell, flywheels, superconducting magnetic energy storage systems and super capacitors – Energy storage for wind power

UNIT V CASE STUDIES AND TESTBEDS 9

Demonstration projects – Advanced metering – Power system unit commitment problem – ADP for optimal network reconfiguration in distribution automation – Case study of RER integration – Testbeds and benchmark systems – Challenges of smart transmission – Benefits of smart transmission

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. JanakaEkanayake and Nick Jenkins, "Smart Grid - Technology and Applications", 1st edition, John Wiley and Sons, Canada, 2012
2. James Momoh, "Smart Grid - Fundamentals of Design and Analysis", IEEE Press, John Wiley and Sons, Canada, 2012

REFERENCES:

1. Ali Keyhani and Muhammad Marwali, "Smart Power Grids 2011", Springer, 2011
2. Takuro Sato, Daniel M. Kammen, Bin Duan, Muhammad Tariq, Zhenyu Zhou, Jun Wu and Solomon AbebeAsfaw, "Smart Grid Standards Specifications, Requirements, and Technologies", John Willey and Sons, 2015

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3. Phadke A.G. and Thorp J.S., "Synchronized Phasor Measurements and their Applications", Springer, 2010

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Interpret the knowledge on smart power grids and its issues	Understand
CO2	Outline the communication standard and measurement technologies	Understand
CO3	Apply the optimization and computational intelligence techniques for smart grid design	Apply
CO4	Summarize the power electronic converters and energy storage systems	Understand
CO5	Develop case studies for specified problem, test bench and its benchmark system	Apply

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO2	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO3	3	2	2	1	2	1	-	1	-	-	-	1	-	2
CO4	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO5	3	2	2	1	2	1	-	1	-	-	-	1	-	2
CO	3	2	1.4	1	1.4	1	-	1	-	-	-	1	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP07	ARTIFICIAL INTELLIGENCE APPLICATIONS TO POWER SYSTEMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Problem Solving using Python Programming, Power System Analysis

COURSE OBJECTIVES:

- To acquire the knowledge of different soft computing techniques
- To understand the principle of ANN, fuzzy logic and genetic algorithm
- To apply the soft computing techniques for solving power system problems of resonance and coupled circuits

UNIT I SOFT COMPUTING TECHNIQUES 9

Definition of AI – Difference between soft computing and hard computing techniques – Expert systems – Brief history of ANN, Fuzzy and GA - Basic concepts of Neural Networks, human brain, model of artificial neuron – Difference between GA and traditional methods

UNIT II NETWORK THEOREMS 9

Neural Network architectures – Single layer and multi-layer feed forward network, recurrent networks – Characteristics of NN, Learning Methods Perceptron – ADALINE MADALINE networks – Architecture of back propagation network – Nonlinear activation operators – Single and multilayer ANN – Learning methods

UNIT III FUZZY LOGIC SYSTEM 9

Comparison between fuzzy and crisp logic, fuzzy sets, membership function, basic fuzzy set – Operations, properties of fuzzy set, fuzzy relations, fuzzy interference system, mamdani, sugeno, fuzzy rule-basedsystem, defuzzification methods

UNIT IV GENETIC ALGORITHM 9

Working principles – Coding methods, fitness function – Types of GA operators: Roulette wheel selection, stochastic remainder, roulette wheel selection, rank selection, tournament selection and stochastic universal sampling – Cross over methods in GA, mutation, schema theorem, elite preserving operator, GA's for constrained optimization, understating the working of GA using flow chart

UNIT V APPLICATION OF AI TO POWER SYSTEM 9

Applications of ANN – Fuzzy logic and GA in power systems operation and control for solving problems of load forecasting, voltage control – Voltage stability – Security assessment – Feeder load balancing, AGC – Economic load dispatch – Unit commitment – Condition monitoring

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Rajasekaran S. and VijayalakshmiPai G.A., "Neural Networks, Fuzzy logic and Genetic Algorithms", PHI publication, 2017
2. Kalyanmoy Deb, "Optimization for Engineering Design", PHI publication, 2012

REFERENCES:

1. Kalyanmoy Deb, "Multi-objective Optimization using Evolutionary Algorithms", Wiley Publication, 2010
2. Ross T.J., "Fuzzy logic with Fuzzy Applications", McGraw Hill Inc, 2008

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3. Simon Haykins, "Neural Networks: A comprehensive Foundation", Pearson Edition, 2003

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the concept of ANN, Fuzzy and GA	Understand
CO2	Illustrate the principle of artificial neural networks	Understand
CO3	Impart knowledge on fuzzy logic system	Understand
CO4	Apply the principle of genetic algorithm for real time applications	Apply
CO5	Develop ANN, Fuzzy and GA for power system applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	-	-	1	-
CO2	3	2	1	-	1	-	-	-	-	-	-	-	1	-
CO3	3	2	1	-	1	-	-	-	-	-	-	1	1	-
CO4	3	2	2	1	1	1	1	-	-	-	-	1	1	-
CO5	3	2	2	1	1	1	1	-	-	-	-	1	1	-
CO	3	2	1.4	1	1	1	1	-	-	-	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP08	POWER SYSTEM RESTRUCTURING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Power System Analysis

COURSE OBJECTIVES:

- To acquire the knowledge on restructuring of power industries and market models
- To understand the fundamental concepts of marginal pricing and financial transmission rights
- To apply pricing and financial rights in power system

UNIT I RESTRUCTURING OF POWER INDUSTRY 9

Deregulation of power industry – Restructuring process – Issues involved in deregulation – Deregulation fundamentals of economics – Various costs of production – Market models based on contractual arrangements – Electricity commodities – Market architecture – Case study

UNIT II TRANSMISSION CONGESTION MANAGEMENT 9

Reasons for transfer capability limitation – Importance – Features – Classification – Calculation of ATC – Non-market methods – Market methods – Nodal pricing – Inter and Intra zonal congestion management – Price area congestion management – Capacity alleviation method

UNIT III LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS 9

Lossless and loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Auction – Allocation – Treatment of revenue shortfall – Secondary trading of FTRs – Flow gate rights – FTR and market power – FTR and merchant transmission investment

UNIT IV ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK 9

Classification – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service – Co-optimization of energy and reserve services – Transmission pricing – Rolled in transmission pricing methods – Marginal pricing paradigm

UNIT V REFORMS IN INDIAN POWER SECTOR 9

Framework of Indian power sector – Reform initiatives – Availability based tariff – Electricity act 2003 – Open access issues – Power exchange – Reforms in the near future

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Mohammad Shahidehpour, MuwaffaqAlomoush, Marcel Dekker, "Restructured Electrical Power Systems: Operation, Trading and Volatility", 1st edition, CRC Press, 2017
2. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of Restructured Power Systems", Kluwer Academic Publication, 2012

REFERENCES:

1. Sally Hunt, "Making Competition Work in Electricity", John Willey and Sons Inc. 2002
2. Steven Stoft, "Power System Economics: Designing Markets for Electricity", John Wiley & Sons, 2002

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3. Venktesh P., Manikandan B.V., Charles Raja S. and Srinivasan A., "Electrical Power Systems Analysis, Security and Deregulation", PHI Learning Private limited, 2012

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Describe the restructuring of power industry	Understand
CO2	Summarize the congestion management methods	Understand
CO3	Infer the locational margin prices and financial transmission rights	Understand
CO4	Illustrate the significance of ancillary services and pricing of transmission network	Understand
CO5	Explain the knowledge on various power sectors in India	Understand

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	1	-	-	-	1	-	2
CO2	3	1	1	-	-	-	-	-	-	-	-	1	-	2
CO3	3	1	1	-	-	-	-	1	-	-	1	1	-	2
CO4	3	1	1	-	-	-	-	-	-	-	-	1	-	2
CO5	3	1	1	-	-	-	-	1	-	-	-	1	-	2
CO	3	1	1	-	-	-	-	1	-	-	1	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19EEP09	MICROGRID	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Transmission and Distribution, Power System Analysis

COURSE OBJECTIVES:

- To acquire the knowledge of microgrid technology, types and its issues
- To understand the control and operational strategies of microgrid
- To apply the converters and control strategies for microgrid operation

UNIT I MICROGRID STRUCTURE 9

Typical structure and configuration – Significance – Sources – Types: AC, DC and hybrid microgrid – Technical implications and social fall out – Market models and business cases for microgrid

UNIT II MICROGRID SOURCES AND POWER ELECTRONIC INTERFACES 9

Review of microgrid sources – Basic characteristics and selection – Power electronics interface – Design for microgrid – DC and AC sources – Protection and co-ordination – Power quality issues and solutions

UNIT III CONTROL AND DESIGN OF POWER ELECTRONIC INTERFACES 9

Determination of control laws – Power relations and power control – Bi directionality and its need in a microgrid – Control of DC-DC converters and inverter – Challenges in a microgrid – Control strategies: Centralized, decentralized and hierarchical control – Multi-agent system-based control – Energy management in microgrid

UNIT IV COMMUNICATION INFRASTRUCTURE 9

Requirement of communication system in microgrid – Communication protocols and standards – Selection of communication protocols for microgrid – Event triggered system and Time triggered system – Unicast and multicast communication – Impact of time latencies on operation

UNIT V OPERATION AND PROTECTION OF MICROGRID 9

Grid connected and islanding mode of operation – Issues in island mode of operations – Islanding detection – Reliability and stability Issues in islanding – Protection: Fault behavior in grid connected and island mode – Types of protection systems – Fault source-based protection and adaptive protection

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Nikos Hatziargyriou, "Microgrids: Architectures and Control", Wiley-IEEE Press, 2013
2. Sharkh S.M., Abu-Sara M.A., Orfanoudakis G.I. and Hussain B., "Power Electronic Converters for Microgrids", Wiley – IEEE Press, 2014

REFERENCES:

1. NaserMahdaviTabatabaei, ErsanKabalci, NicuBizon, "Microgrid Architectures, Control and Protection Method", Springer, 2020
2. Magdi S. Mahmoud, "Microgrid Advanced Control Methods and Renewable Energy System Integration", Elsevier, 2017
3. Li Fusheng, Li Ruisheng, Zhou Fengquan, "Microgrid Technology and Engineering Application", Elsevier, 2016

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Understand the concepts of microgrid technologies	Understand
CO2	Illustrate the characteristics and selection of power electronics interfaces	Understand
CO3	Choose the converters, inverters for microgrid	Apply
CO4	Demonstrate the communication protocols and infrastructure	Understand
CO5	Interpret the operation of microgrid and its protection schemes	Understand

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	1	-	1
CO2	3	1	1	-	1	-	-	-	1	1	1	1	-	1
CO3	3	2	2	1	1	1	1	-	1	1	1	1	-	1
CO4	3	1	1	-	-	-	-	-	-	-	-	1	-	1
CO5	3	1	1	-	-	-	-	-	-	-	-	1	-	1
CO	3	1.2	1.2	1	1	1	1	-	1	1	1	1	-	1

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP10	POWER SYSTEM SECURITY	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Power System Analysis

COURSE OBJECTIVES:

- To acquire the knowledge on factors affecting the power system security
- To understand the concepts of state estimation, assessment and enhancement
- To apply the security assessment techniques for improving power system reliability

UNIT I BASICS OF POWER SYSTEM SECURITY 9

Factors affecting power system security – Decomposition and multilevel approach – State estimation – System monitoring – Security assessment and security enhancement

UNIT II POWER SYSTEM STATE ESTIMATION 9

Maximum likelihood weighted least-square estimation – State estimation – Detection and identification of bad measurements – Estimation of quantities not being measure – Network observability and pseudo measurements

UNIT III SECURITY ASSESSMENT 9

Detection of network problems – Network equivalent for external system – Network sensitivity methods – Calculation of network sensitivity factors – Fast contingency algorithms – Contingency ranking – Dynamic security indices

UNIT IV SECURITY ENHANCEMENT 9

Correcting the generator dispatch by sensitivity methods – Compensated factors – Security constrained optimization – Preventive – Emergency and restorative control through NLP and LP methods

UNIT V SECURITY TECHNIQUES 9

Voltage security assessment – Transient security assessment methods – Comparison – Case study

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Kothari D.P. and Nagrath I.J., "Power System Engineering", 3rd edition, Tata McGraw-Hill Education, 2019
2. Wood, A.J. and Woolenberg, "Power Generation Operation for Security", John Wiley and Sons, 2010

REFERENCES:

1. Allen J. Wood, Bruce F. Wollenberg and Gerald B. Sheble, "Power Generation, Operation and Control", 3rd edition, John Wiley and Sons, 2013
2. Venkatesh P, Manikandan B.V. and Charles Raja S., "Electrical Power Systems: Analysis, Security and Deregulation", PHI learning Pvt. Ltd., 2012
3. Leonard L. Grigsby, "Power System Stability and Control", 3rd edition, CRC Press, 2012

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Outline the factors affecting power system, security assessment and security enhancement	Understand
CO2	Organize the state estimation of power system	Apply
CO3	Choose the network sensitivity factors using various algorithms	Apply
CO4	Interpret the various methods for enhancing the security in power systems	Understand
CO5	Compare the various security assessment techniques	Understand

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO2	3	3	2	1	1	1	-	1	-	-	-	1	-	2
CO3	3	3	2	1	1	1	-	-	-	-	-	1	-	2
CO4	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO5	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO	3	2.4	1.4	1	1	1	-	1	-	-	-	1	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP11	HIGH VOLTAGE ENGINEERING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Transmission and Distribution

COURSE OBJECTIVES:

- To acquire the knowledge on high voltage transmission and breakdown mechanisms in dielectrics
- To understand the various high voltage, high current generation and measurement techniques
- To apply the various testing and computational tool for high voltage equipment

UNIT I ELECTRIC BREAKDOWN IN DIELECTRICS 9

High voltage transmission – Advantages – Need for generating high voltages in laboratory – Electric field stresses – Breakdown mechanism in gaseous, vacuum, liquids, solids and composite dielectrics

UNIT II GENERATION OF HIGH VOLTAGES AND CURRENTS 9

Generation of high DC and AC voltages – Generation of impulse voltages and impulse currents – Tripping and control of impulse generators

UNIT III MEASUREMENT OF HIGH VOLTAGES AND CURRENTS 9

Measurement of high DC and AC voltages – High DC and AC currents – High impulse voltages and impulse currents – Oscilloscopes for high voltages and currents

UNIT IV TESTING METHODS 9

Definitions and terms – Dielectric loss and partial discharge measurement – Testing of insulators, circuit breakers, transformers, cables and surge diverters

UNIT V ANSOFT AND ITS APPLICATION 9

ANSOFT software elements – Preprocessing – Modeling – Meshing – Governing equations – Boundary conditions and material characteristics – Setting up solution – Post processing – Design of insulators and bushings

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Naidu M.S. and Kamaraju V., "High Voltage Engineering", 5th edition, Tata McGraw Hill Ltd., 2013
2. Wadhwa C.L., "High Voltage Engineering", 3rd edition, New Age International Private Ltd., 2012

REFERENCES:

1. Arora R. and Rajpurohit B.S., "Fundamentals of High Voltage Engineering", 2nd edition, Newnes, 2019
2. Farouk A.M. Rizk and Giao N. Trinh, "High Voltage Engineering", CRC Press, 2018
3. Kuffel E. and Zaengl W.S., "High Voltage Engineering Fundamentals", Pergamon Press, 2013

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Interpret the various breakdown mechanisms in dielectrics	Understand
CO2	Illustrate the generation methods of high voltage and current	Apply
CO3	Summarize the measurement techniques of high voltage and current	Understand
CO4	Outline the various testing methods for high voltage equipment	Understand
CO5	Apply the computational tool to design insulators and bushings	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO2	3	2	2	1	1	1	-	-	-	-	-	1	-	2
CO3	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO4	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO5	3	2	2	1	2	1	-	1	-	-	-	1	-	2
CO	3	2	1.4	1	1.2	1	-	1	-	-	-	1	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP12	UTILIZATION, COSTING AND ESTIMATION	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Power System Analysis

COURSE OBJECTIVES:

- To acquire the knowledge on working principle and characteristics of traction motors
- To understand the importance of tariff and energy conservation
- To design illumination systems and estimate cost various lighting schemes

UNIT I ELECTRIC TRACTION SYSTEM 9

Traction motor characteristics – Starting and speed control – Electric braking – Energy consumption – Power of electric traction – Traction motor control – Track equipment and collection gear – Block diagram of a modern locomotive – Metro-rail system

UNIT II ECONOMIC ASPECTS OF UTILIZATION 9

Load curves – Load factors and its improvement – Availability based tariff – Demand side management – Peak clipping – Peak shifting – Valley filling – Use of off-peak energy – Case studies on energy efficiency in thermal and electrical utilities (Quantitative analysis only)

UNIT III DESIGN OF ILLUMINATION SCHEMES 9

Illumination engineering – Lamp types – Incandescent lamp, fluorescent lamp – Design of illumination systems – Indoor lighting schemes – Outdoor lighting schemes – Street lighting – CFL, OCFL and LED lighting system

UNIT IV ESTIMATION AND COSTING 9

Estimation and costing – Electrical schedule, catalogues, market survey and source selection, bill of materials – Purchase system – Purchase enquiry and selection of appropriate purchase mode – Purchase orders, Payment of bills, tender form

UNIT V ELECTRICAL INSTALLATION 9

Guidelines for wiring of residential installation and positioning of equipment – Circuit design in lighting and power circuits – Selection of wires and cables – Load calculations and selection of conductor size – Selection of switch rating, protective switchgear ELCB, MCB and wiring accessories – Case study: House wiring

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Openshaw Taylor E., "Utilisation of Electric Energy in SI Units", reprint, Universities Press, Hyderabad, 2011
2. Wayne J. Del Pico, "Electrical Estimating Methods", 4th edition, John Wiley & Sons, 2015

REFERENCES:

1. Wadhwa C.L., "Generation, Distribution and Utilization of Electrical Energy", 3rd edition, New Academic Science, 2011
2. Rajput R.K., "Utilization of Electrical Power", 2nd edition,Laxmi Publication Pvt. Ltd, 2013
3. Rajiv Shankar, "Energy Auditing in Electrical Utilities", Viva Books, 2014

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Select the drives for speed control of electric traction	Understand
CO2	Describe the economic aspects in tariff and energy auditing	Understand
CO3	Design the illumination systems for various types of lighting schemes	Understand
CO4	Develop bill of material and selection of appropriate purchase mode	Apply
CO5	Identify the wiring design and selection of cable for electrical installations	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	2
CO2	3	2	1	-	-	-	-	1	-	-	1	1	-	2
CO3	3	3	2	-	1	1	1	1	-	-	-	1	-	2
CO4	3	2	1	-	-	-	-	1	-	-	1	1	-	2
CO5	3	3	2	1	1	1	1	1	-	-	1	1	-	2
CO	3	2.4	1.4	1	1	1	1	1	-	-	1	1	-	2
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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PROFESSIONAL ELECTIVE

U19EEP13	EHV AC AND DC TRANSMISSION	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Power System Analysis

COURSE OBJECTIVES:

- To acquire the knowledge on transmission systems
- To understand the concept of EHV AC and DC transmission systems
- To apply the power flow analysis techniques for EHV transmission systems

UNIT I TRANSMISSION SYSTEM 9

EHV transmission – Comparison of EHV AC and DC transmission systems – Applications and limitations – Surface voltage gradients – Distribution of voltage gradients – Modern trends in EHV AC and DC transmission

UNIT II EHV AC TRANSMISSION 9

Generation and characteristics of corona – Radio interference effects – Over voltage due to switching – Ferro resonance – Reduction of switching surges on EHV system

UNIT III EHV DC TRANSMISSION 9

Converter configurations – Types of DC links – DC link control – Converter control characteristics – Firing angle control – Current and excitation angle control – Starting and stopping of DC link

UNIT IV POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Modeling of DC links – DC network – DC converter – Controller equations – Solution of DC load flow – DC quantities – Solution of AC-DC power flow – Simultaneous method – Sequential method

UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Electric shock – Threshold currents – Calculation of electrostatic fields and magnetic fields of AC and DC lines – Effect of fields on living organism – Electrical field measurement – Field visit

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Begamudre R.D., "Extra High Voltage AC Transmission Engineering", Wiley Eastern, 2017
2. Padiyar K.R., "HVDC Power Transmission Systems: Technology and System Reactions", New Age International, 2011

REFERENCES:

1. Arrillaga, J., "High Voltage Direct Current Transmission", IFFE Power Engineering Series 6, Peter Peregrinus Ltd, London, 2018
2. Naidu M. S., and Kamaraju V., "High Voltage Engineering", Tata McGraw Hill, 2013
3. Rao S., "EHV AC and HVDC Transmission Engineering and Practice", Khanna Publisher, 2009

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the need of EHV transmission and its modernization	Understand
CO2	Describe the EHV AC system and the problems associated	Understand
CO3	Identify the EHV DC system requirements and its controls	Understand
CO4	Solve the power flow problem in EHV DC transmission system	Understand
CO5	Calculate the effect of EHV systems on environment	Apply

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	1
CO3	3	2	1	-	-	-	-	-	-	-	-	-	-	1
CO4	3	2	1	-	1	-	-	-	-	-	-	-	-	1
CO5	3	2	1	1	1	-	-	1	-	-	-	1	-	1
CO	3	2	1	1	1	-	-	1	-	-	-	1	-	1
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19EEP14	POWER QUALITY	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Power System Analysis

COURSE OBJECTIVES:

- To acquire the knowledge on power quality issues
- To understand the types of power quality problems and mitigation techniques
- To apply the concept of mitigation techniques for solving power quality issues

UNIT I POWER QUALITY AND ITS STANDARDS 9

General classes of power quality problems – Concepts of transients – Short duration and long duration voltage variations – Voltage imbalance – Waveform distortions – Voltage fluctuations – Power frequency variations – Power quality standards: IEEE, IEC and CBEMA curve

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 9

Sources of sags and interruptions – Estimating voltage sag performance – Analysis and calculation of various fault conditions – Mitigation of voltage sags – Active series compensators – Static transfer switches and fast transfer switches.

UNIT III OVER VOLTAGES AND MITIGATIONS 9

Sources of over voltages – Capacitor switching – Lightning – Mitigation of voltage swells – Surge arresters – Power conditioners – Lightning protection – Line arresters – Protection of transformers and cables – Devices for controlling harmonic distortion.

UNIT IV HARMONICS AND ITS EFFECTS 9

Harmonic distortion – Voltage and current distortions – Power system quantities under non – sinusoidal conditions – Harmonic sources from commercial and industrial loads – Effect of harmonics – Resonance.

UNIT V POWER QUALITY MEASURING INSTRUMENTS 9

Power quality monitoring – Flicker meters – Disturbance analyzer – Spectrum and Harmonic analyzer – Data chart recorders – Smart power quality monitors – Introduction to computer analysis tools – Intelligent system for power quality monitoring.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and H. Wayne Beaty, "Electrical Power Systems Quality", 3rd edition, TataMcGraw Hill, 2012
2. Bhim Singh, Ambrish Chandra and Kamal Al-Haddad, "Power Quality Problems and Mitigations Techniques", 2nd edition, John Wiley, 2015

REFERENCES:

1. Math H.J.Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", IEEE Press, New York, 2011
2. Arrillaga.J., Watson.N.R. and Chen.S., "Power System Quality Assessment", 3rd edition, John Wiley and Sons Ltd., England, 2011
3. Beaty H. Wayne, McGranaghan and Mark, "Electrical Power Systems Quality", 3rd edition, 2012

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Interpret the various classes of power quality problems and power quality standards	Understand
CO2	Classify the sources of voltage sags and its mitigation techniques	Understand
CO3	Identify the various cases of over voltages and its mitigation method	Understand
CO4	Recognize the harmonic effects in power system	Understand
CO5	Acquire knowledge on harmonics measurement techniques	Understand

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	1	-	1	-	-	-	1	-	2
CO2	3	2	1	-	1	-	-	1	-	-	-	1	-	2
CO3	3	2	1	-	1	-	-	1	-	-	-	1	-	2
CO4	3	1	1	-	1	-	-	1	-	-	-	1	-	2
CO5	3	1	1	-	1	-	-	1	-	-	-	1	-	2
CO	3	1.6	1	-	1	1	-	1	-	-	-	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

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PROFESSIONAL ELECTIVE

U19EEP15	SENSORS AND ITS APPLICATIONS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Measurements and Instrumentation

COURSE OBJECTIVES:

- To acquire the knowledge in physical parameters using smart sensors
- To understand various types of sensors and its characteristics
- To apply smart sensors in real time applications

UNIT I SENSOR CHARACTERISTICS 9

Characteristics – Classification – Calibration techniques – Output signal types – Properties – Dynamic models of sensor elements

UNIT II OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9

LDR – Fiber optic sensors – Pressure sensors – Piezoelectric sensors – Acoustic sensors – Radiation sensors – LASER sensors – MEMS and Nano sensors

UNIT III MOTION AND RANGE SENSORS 9

Motion sensors – Encoders – Optical, Magnetic, Inductive and Capacitive type – Accelerometer – Range sensors – Radar – Flex ray – RF beacons – LIDAR

UNIT IV SENSORS FOR AUTOMOTIVE INDUSTRY 9

Air mass sensors – Wheel speed sensors – Suspension sensors – Impact sensors – Oil sensors – Brake sensors – Battery sensor – Parking sensors – Lane control sensors

UNIT V SENSOR INTERFACE AND APPLICATIONS 9

Battery monitoring sensors – Smart building sensors – Smoke and occupancy sensors – Oxygen sensors – Rain sensors – Flame sensors – Gas sensors

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Jon S. Wilson, "Sensor Technology Handbook", 1st edition, Elsevier, 2011
2. Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Applications", 3rd edition, Springer, 2015

REFERENCES:

1. Patranabis D., "Sensors and Transducers", 2nd edition, PHI, New Delhi, 2010
2. John G. Webster, "Measurement, Instrumentation and Sensor Handbook", 2nd edition, CRC Press, 2017
3. Richard Zurawski, "Industrial Communication Technology Handbook", 2nd edition, CRC Press, 2015

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Infer the characteristics and calibration techniques of sensors	Understand
CO2	Describe the operating principle of optical, pressure and radiation sensors	Understand
CO3	Explain the operating principle of motion and range sensors	Understand
CO4	Select the sensor for automotive and mechatronics applications	Apply
CO5	Implement the systems with sensors for real time applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	1	-	-	1	1	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	2	1	-	1	1	-	-	-	1	1	2	-
CO5	3	2	2	1	-	1	1	-	-	-	1	1	2	-
CO	3	2	1.4	1	-	1	1	1	-	-	1	1	1.4	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP16	ENERGY STORAGE SYSTEMS AND CONTROLLERS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Chemistry for Electrical Engineers

COURSE OBJECTIVES:

- To acquire the knowledge of energy storage systems
- To understand the operation and performance of energy storage systems
- To apply the concept of charge controllers for real time applications

UNIT I ENERGY STORAGE TECHNOLOGIES 9

Types – Thermal – Mechanical – Hydrogen – Electro chemical – Battery parameters – Power density – Nominal voltage – Cut off voltage – Float voltage – Nominal capacity – Service time – Cycle life.

UNIT II PRIMARY BATTERIES 9

Dry cells and alkaline batteries – Fabrication techniques – Packing – Rating – Effect of temperature – Internal resistance – Charging – Discharging – Safety

UNIT III SECONDARY BATTERIES 9

Lead acid – Lithium polymer – Lithium ion and air flow batteries – Construction – Working principle – Characteristics – SOC – DOD – SOH – ROD – C rating – E rating – Applications

UNIT IV FUEL CELLS 9

Hydrogen – Alkaline – Solid oxide fuel cells – Construction – Working principle – Characteristics – Thermodynamic analysis – Thermal effect – Reversible voltage – Applications

UNIT V CHARGE CONTROLLERS 9

Types – Standalone, series, shunt – Integrated charge controller – Battery balancing, monitoring and management system – Safety measures – Applications

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Aulice Scibioh M. and Viswanathan B., "Fuel Cells – Principles and Applications", University Press (India), 2006
2. David linden, Thomas B. Reddy, "Handbook of Batteries", 3rd edition, Tata McGraw-Hill Handbook, 2001

REFERENCES:

1. Christopher M. and Brett A., "Electrochemistry – Principles, Methods and Applications", Oxford University, 2004
2. Newman J.S. and Thomas - Alyea K.E., "Electrochemical Systems" 3rd edition, Wiley, Hoboken, NJ 2004
3. David Elliott, "Energy Storage Systems", IOP Publishing Ltd, 2017

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the concepts of energy storage technologies	Understand
CO2	Summarize the fabrication and performance evaluation of primary batteries	Understand
CO3	Describe the fabrication and performance evaluation of secondary batteries	Understand
CO4	Infer the importance and classification of fuel cells	Understand
CO5	Illustrate the concept of charge controllers	Understand

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO2	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO3	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO4	3	2	1	-	-	-	-	-	-	-	-	1	-	2
CO5	3	2	1	-	-	-	-	-	-	-	-	1	-	2
CO	3	2	1	-	1	-	-	-	-	-	-	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

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PROFESSIONAL ELECTIVE

		Category: PE			
		L	T	P	C
U19EEP17	ADVANCED ELECTRIC MOTORS AND CONTROL	3	0	0	3

PRE–REQUISITES:

- Electrical Machines – II

COURSE OBJECTIVES:

- To acquire the knowledge on selection of suitable special machine drive based on the application
- To understand the working of different drives and its controls
- To apply the appropriate control scheme for the specified application

UNIT I STEPPER MOTOR 9

Constructional features – Principle of operation – Modes of excitation torque production in variable reluctance stepping motor – Dynamic characteristics – Drive systems and circuit for open loop control – Closed loop control of stepping motor – Intelligent control techniques

UNIT II SYNCHRONOUS RELUCTANCE MOTOR AND SERVO MOTOR 9

Constructional features – Principle of operation – Characteristics – Open loop and closed loop control – Microprocessor, DSP and microcontroller-based control – Sensor less control – Servo motor: Construction – Principle of operation – Control strategies – Applications

UNIT III PERMANENT MAGNET SYNCHRONOUS MOTOR 9

Construction – Principle of operation – EMF, power input and torque expressions – Phasor diagram – Power controllers – Torque speed characteristics – Self-control – Vector control – Current control schemes – Sensor less control

UNIT IV LINEAR MOTOR 9

Linear Reluctance Motor (LRM) classification – Construction – Principle of operation – Concept of current sheet – Goodness factor – DC Linear Motor (DCLM) types – Circuit equation – DCLM control applications

UNIT V ENERGY EFFICIENT MOTOR 9

Standard motor efficiency – Concept of energy efficient motor – Efficiency evaluation technique – Direct measurement method – Loss in electric drive system – Segregation method – Motor efficiency labeling – Energy efficient motor standards – Adjustable drive systems

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Venkataratnam K., "Special Electrical Machines", University Press, Hyderabad, 2008
2. Vedam Subramanyam, "Electric Drives - Concepts and Applications", 2nd edition, McGraw Hill, 2010

REFERENCES:

1. Krauss, Wasyncsuk and Sudholf, "Analysis of Electrical Machines and Drive Systems", John Wiley, 2014
2. Ned Mohan, "Advanced Electric Drives: Analysis, Control and Modeling using MATLAB / Simulink", Wiley, 2014
3. Fouad Giri, "AC Electric Motors Control: Advanced Design Techniques and Applications", Wiley, 2013

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Illustrate the construction, principle of operation and the control techniques of stepper motor	Understand
CO2	Interpret the operation of synchronous reluctance motor and servo motor	Understand
CO3	Analyze the characteristics of permanent magnet synchronous motor	Apply
CO4	Compare the control methods of various types of linear motor	Apply
CO5	Explain the concept of energy efficient motor	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO3	3	1	2	1	1	1	1	-	-	-	-	-	2	-
CO4	3	2	2	1	1	1	1	-	-	-	-	1	2	-
CO5	3	1	1	-	1	-	-	-	-	-	-	-	2	-
CO	3	1.6	1.4	1	1	1	1	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP18	EV BATTERIES AND CHARGING SYSTEMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire the knowledge of energy system in electric vehicles
- To understand the operation of charging infrastructure
- To apply the concepts in effective energy management

UNIT I ELECTROCHEMICAL BATTERIES 9

Electrochemical reactions – Thermodynamic voltage – Specific energy – Specific power – Energy efficiency – Battery Technologies: Lead acid batteries, Nickel-based batteries and Lithium based batteries

UNIT II EV BATTERY TECHNOLOGIES 9

Energy storage issues: Battery Chemistries, battery modeling and simulation – Lithium-ion batteries: Characteristics – Cycle life versus State of Charge

UNIT III CHARGING SYSTEM 9

Charging regimes for batteries: Battery parameters, charging methods, termination methods and charging algorithm – Charging from grid – Charging from renewable energy sources

UNIT IV POWER CONVERTERS FOR CHARGING 9

Grid and photovoltaic system for charging – DC/DC converters and DC/AC inverters for Grid/PV interconnections – Integrated DC/AC/DC Converter – High frequency transformer based isolated charger topology – Component design

UNIT V ELECTRIC VEHICLE SUPPLY EQUIPMENT TECHNOLOGY 9

Basic components – Charger classification – Battery charging duration – Charging network – Charging expenses – Wireless charging – Infrastructure safety codes and standards.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Mehrdad Ehsani, Yimin Gao, Sebastein E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamental, Theory and Design", 1st edition, CRC Publication, 2005
2. Shedon S. Williamson, "Energy Management Strategies for Electric and Plugin Hybrid Electric Vehicles", 1st edition, Springer, 2013

REFERENCES:

1. Doug Kettles, "Electric Vehicle Charging Technology Analysis and Standards", FSEC Report number FSEC-CR-1996-15, 2015
2. Vermont Energy Investment Corporation." Electric Vehicle Charging Station Guidebook Planning for Installation and Operation", June 2014
3. Narayanaswamy P. and Iyer R., "Power Electronic Converters Interactive Modelling using Simulink", CRC Press, 2018

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COURSE OUTCOMES:

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

Cos	Statements	K-Level
CO1	Explain the working of various battery technologies	Understand
CO2	Explain the characteristics of batteries through modeling	Understand
CO3	Describe the charging system for battery from grid, renewable energy and integration of both	Understand
CO4	Describe the role of power converters in electric vehicle charging	Understand
CO5	Illustrate the components and working of EVSE technologies	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	1	1	-	2
CO2	3	2	1	-	1	-	-	-	-	-	1	1	-	2
CO3	3	2	1	-	1	-	-	-	-	-	1	1	-	3
CO4	3	2	1	-	1	-	-	-	-	-	1	1	-	2
CO5	3	2	1	-	1	-	-	-	-	-	1	1	-	2
CO	3	2	1	-	1	-	-	-	-	-	1	1	-	2.2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)			3: Substantial (High)							

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PROFESSIONAL ELECTIVE

U19EEP19	ELECTRIC VEHICLES AND DYNAMICS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Electrical Machines – II, Solid State Drives

COURSE OBJECTIVES:

- To acquire knowledge on the structure and requirements of electric vehicles
- To understand the operation and characteristics of electric vehicles
- To apply the energy management strategies for electric vehicles

UNIT I CONVENTIONAL VEHICLES 9

Overview – Basics of vehicle performance – Vehicle power source characterization – Transmission characteristics and mathematical models

UNIT II ELECTRIC VEHICLES 9

Configuration – Fixed and variable gearing system – Single and multiple motor drive – Hybrid and electric vehicles – Social and environmental importance – Future of electric vehicles – Comparison of EV and IC engines

UNIT III ELECTRIC VEHICLE DRIVE TRAIN 9

Transmission configuration – Components, gears, clutch, brakes, regenerative braking, motor sizing – Basic concept of electric traction – Various drive train topologies – Power flow control – Fuel efficiency analysis

UNIT IV ELECTRIC PROPULSION UNIT 9

Electric components used in hybrid and electric vehicles – Configuration and control of DC motor drives, Induction motor drives, Permanent magnet motor drives, Switched reluctance motor drives – Drive system efficiency.

UNIT V ENERGY MANAGEMENT STRATEGIES 9

Energy management strategies used in hybrid and electric vehicle – Classification – Comparison – Implementation issues of energy strategies – Battery Electric Vehicle (BEV)

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Iqbal Hussain, "Electric and Hybrid Vehicles-Design Fundamentals", 2nd edition, CRC Press, 2011
2. Mehrdad Ehsani, Yimin Gao and Ali Emadi, ""Modern Electric, Hybrid and Fuel Cell Vehicles: Fundamentals" 5th edition, Prentice Hall India, 2010

REFERENCES:

1. Chris Mi, Masrur M.A. and Gao D.W., "Hybrid Electric Vehicles - Principles and Applications with Practical Perspectives", Wiley, 2011
2. Davide Andrea, "Battery Management Systems for Large Lithium - Ion Battery Packs", Artech House, 2010
3. Hui Zhang, Dongpu Cao and Haiping Du, "Modeling, Dynamics and Control of Electrified Vehicles", Elsevier Science, 2017

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Infer the characteristics and performance of conventional vehicles	Understand
CO2	Summarize the importance and applications of electric vehicles	Understand
CO3	Illustrate the components of electric vehicles	Understand
CO4	Describe the configuration and control of electric drives	Understand
CO5	Explain the concept of energy management strategies	Understand

COURSE ARTICULATION MATRIX:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO2	3	2	1	-	1	-	-	-	-	-	-	1	2	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO4	3	2	1	-	1	-	-	-	-	-	-	1	2	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO	3	2	1	-	1	-	-	-	-	-	-	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19EEP20	AUTOMOTIVE MEMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Measurements and Instrumentation

COURSE OBJECTIVES:

- To acquire knowledge in the design and modeling of electrostatic sensors and actuators
- To understand the properties of materials, microstructure and fabrication methods
- To apply MEMS sensors in automotive systems

UNIT I MEMS AND MICROFABRICATION 9

Need for miniaturization – MEMS and microsystems – Microsystem products – Micro gears, micro turbines, micro motors, micro-optical devices – Micro fabrication – Microelectronic fabrication process – Silicon based MEMS process – Semiconductor devices – Stress and strain analysis – Flexural beam bending – Torsional deflections – Intrinsic stress

UNIT II MICROMACHINING 9

Photolithography – Ion implantation – Diffusion – Oxidation – Thermal oxidation) – Oxidation by chemical vapour deposition – Physical vapour deposition – Sputtering – Etching – Chemical, plasma, LIGA process – Micromachining – Bulk micromachining, surface micromachining

UNIT III SENSING AND ACTUATION 9

Electrostatic sensor – Parallel plate capacitors – Design and fabrication – Interdigitated finger capacitor – Comb drive devices – Applications – Thermal sensor – Design and fabrication – Thermocouples – Thermal resistors – Thermal bimorph – Applications

UNIT IV MECHANICAL SENSORS AND PACKAGING 9

Mechanical transduction techniques – Piezo resistivity – Piezo electricity – Capacitive, optical, resonant actuation techniques – Pressure sensors – Force and torque sensors – Inertial sensors – Flow sensors; Standard IC packaging – Packaging process – MEMS mechanical sensors packing

UNIT V AUTOMOTIVE APPLICATIONS 9

MEMS for passenger safety – Vehicle stability control – Automotive tire pressure monitoring systems – Pressure and flow sensors for engine management system – RF MEMS and its application – MEMS for passenger comfort in vehicles

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", 2nd edition, Pearson Education India, 2014
2. Michael Kraft and Neil M. White, "MEMS for Automotive and Aerospace Applications", Woodhead Publishing Limited, Oxford, 2013

REFERENCES:

1. Vinoy K.J., Ananthasuresh G.K. and Rudra Pratap, "Micro and Smart Devices and Systems", Springer India, 2014
2. Stephen Beeby, Graham Ensell, Michael Kraft and Neil White, "MEMS Mechanical Sensors", Artech House, Inc., Boston, London, 2004
3. Thomas M. Adams and Richard A. Layton, "Introductory MEMS: Fabrication and Applications", Springer, 2010

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the working principle of micro system and micro devices	Understand
CO2	Sketch micro systems using MEMS fabrication process	Apply
CO3	Describe the operation of various sensors and actuators	Understand
CO4	Identify the sensor type and required packaging methods	Understand
CO5	Choose the appropriate MEMS for automotive applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO3	3	1	1	-	-	-	-	-	-	-	-	-	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO5	3	2	1	1	-	1	-	-	-	-	-	-	1	-
CO	3	1.6	1	1	-	1	-	-	-	-	-	-	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19EEP21	EV STANDARDS AND TESTING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Chemistry for Electrical Engineers, Solid State Drives

COURSE OBJECTIVES:

- To acquire the knowledge in standards of EV, battery and charger systems
- To understand the concepts of wind tunnel, body and wheel of EV
- To apply the testing methods of energy and fuel consumption of EV

UNIT I EV STANDARDS 9

Electric power train vehicles – Construction and functional safety requirements – Measurement of electrical energy consumption – Measurement of range – Measurement of net power and the maximum 30-minute power – Central Motor Vehicle Rules (CMVR) type approval for electric power train vehicles

UNIT II TRACTION BATTERY AND CHARGER STANDARDS 9

Battery operated vehicles – Safety requirements of traction batteries – Charger standards – Electric vehicle conductive AC and DC charging system – Public EV charging standards – Charging for high voltage EVs – Home charging standards

UNIT III WIND TUNNEL AND BODY TESTING 9

Wind tunnel test requirements – Ground boundary simulation – Wind tunnel selection and Reynolds number capability – Model details, mounting of model – Test procedure – Body test – Dynamic simulation sled testing – Dolly roll over test – Dolly roll over fixture – Vehicle roof strength test – Door system crash test

UNIT IV CRASH AND WHEEL TESTING 9

Crash testing: Human testing – Dummies – Crash worthiness – Pole crash and near crash testing – Vehicle to vehicle impact and side impact testing – Crash test sensor – Sensor mounting – Braking distance test. Wheel testing: Dynamic cornering and dynamic radial fatigue tests – Procedures, bending moment and radial load calculations – Impact test: Road hazard impact test for wheel and tyre assemblies – Test procedures – Failure criteria and performance criteria

UNIT V ENERGY AND FUEL CONSUMPTION TESTING 9

Energy consumption by engine cooling fan, air conditioning and brake compressors – Hydraulic pumps power consumption, ABS energy consumption – Test route selection – Vehicle speed test – Cargo, weight and driver selection – Tested data, findings and calculations – Test on rough terrain – Pot hole with laden and unladden conditions

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. John G. Hayes and G. Abas Goodarzi, "Electric Power Train: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles", Wiley, 2018
2. Course W.H. and Anglin D.L., "Automotive Mechanics", TMG publishing company, 2017

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REFERENCES:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd edition, CRC press, 2010
2. Automotive Handbook, Bosch - Website: www.mainindia.com/Draft, AIS standards.asp
3. DHI Centre of Excellence for E-Mobility, Standards - Website: https://emobility.araiindia.com/standards/

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the standards of electric vehicle	Understand
CO2	Interpret the standards of traction battery and charger	Understand
CO3	Apply the testing methods to wind tunnel and body of an EV	Apply
CO4	Illustrate the crash and wheel testing	Understand
CO5	Design methodologies for energy and fuel consumption testing	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	1	-	-	-	1	-	1
CO2	3	2	1	-	1	-	-	1	-	-	-	1	-	1
CO3	3	2	2	1	1	1	1	-	-	-	-	1	-	2
CO4	3	2	2	-	1	-	-	-	-	-	-	1	-	1
CO5	3	2	2	1	1	1	1	-	-	-	-	1	-	2
CO	3	2	1.6	1	1	1	1	1	-	-	-	1	-	1.4

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP22	HYBRID ELECTRIC VEHICLES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire the fundamental knowledge of hybrid electric vehicles
- To understand the operational behavior of various components of hybrid electric vehicle
- To apply the concept modeling hybrid electric vehicles

UNIT I FUNDAMENTALS OF VEHICLES 9

Vehicle movement – Vehicle resistance – Dynamic equation – Power train tractive effort and vehicle speed – Characteristics: vehicle power plant and transmission – Vehicle performance

UNIT II HYBRID ELECTRIC VEHICLE 9

Classification of HEV – Architectures of HEV's drive train – Operation pattern – Control strategies

UNIT III ELECTRIC PROPULSION SYSTEM 9

DC Motor: Armature and field control, chopper-based control – Induction Motor: Voltage/frequency control, field-oriented Control – Permanent Magnet Brushless DC Motor: Construction and classification – Sensorless techniques – Switched reluctance motor drive: Sensorless Control

UNIT IV POWER ELECTRONICS IN HEV 9

Rectifiers – Non isolated bidirectional DC - DC converter – Isolated bidirectional DC - DC converter –Voltage source inverters and current source inverters – Modeling and simulation – Thermal management

UNIT V HEV MODELING 9

Modeling for energy analysis – Vehicle level energy analysis: equations of motions, vehicle energy balance, driving cycles – Power train components

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Mehrdad Ehsani, Yimin Gao, Sebastein E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles - Fundamental, Theory and Design", 1st edition, CRC Publication, 2005
2. Chris Mi and Abul Masrur M., "Hybrid Electric Vehicle Principles and Applications with Practical Perspectives", 1st edition, Wiley and Sons, 2018

REFERENCES:

1. Simona Onori, Lorenzo Serrao and Giorgio Rizzoni, "Hybrid Electric Vehicles - Energy Management Strategies", 1st edition, Springer, 2016
2. R. Krishnan, "Electric Motor Drives Modeling, Analysis and Control", 1st edition, Prentice Hall, 2001
3. Narayanaswamy P. and Iyer R., "Power Electronic Converters Interactive Modelling using Simulink", CRC Press, 2018

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the fundamentals and characteristics of traction system in vehicle	Understand
CO2	Design the various architectures of hybrid electric vehicle with their control strategies	Apply
CO3	Describe the operation and control of propulsion system	Understand
CO4	Infer the power electronic converters used in HEV	Apply
CO5	Explain the energy management system in HEV	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	1	1	-	1
CO2	3	2	2	1	1	1	1	-	-	-	1	1	-	1
CO3	3	2	1	-	-	-	-	-	-	-	1	1	-	1
CO4	3	2	2	1	1	1	1	-	-	-	1	1	-	1
CO5	3	2	1	-	-	-	-	-	-	-	1	1	-	1
CO	3	2	1.4	1	1	1	1	-	-	-	1	1	-	1
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

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PROFESSIONAL ELECTIVE

		Category: PE			
U19EEP23	PROCESS DYNAMICS AND CONTROL	L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Control Systems

COURSE OBJECTIVES:

- To acquire the knowledge in process modeling
- To understand the dynamic and static behavior of the modeled system
- To apply PID and advanced control strategies based on process model

UNIT I PROCESS DYNAMICS 9

Process control – Objective of modeling – Models of hydraulic, liquid, thermal and gas systems – Degrees of freedom – Continuous and batch processes – Self regulation – Lumped and distributed parameter models – Linearization of nonlinear systems

UNIT II DYNAMIC AND STEADY STATE BEHAVIOR OF PROCESS 9

Dynamic response of a first order process – First order plus dead time process – Second order process – Pure capacitive process – Pure dead time – Higher order process – Inverse response – Pade approximation.

UNIT III FINAL CONTROL ELEMENTS 9

I/P converter – Pneumatic and electric actuators – Valve positioner – Control valves – Characteristic of control valves – Inherent and installed characteristics – Modeling of pneumatic control valve – Valve body – Commercial valve bodies – Control valve sizing – Cavitation and flashing – Selection criteria.

UNIT IV CONTROL ACTIONS 9

Concept of servo and regulatory problems – Selection of measured, manipulated and controlled variables – Types of controller – Characteristic of on-off, proportional, integral and derivative controllers – PI, PD and PID control modes – Auto/manual transfer – Reset windup – Practical forms of PID Controller.

UNIT V DESIGN OF FEEDBACK CONTROLLER 9

Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – Tuning – Process reaction curve method, Continuous cycling method – Direct synthesis.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Dale E. Seborg., Duncan A. Mellichamp, Thomas F. Edgar, and Francis J. Doyle, "Process dynamics and control", 4th edition, John Wiley & Sons, 2016.
2. Stephanopoulos and George, "Chemical Process Control: An Introduction to Theory and Practice", Pearson India Education Services, 2015.

REFERENCES:

1. Coughanowr Donald R. and Lowell B. Koppel, "Process systems analysis and control", McGraw-Hill, 2009.
2. Johnson Curtis D., "Process control instrumentation technology", Prentice Hall, 2013
3. McMillan G. K., Douglas Considine, "Process/Industrial Instruments Hand book", 5th edition, McGraw Hill, New York, 2009.

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Develop mathematical models for dynamic processes.	Apply
CO2	Estimate process stability, dynamic responses, frequency analysis of dynamic processes.	Apply
CO3	Choose the necessary final control element for valve application.	Apply
CO4	Select and tune PID controllers for various systems.	Apply
CO5	Examine the performance of a closed loop control approach.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	1	1	-	-	-	-	1	1	-
CO2	3	2	2	1	-	1	1	-	-	-	-	1	1	-
CO3	3	2	2	1	-	1	1	-	-	-	-	1	1	-
CO4	3	2	2	1	-	1	1	-	-	-	-	1	1	-
CO5	3	2	2	1	1	1	1	-	-	-	-	1	1	-
CO	3	2	2	1	1	1	1	-	-	-	-	1	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

14/7/21

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PROFESSIONAL ELECTIVE

U19EEP24	IoT IN EV APPLICATIONS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Solid State Drives

COURSE OBJECTIVES:

- To acquire knowledge about electric vehicle architecture and power train components
- To understand the concept of energy storage systems
- To apply IoT paradigms for EV applications

UNIT I PHYSICAL DESIGN OF IoT 9

IoT System – Characteristics – Logical design – IoT protocols – IoT levels and deployment templates – Need for IoT system management – Network operator requirements – Differences and similarities between M2M and IoT

UNIT II ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS 9

Evolution of Electric Vehicles – Impact of modern drive trains on energy supplies – Architecture of Electric vehicles and hybrid electric vehicles – Plug-in hybrid electric vehicles – Power train components and sizing, gears, clutches, transmission and brakes

UNIT III MECHANICS OF ELECTRIC VEHICLES 9

Fundamentals of vehicle mechanics – Tractive force, power and energy requirements for standard drive cycles of HEVs – Motor torque, Power rating and battery capacity – Range-extended electric vehicles: classification and configurations, fuel cell electric vehicles, solar electric vehicles, electric bi-cycles and their propulsion systems, vehicle-to-grid, vehicle-to-home concepts

UNIT IV ENERGY STORAGE SYSTEMS 9

Storage requirements – Battery – Fuel cell – Super Capacitor – Power pack management systems – Cell balancing techniques – Flywheel based energy storage and its analysis – Hybridization of different energy storage devices – Compressed air storage systems – Super conducting magnetic storage systems

UNIT V IoT APPLICATIONS 9

Energy monitoring system – Autonomous electric vehicles – SOC estimation for lithium-ion batteries – Energy management – DC fast charging system – Methods for battery balancing in electric vehicles

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, Taylor & Francis Group, 2015
2. Husain I., "Electric and Hybrid Vehicles", Boca Raton, CRC Press, 2010

REFERENCES:

1. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands on Approach", Universities Press, 2015

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3. Jack Erjave C. and Jeff Arias, "Alternate Fuel Technology - Electric, Hybrid and Fuel Cell Vehicles", Cengage, 2012

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Describe the basic concepts of IoT	Understand
CO2	Summarize the drive-train topologies and propulsion techniques	Understand
CO3	Explain the fundamentals of vehicle mechanics	Understand
CO4	Analyze hybrid energy storage methodologies	Analyze
CO5	Apply the charging system for electric vehicle	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	2
CO2	3	2	1	-	-	-	-	-	-	-	-	1	-	2
CO3	3	2	1	-	-	-	-	-	-	-	-	1	-	2
CO4	3	2	2	1	1	1	1	-	-	-	1	1	-	2
CO5	3	2	2	1	1	1	1	-	-	-	1	1	-	2
CO	3	2	1.4	1	1	1	1	-	-	-	1	1	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP25	AUTOMOTIVE TRANSMISSION	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Solid State Drives, Measurements and Instrumentation

COURSE OBJECTIVES:

- To acquire the knowledge in the construction and principle of clutch and gearbox
- To understand the hydrodynamic and hydrostatic transmission systems
- To apply the concepts of automotive transmission systems

UNIT I FUNDAMENTALS OF TRANSMISSION 9

Tractive effort – Resistance to motion of a vehicle – Requirements – Classification – Single, two and four-wheel drive systems – Multi axle drives, chain, shaft and electric drives – Different transmissions in scooter, car, MUVs and transport vehicles

UNIT II CLUTCH AND GEAR BOX 9

Requirements of transmission system – Different types of clutches – Principle and construction of single plate coil spring and diaphragm spring clutches – Need and objectives of gear box – Construction and operation of sliding mesh, constant mesh and synchro mesh gearboxes – Determination of gear ratios for vehicles – Performance characteristics in different speeds

UNIT III HYDRODYNAMIC TRANSMISSION 9

Fluid coupling – Principle and constructional details – Torque capacity – Performance characteristics – Reduction of drag torque in fluid coupling – Torque converter – Principle and constructional details – Performance characteristics – Multistage torque converters and polyphase torque converters

UNIT IV HYDROSTATIC TRANSMISSION 9

Principle, types, advantages, limitations – Comparison of hydrostatic drive with hydrodynamic drive – Construction and working of typical Janny hydrostatic drive – Performance Characteristics

UNIT V APPLICATIONS OF AUTOMOTIVE TRANSMISSION 9

Chevrolet turbo glide transmission – Four speed longitudinally mounted automatic transmission – Power glide transmission – Continuously Variable Transmission – Toyota "ECT-i" automatic transmission with intelligent electronic control system – Hydraulic actuation system

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Devaradjane G. and Kumaresan M., "Automobile Engineering", AMK Publishers, 2013
2. Gill P.S., "Automobile Engineering", S K Kataria & Sons, 2014

REFERENCES:

1. Kirk T. Van Gelder, CDX Automotive, "Fundamentals of Automotive Technology: Principles and Practice", Jones & Bartlett Publishers, 2013
2. Chau, K. T., "Electric Vehicle Machines and Drives: Design, Analysis and Application", Wiley-IEEE, 2015
3. Heinz Heisler, "Advance Vehicle Technology", Butterworth-Heinemann, 2002

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the fundamentals of automotive transmission	Understand
CO2	Infer the construction, working principle of clutch and gearbox	Understand
CO3	Describe the construction, principle and performance characteristics of hydrodynamic transmission	Understand
CO4	Illustrate the principle, construction and performance characteristics of hydrostatic transmission	Understand
CO5	Apply the automotive transmission principles to electric vehicles	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	1	-	-	-	-	1	2	-
CO2	3	2	1	1	1	1	1	-	-	-	1	1	2	-
CO3	3	2	1	1	1	1	1	-	-	-	1	1	2	-
CO4	3	2	1	1	1	1	1	-	-	-	1	1	2	-
CO5	3	2	2	2	2	1	1	-	1	-	1	1	2	-
CO	3	2	1.2	1.2	1.2	1	1	-	1	-	1	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

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PROFESSIONAL ELECTIVE

U19EEP26	INDUSTRIAL AUTOMATION	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Embedded Systems

COURSE OBJECTIVES:

- To acquire the knowledge in various industrial applications of Programmable Logic Controller
- To understand the problems related to I/O module, data acquisition system and communication networks using standard devices
- To apply the general structure of automated process using SCADA

UNIT I PROGRAMMABLE LOGIC CONTROLLERS 9

Evolution – Types – Unitary, modular, small, medium, large – Functional Block diagram – Input/Output (I/O) section, processor, power supply, memory – Central processing unit – Processor software / executive software – Multi tasking – Languages – Ladder language

UNIT II LOGICAL INSTRUCTIONS AND PROGRAMMING 9

Bit logic instructions – Input and output contact program symbols, numbering system of inputs and outputs, program format – Equivalent ladder diagram of gates, equivalent ladder diagram – Comparison instructions – PLC timers – ON delay and OFF delay timers, retentive and non-retentive timers – Format of timer instruction – PLC Counter – Operation, counter parameters, counter instructions overview – Count up and count down

UNIT III INPUT / OUTPUT MODULES 9

Overview – Classification – practical I/O systems and its mapping – I/O expansion - I/O systems – Direct, parallel, serial – Sinking and sourcing – Discrete input module – Rectifier with filter, threshold detection, isolation, logic section, specifications – Analog input module – Types – Special input modules – Analog output module – I/O modules in hazardous locations – Power supply requirements – Power supply configuration – Filters

UNIT IV SCADA 9

Generalized architecture – Communication requirements – SCADA system architecture – Monolithic – Distributed – Networked architecture

UNIT V APPLICATIONS 9

SCADA systems in operation and control of interconnected power system – Power system automation, petroleum refining process, sugar and cogeneration plant – Plant wide control – Internet of things – Cloud based automation – Object Linking and Embedding for process control – Safety PLC

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Madhuchhanda Mitra and Samarjit Sen Gupta, "PLC and Industrial Automation: An Introduction", 2nd edition, Penram International Publishing (India) Pvt. Ltd., 2017
2. Ronald L. Krutz, "Securing SCADA Systems", 4th edition, John Wiley and Sons, 2015

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Learn Beyond

REFERENCES:

1. Rajesh Mehra and Vikrant Vij, "PLCs & SCADA: Theory and Practice", 1st edition, University Science press, 2011
2. Kunal Chakraborty, Palash De and Indranil Roy, "Industrial Applications of Programmable Logic Controllers and SCADA", Anchor Academic Publishing, 2016
3. Stuart A Boyer, "SCADA: Supervisory Control and Data Acquisition", 4th edition, Inscribe Digital, 2016

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the internal architecture and operations of Programmable Logic Controller	Understand
CO2	Describe the basic programming concepts and various logical instructions	Understand
CO3	Compute the extent and nature of electronic circuitry	Apply
CO4	Infer the general structure of SCADA for real time industrial applications	Understand
CO5	Apply the advanced automation technology for various applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	-	1	2	-
CO2	3	2	1	-	1	-	-	-	-	-	-	1	2	-
CO3	3	2	2	1	1	1	1	-	-	-	-	1	2	-
CO4	3	2	1	-	1	-	-	-	-	-	-	1	2	-
CO5	3	2	2	1	1	1	1	1	-	-	1	1	2	-
CO	3	2	1.4	1	1	1	1	1	-	-	1	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

		Category: PE			
U19EEP27	EMBEDDED NETWORKING AND AUTOMATION OF ELECTRICAL SYSTEMS	L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Embedded Systems

COURSE OBJECTIVES:

- To acquire the knowledge in building blocks of digital instrument
- To understand the concepts of grid automation and embedded networking
- To apply the digital instrument for power quality monitoring

UNIT I BUILDING SYSTEM AUTOMATION 9

Data acquisition system – Signal conditioning circuit design – Automation and protection of electrical appliances – Processor based digital controllers for switching actuators: Stepper motors, relays – System automation with multichannel instrumentation and interface

UNIT II EMBEDDED NETWORKING OF INSTRUMENT CLUSTER 9

Embedded networking – Cluster of instruments in system – Embedded ethernet: MOD bus, CAN bus and LIN bus – WSN – Sensor nodes – Zigbee protocol – Network topology – Energy efficient MAC protocols

UNIT III AUTOMATION OF SUBSTATION 9

Substation automation – Distribution SCADA system principles – Role of PMU, RTU, IEDs, BUS – Role of IEC 61850, IEEEC 37.118 std – IEC 61850 – Challenges of substations in smart grid, energy storage and distribution systems monitoring

UNIT IV METERING OF SMART GRID 9

Characteristics of smart grid – Renewable energy grid – Electrical measurements with AMI – Smart meters in EV charging station – Net metering and demand side energy management applications

UNIT V SMART METERS FOR PQ MONITORING 9

Power quality issues of grid connected energy sources – Smart meters for power quality monitoring and control – Inter harmonics – Power quality benchmarking – Fluke meter – Meter data management in smart grid – Communication enabled power quality metering

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Wehrie K. and Gunes J. Gross, "Modeling and Tools for Network simulation", Springer, 2010
2. Krzysztof Iniewski, "Smart Grid, Infrastructure & Networking", Tata McGraw Hill, 2012

REFERENCES:

1. Shih-Lin Wu and Yu-Chee Tseng, "Wireless Ad Hoc Networking, PAN, LAN, SAN", Auerbach, 2012
2. Ernest O. Doeblin and Dhanesh N Manik, "Measurement Systems – Application and Design", 5th edition, Tata McGraw Hill, 2007
3. Dimitrios Hristu-Varsakelis and William S. Levine, "Handbook of Networked and Embedded Control System", Springer, 2005

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain about the sensors, processors and controllers used for system automation	Understand
CO2	Illustrate the basics of ethernet communication protocols	Understand
CO3	Recognize the needs and standards in substation automation	Understand
CO4	Analyze the metering network for commercial applications	Apply
CO5	Describe about smart meters for power quality monitoring	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO2	3	1	1	-	-	-	-	-	-	-	-	-	2	-
CO3	3	1	1	1	1	-	-	-	-	-	-	1	2	-
CO4	3	2	2	1	-	1	1	-	-	-	-	1	2	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO	3	1.6	1.2	1	1	1	1	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

		Category: PE			
U19EEP28	DATA ACQUISITION AND ROBOTIC CONTROL	L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Measurements and Instrumentation, Embedded Systems

COURSE OBJECTIVES:

- To acquire the knowledge in sensor signal conditioning, transmission and analysis
- To understand the concepts of motion planning algorithm
- To apply the concepts of navigation and obstacle in robotic control systems

UNIT I BASIC DATA ACQUISITION 9

Single ended and differential measurement systems, common-mode rejection ratio, referenced and non-referenced single – Ended measurement systems, hardware versus software timing, comparing DAQ devices and computer – Based instruments for data acquisition, instrument I/O, Buffered I/O

UNIT II ADVANCED DATA ACQUISITION 9

Measurements using DAQ cards, real-time system, VISA field point I/O, compact RIO I/O and intelligent real – Time embedded controller – PCI or PXI R series device, device calibration – External calibration and internal calibration

UNIT III MOTION PLANNING ALGORITHMS 9

Motion planning overview – Sensor-based motion planning: the bug algorithms – Workspace decomposition and search algorithms on graphs (basic search on graphs, A∗ and overview of D∗)

UNIT IV OBSTACLE PLANNING 9

Configuration space and configuration – Space obstacles – Sampling-based motion planning (probabilistic roadmaps, RRTs, collision-checking primitives) – Brief overview of kinematic and dynamic models for robots – Local motion planners – Nonlinear control class

UNIT V ROBOT CELL DESIGN AND APPLICATIONS 9

Robot work cell design and control – Sequence control – Operator interface – Safety monitoring devices in Robot – Mobile robot working principle, actuation using software. Introductions – Robot applications Material handling – Machine loading and unloading – Assembly, inspection, welding, spray painting and underwater robot

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Barry Paron, "Sensor, Transducers and LabVIEW", Prentice Hall, New Delhi, 2000
2. Choset H., Lynch K.M., Hutchinson S., Kantor G., Kavraki L.E. and Thrun S., "Principles of Robot Motion: Theory, Algorithms and Implementations", The MIT Press, 2005

REFERENCES:

1. LabVIEW: Basics I & II Manual, National Instruments, 2005
2. Thrun S., Burgard W. and Fox D., "Probabilistic Robotics, Intelligent Robotics and Autonomous Agents", The MIT Press, 2005.
3. Sanjay Gupta and Joseph John, "Virtual Instrumentation Using Lab View", 2nd edition, Tata McGraw Hill Publisher Ltd., New Delhi, 2010

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the basic data acquisition and DAQ device	Understand
CO2	Describe the advanced data acquisition and various real time system to interface	Understand
CO3	Implement simulation and analysis of complex robotic systems	Apply
CO4	Determine the models of simple systems for obstacle planning	Apply
CO5	Determine major robot work cell design and robot applications for manufacturing and assembly sectors	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO3	3	2	2	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	2	1	-	-	-	-	-	-	-	1	1	-
CO5	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO	2.8	1.8	1.4	1	-	-	-	-	-	-	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

		Category: PE			
U19EEP29	DATA BASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Object Oriented Programming and Advanced Data Structures

COURSE OBJECTIVES:

- To acquire the knowledge on data models, database design, transactions and implementations
- To understand the concept of database design and transaction
- To apply the concept of data base management systems in storage and query processing techniques

UNIT I RELATIONAL DATABASES 9

Purpose of Database system – Data models – Database system architecture – Relational databases – Relational model – Keys – Relational algebra – SQL fundamentals – Advanced SQL features – Embedded SQL – Dynamic SQL

UNIT II DATABASE DESIGN 9

Entity – Relationship model – Enhanced–ER Model – ER – to – Relational mapping – Functional dependencies – Non-loss decomposition – First, second, third normal forms, dependency preservation – Multi-valued dependencies and fourth normal form – Join dependencies and fifth normal form

UNIT III TRANSACTIONS 9

Transaction concepts – ACID properties – Schedules – Serializability – Concurrency control – Need for concurrency – Locking protocols – Transaction recovery – Save points – SQL facilities for concurrency and recovery

UNIT IV IMPLEMENTATION TECHNIQUES 9

RAID – File organization – Indexing and hashing – Ordered indices – B tree index files – Query processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and cost estimation

UNIT V ADVANCEMENTS IN DBMS 9

Distributed databases: Architecture, data storage, transaction processing – ODMG object model, ODL, OQL – XML databases: XML hierarchical model, XML Schema, XQuery – Information retrieval: IR concepts, Retrieval models, Queries in IR systems

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, Sudarshan S., "Database System Concepts", 6th edition, Tata McGraw Hill, 2011
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database System", 6th edition, Pearson Education, 2011

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REFERENCES:

1. Date C.J., Kannan A and Swaminathan S, "An Introduction to Database System", 8th edition, Pearson Education, 2006
2. Raghu Ramakrishnan, "Database Management Systems", 4th edition, McGraw Hill,2015
3. Gupta G.K., "Database Management System", Tata McGraw Hill, 2011

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Infer the data model and architecture of database system	Understand
CO2	Outline the ER model and relational model	Understand
CO3	Identify the transaction process in database management systems	Apply
CO4	Develop the various indexing strategies in database systems	Apply
CO5	Outline the advance database differ from traditional databases	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	1	-	-	-	-	-	-	1	-	-
CO2	3	1	-	-	1	-	-	-	-	-	-	1	-	-
CO3	3	2	1	-	1	-	-	-	-	-	-	1	-	-
CO4	3	1	-	-	1	-	-	-	-	-	-	1	-	-
CO5	3	1	-	-	1	-	-	-	-	-	-	1	-	-
CO	3	1.2	1	-	1	-	-	-	-	-	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP30	WEB TECHNOLOGY	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Problem Solving using Python Programming

COURSE OBJECTIVES:

- To acquire knowledge about world wide web and web page designing
- To understand the concept of markup language and script language for web designing
- To develop the web page using markup language and script language

UNIT I INTRODUCTION 9

Internet Protocols – TCP/IP, UDP, DNS and domain Names, higher level protocols, WWW – Versions – HTTP – Request and response messages – URI, URN, URL, MIME Type – Application and development tools – The web browser – Server – Choices – Setting up UNIX and Linux web servers – Logging users – Dynamic IP – Web Design: Web site design principles – Planning and navigation

UNIT II HYPERTEXT MARKUP LANGUAGE 9

HTML: The development process – HTML tags and simple HTML forms – Web site structure – XHTML: Move to XHTML – Meta tags – Character entities – Frames and frame sets – Inside browser – CSS – Benefits – Types

UNIT III JAVA SCRIPT 9

Client-side scripting – Java script, development of Java script – Simple Java script – Variables – Functions – Conditions – Loops and repetition – Advance script – Java script own objects – DOM and web browser environments – Forms and validations

UNIT IV XML 9

XML – Uses of XML – simple XML – key components – DTD and schemas – Well formed – Application – XSL – XML transformed simple example – XSL elements – Transforming with XSLT

UNIT V PHP 9

Starting to script on server side – Arrays – Function and forms – Advance PHP – Databases: Basic command with PHP examples – Connection to server – Creating database – Selecting a database – Listing database – Listing table names creating a table – Inserting data – Altering tables – Queries – Deleting database, deleting data and tables – phpMyAdmin and database bugs

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Robert W. Sebesta, "Programming the World Wide Web", 8th edition, Addison-Wesley, 2015
2. Deitel and Deitel, "Internet and World Wide Web: How to Program", 5th edition, Pearson Education, 2012

REFERENCES:

1. Steven Holzner, "HTML Black Book", Dreamtech Press, 2000
2. Kogent Learning Solutions Inc., "Web Technologies Black Book", Dreamtech Press, 2009
3. Knuckles, "Web Applications: Concepts and Real-World Design", John Wiley & Sons, 2006

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Describe the overview of web page	Understand
CO2	Summarize the various HTML tags used for developing the web pages	Understand
CO3	Apply client-side scripting using Java script	Apply
CO4	Infer the data processing in hardware and software using XML	Understand
CO5	Model the server-side scripting using PHP	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	2	-	-	-	-	-	-	2	-	-
CO2	3	2	1	-	2	-	-	-	-	-	-	2	-	-
CO3	3	2	2	-	2	1	-	-	-	-	-	2	-	-
CO4	3	2	1	1	2	-	-	-	-	-	-	2	-	-
CO5	3	2	2	-	2	1	-	-	-	-	-	2	-	-
CO	3	2	1.4	1	2	1	-	-	-	-	-	2	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

		Category: PE			
U19EEP31	SYSTEM PROGRAMMING AND OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Data Structures in C

COURSE OBJECTIVES:

- To acquire the concepts of assembler, linker, macros and loaders
- To understand the basics of process management and process synchronization
- To apply the knowledge in memory management for paging and segmentation

UNIT I SYSTEM SOFTWARE 9

Overview of language processors – Assemblers – Elements of assembly language programming – Pass structure of assemblers – Design of two pass assembler – Algorithm for single pass assembler

UNIT II MACROS, LINKERS AND LOADERS 9

Macro and Macro preprocessors – Macro definition and call – Macro expansion – Advanced macro facilities – Design of macro preprocessor – Linkers and Loaders – Relocation and linking concept – Design of Linker – Self relocating programs – Loaders

UNIT III PROCESS MANAGEMENT AND SYNCHRONIZATION 9

Operating System – User view – Process management and concepts – Threads - Scheduling criteria and algorithms – Process synchronization – Semaphores, monitors – Deadlock – Deadlock characterization

UNIT IV MEMORY MANAGEMENT 9

Memory management requirements – Memory partitioning – Paging – Segmentation – Virtual memory concepts – Demand paging and performance – Page replacement algorithms – Thrashing - Cache memory organization – Locality of reference

UNIT V STORAGE MANAGEMENT 9

Disk structure and attachment – Disk scheduling – Swap Space Management– RAID structure – File system and concept – Access methods – Directory and disk structure – File system mounting – File sharing – File system implementation issues – File system protection and security

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Dhamdhere D.M., "System Programming", Tata McGraw Hill Education Private Limited, 2011
2. Silberschatz A, Peter Baer Galvin and Greg Gagne, "Operating System concepts", 9th edition, John Wiley and sons Inc., 2012

REFERENCES:

1. Andrew S. Tanenbaum and Albert S. Woodhull: "Operating Systems, Design and Implementation", 3rd edition, Prentice Hall, 2011
2. Gary Nutt: "Operating Systems", 3rd edition, Pearson Education, 2009
3. Dhamdhere D.M., "Operating Systems: A Concept-based Approach", 2nd edition, Tata McGraw-Hill Education, 2009

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Describe the concept of system software and assembler	Understand
CO2	Explore the models of macros, linkers and loaders	Understand
CO3	Acquire the knowledge of process management and synchronization	Understand
CO4	Identify different kinds of memory management techniques	Understand
CO5	Illustrate different file systems, file sharing and implementation issues	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	-	1	1	-
CO2	3	2	1	-	1	-	-	-	-	-	-	1	1	-
CO3	3	2	1	-	1	-	-	-	-	-	-	1	1	-
CO4	3	2	1	-	1	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	1	-	-	-	-	-	-	1	1	-
CO	3	2	1	-	1	-	-	-	-	-	-	1	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19EEP32	APPLICATION DEVELOPMENT PRACTICES	Category: PE			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Problem Solving using Python Programming

COURSE OBJECTIVES:

- To acquire the knowledge on web page development
- To understand the use of HTML tags and cascading style sheets tags
- To develop an application using multimedia files, HTML5 and CSS3

UNIT I INTRODUCTION 4

HTML Editors – CSS JS – Basics – Formatting – Quotations – Meta Tags

UNIT II CASCADING STYLE SHEETS 5

Overview of CSS – Basics – Text, fonts, icons, links – Box model, backgrounds, borders, margins, positioning

UNIT III CSS POSITIONING 7

Comments – Links – Images – Tables – Lists – Padding – Height – Width – Inline styles – Visibility – Positioning – Layers – Z-index

UNIT IV CSS3 7

Classes and ID – Media, Video, Audio, YouTube – CSS3 – Rounder corner, border images, multi background, multi columns – CSS3 – Color, gradients, shadow, text – 2D and 3D transform – Animation – Media query

UNIT V HTML 5 7

Overview of HTML5 – Form elements – HTML5 features – SVG, canvas – Local storage – Add, display, edit, update, delete, clear

LIST OF EXPERIMENTS

1. Create a web page with the following using HTML
2. Embed an image map in a web page
3. Fix the hot spots and show all the related information when the hot spots are clicked
4. Create a web page with all types of cascading style sheets
5. Design of web pages – Use of cascading style sheets to style the way a webpage looks
6. Incorporating multimedia into a webpage (Text/ Audio / Image / Video / Animation)
7. Designing a static website using content management frameworks

Contact Periods:

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

TEXT BOOKS:

1. Andy Harris, "HTML5 and CSS3 All –in –one for Dummies", 3rd edition, John Wiley & Sons, 2014
2. Mark A. Lassoff, "HTML and CSS for Beginners with HTML5", 1st edition, learn to program.tv Inc., 2013

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REFERENCES:

1. Elisabeth robson, "Head First HTML and CSS: A learner's Guide to creating Standards based Web Pages", kindle Edition, Oreilly, 2012
2. Jon Duckett, "HTML and CSS: Design and build Websites", John Wiley & Sons Inc., 2011
3. Web link: Course "HTML and CSS", - www.guvi.in

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Compare the purpose of HTML and CSS in web development	Understand
CO2	Illustrate the uses of CSS to control text styles and layout	Understand
CO3	Develop a webpage with paragraphs, div, images, links, and lists using HTML application	Apply
CO4	Construct the webpage with CSS3 ID's, classes and multimedia options	Apply
CO5	Explain the usage of HTML5 and its features	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	1	1	1	1	1	-	-
CO2	3	2	1	1	1	-	-	1	1	1	1	1	-	-
CO3	3	2	1	1	1	-	-	1	1	1	1	1	-	-
CO4	3	2	2	1	1	-	-	1	1	1	1	1	-	-
CO5	3	2	2	1	1	-	-	1	1	1	1	1	-	-
CO	3	2	1.4	1	1	-	-	1	1	1	1	1	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19EEP33	DIGITAL IMAGE PROCESSING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Fourier Analysis and Partial Differential Equations

COURSE OBJECTIVES:

- To acquire knowledge on digital image fundamentals and image enhancement techniques
- To understand the concept of image restoration, segmentation and representation techniques
- To apply the image processing concept for image compression and recognition

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Introduction – Origin – Steps in digital image processing – Components – Elements of visual perception – Image sensing and acquisition – Image sampling and quantization – Relationships between pixels – Color models

UNIT II IMAGE ENHANCEMENT 9

Spatial domain: Gray level transformations – Histogram processing – Basics of spatial filtering – Smoothing and sharpening spatial filtering – Frequency domain – Smoothing and sharpening frequency domain filters – Ideal, butterworth and Gaussian

UNIT III IMAGE RESTORATION AND SEGMENTATION 9

Noise models – Mean filters – Order statistics – Adaptive filters – Band reject filters – Band pass filters – Notch filters – Optimum notch filtering – Inverse filtering – Wiener filtering – Segmentation: Detection of discontinuities – Edge linking and boundary detection – Region based segmentation morphological processing – Erosion and dilation

UNIT IV WAVELET AND IMAGE COMPRESSION 9

Wavelets – Sub band coding – Multiresolution expansions - Compression: Fundamentals – Image compression models – Error free compression – Variable length coding – Bit-plane coding – Lossless predictive coding – Lossy compression – Lossy predictive coding – Compression standards

UNIT V IMAGE REPRESENTATION AND RECOGNITION 9

Boundary representation – Chain code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier descriptor, moments – Regional descriptors – Topological feature, texture – Patterns and pattern classes - Recognition based on matching

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: –Periods Total: 45 Periods

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 3rd edition, Pearson, 2010
2. Anil K. Jain, "Fundamentals of Digital Image Processing", 4th edition, Pearson, 2018

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods and Steven L. Eddins, "Digital Image Processing using MATLAB", 3rd edition, Tata McGraw-Hill Pvt. Ltd, 2011
2. William K. Pratt, "Digital Image Processing", John Wiley, 2002

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3. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", 3rd edition, PHI Learning Pvt. Ltd., 2011

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Describe the digital image fundamental such as image sensing, sampling and quantization	Understand
CO2	Explain image enhancement techniques in time domain and frequency domain	Understand
CO3	Infer the image restoration and image segmentation techniques	Understand
CO4	Apply the various techniques for image compression	Apply
CO5	Describe the features of images representation and recognition	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	1	1	1	-	-	-	-	-	-	1	1	-
CO3	3	2	1	1	1	-	-	-	-	-	-	1	1	-
CO4	3	2	1	1	1	-	-	-	-	-	-	1	1	-
CO5	3	2	1	1	1	-	-	-	-	-	-	1	1	-
CO	3	2	1	1	1	-	-	-	-	-	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

		Category: PE			
U19EEP34	ARTIFICIAL NEURAL NETWORK AND FUZZY SYSTEMS	L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To expose the basic concepts of various neural network and fuzzy systems
- To provide the adequate knowledge in neural network and fuzzy systems
- To provide comprehensive knowledge in the application of neural network and fuzzy logic control systems

UNIT I FUNDAMENTALS OF NEURAL NETWORK 9

Introduction to artificial neutral network – Biological neurons and their artificial models – Neural processing – Learning and adaptation – Neural network learning rules – Hebbian, Perception, Delta, Widrow– Hoff correlation – Activation functions – Learning factors – Linear separability

UNIT II NEURAL NETWORKS FOR CONTROL 9

Single layer perceptions – Adaline – Madaline – Multilayer feed forward networks – Back propagation network – Self organizing feature maps – Radial basis function networks

UNIT III FUZZY SYSTEMS 9

Crisp set – Vagueness – Uncertainty and imprecision – Fuzziness – Basic definitions – Fuzzy set theory – Classical set Vs Fuzzy set – Properties of fuzzy sets – Fuzzy operation – Fuzzy arithmetic – Fuzzy relation – Fuzzy relational equations – Fuzzy Cartesian product and composition

UNIT IV FUZZY MODELS AND CONVERSION 9

Introduction to Fuzzy model – Structure of fuzzy logic control – Fuzzification models – Knowledge base – Rule base – Inference engine – Fuzzy to crisp conversion – Lambda cuts for fuzzy sets and relations – Defuzzification methods

UNIT V APPLICATION OF NEURAL NETWORKS AND FUZZY SYSTEMS 9

Neural Network: Hand written character recognition – Travelling salesman problem – Fuzzy logic control: Home heating system – Liquid level control – Fuzzy PID control – Fuzzy based motor control

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Pearson Education India, 2006
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 4th edition, Wiley, 2016

REFERENCES:

1. Sivanandam S.N. and Deepa S.N., "Introduction to Neural Networks Using MATLAB 6.0", Tata McGraw – Hill Education, 2016
2. Rajasekaran S. and Pai G.A.V., "Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis and applications", PHI, New Delhi, 2017
3. John Yen and Reza Langari, "Fuzzy Logic – Intelligence Control & Information", Pearson Education, New Delhi, 2003

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the basic concepts and various activation functions of neural networks	Understand
CO2	Choose the suitable neural network for real time problems	Apply
CO3	Apply fuzzy rules and reasoning to develop decision making and expert systems	Apply
CO4	Relate the fuzzy models and conversion	Understand
CO5	Select the neural network and fuzzy systems for real time applications	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	-	1	1	-
CO2	3	2	1	-	1	-	-	-	-	-	-	1	1	-
CO3	3	2	2	1	1	1	1	-	-	-	-	1	1	-
CO4	3	2	2	1	1	1	1	-	-	-	-	1	1	-
CO5	3	2	1	-	1	-	-	-	-	-	-	1	1	-
CO	3	2	1.4	1	1	1	1	-	-	-	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP35	IoT SYSTEM DESIGN AND SECURITY	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Computational Thinking

COURSE OBJECTIVES:

- To acquire the fundamental knowledge on Internet of Things
- To understand the concept of IoT architecture, protocols, communications and security
- To develop an IoT model for real time problem

UNIT I FUNDAMENTALS OF IoT 9

Evolution of IoT – Machine to Machine – Simplified IoT architecture and Core IoT functional stack – Functional blocks of an IoT ecosystem – Sensors, Actuators – Smart Objects and connecting smart objects

UNIT II IoT DATA LINK PROTOCOLS 9

Protocol Standardization for IoT – IEEE802.15.4, IEEE 802.11 AH, LTE-A, M2M and WSN Protocols –SCADA and RFID Protocols – Issues with IoT standardization – Zigbee – network layer – APS layer

UNIT III IoT ARCHITECTURE 9

IoT open-source architecture – OIC architecture and design principles – IoT devices and deployment models – IoTivity: An open source IoT stack overview – resource model and abstraction

UNIT IV COMMUNICATION AND SERVICE DISCOVERY 9

IoT application development – Application protocols: Communication protocols based on the exchange of messages (MQTT), – Service oriented protocols (COAP) – Data processing for IoT – Organization of data processing for Internet of Things

UNIT V IoT Security 9

IoT Security, System security – Security issues in Zigbee – IoT application: smart and connected cities layered architecture, smart lighting, smart parking architecture and smart traffic control

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Jamil Y. Khan and Mehmet R. Yuce, "Internet of Things Systems and Application", Jenny Stanford 2019
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017

REFERENCES:

1. Dimitrios Serpanos, Marilyn Wolf, "Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies", Springer International Publication, 2018
2. Alvaro Vives, Marco Zennaro, "Internet of Thing", Taylore & Francis Group, 2018
3. https://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Understand the fundamentals of Internet of Things. (U)	Understand
CO2	Describe the various IoT protocols. (U)	Understand
CO3	Identify the IoT Architecture for real time problems (U)	Understand
CO4	Develop the MQTT services for a real time application. (Ap)	Apply
CO5	Model the real-world applications using IoT concepts	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	1	-	-	-	-	-	-	1	1	-
CO2	3	1	1	-	1	-	-	-	-	-	-	1	1	-
CO3	3	1	1	-	1	-	-	-	-	-	-	1	1	-
CO4	3	1	2	1	1	1	1	-	-	-	-	1	1	-
CO5	3	1	2	1	1	1	1	-	-	-	-	1	1	-
CO	3	1	1.4	1	1	1	1	-	-	-	-	1	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19EEP36	MACHINE LEARNING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Computational Thinking

COURSE OBJECTIVES:

- To acquire the knowledge on data regression, data classification and transformation, deep neural networks
- To understand the concept of data regression, classification, clustering and transformation and deep neural networks
- To implement the data regressive and classification concept for electrical engineering applications

UNIT I INTRODUCTION 9

Overview – Data representation – Diversity of data – Types of data – Different forms of learning – Types of learning – Bias and variance – Heuristic search in inductive learning – Generalization errors

UNIT II LINEAR MODELS AND ASSOCIATION RULE 9

Linear basis function models – Bayesian linear regression – Association rule mining – Market basket analysis – Case studies: electricity consumption, weather forecasting

UNIT III DATA CLASSIFICATION 9

Perceptron algorithm – Linear maximal margin classifier – Linear soft margin classifier – Nonlinear classifier – Regression by SVM – Variants of SVM techniques – Decision tree: Classification – Measures of impurity – ID3, C4.5, CART – ID3, C4.5 – Case study: fault classifier

UNIT IV DATA CLUSTERING AND TRANSFORMATION 9

Unsupervised learning – Clustering Methods – K-Means Clustering – EM algorithm – Data transformation – Entropy based method for attribute discretization – PCA for attribute reduction – Case study: clustering electricity usage

UNIT V DEEP NEURAL NETWORK 9

Neuron models – Networks: Perceptron, radial bias function – Back propagation algorithm – Case studies: Lane detection, Vehicle detection

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (India) Private Limited, 2013
2. Murphy K., "Machine Learning: A Probabilistic Perspective", MIT Press, 2012

REFERENCES:

1. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014
2. John Mueller and Luca Massaron, "Machine Learning for Dummie", John Wiley & Sons, 2016
3. Gopal M., "Applied Machine Learning", TMH, 2018

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Infer the various types of data and various types of learning	Understand
CO2	Explain the linear models and association rule	Understand
CO3	Apply the data classification concept for electrical fault grouping problem	Apply
CO4	Apply the data clustering and transformation concept for electricity usage problem	Apply
CO5	Implement the deep neural network model for lane and vehicle detection	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	1	1	-	-	1	-	-	1	1	2	-
CO4	3	2	2	1	1	-	-	1	-	-	1	1	2	-
CO5	3	2	2	1	1	-	-	1	-	-	1	1	2	-
CO	3	2	1.8	1	1	-	-	1	-	-	1	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP37	AUGMENTED REALITY AND VIRTUAL REALITY APPLICATIONS IN ENGINEERING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Problem Solving using Python Programming

COURSE OBJECTIVES:

- To acquire the fundamentals of augmented reality and virtual reality
- To understand the 3D user interfacing and various technologies
- To apply the 3D interaction techniques and mixed reality

UNIT I VIRTUAL REALITY AND VIRTUAL ENVIRONMENTS 9

Development of VR – Scientific landmarks – Computer graphics – Real-time computer graphics – Flight simulation – Virtual environments – Requirements for VR – Benefits of virtual reality – Hardware technologies for 3D user interfaces – Displays: visual, auditory, haptic – Choosing output devices for 3D user interfaces

UNIT II 3D USER INTERFACE INPUT HARDWARE 9

Input device characteristics – Desktop input devices – Tracking Devices – 3D Mice – Special purpose input devices – Direct human input – Home – Brewed input devices – Choosing input devices for 3D interfaces

UNIT III SOFTWARE TECHNOLOGIES 9

Database – World space, world coordinate, world environment, objects – Geometry, position / orientation – Hierarchy – Bounding volume – Scripts and other attributes – VR environment – VR database – Tessellated data and LODs – Cullers and occludes – Lights and cameras, scripts, interaction – Simple feedback – Graphical user interface – Control panel – 2D Controls – Hardware controls – Room / stage / area descriptions – World authoring and playback – VR toolkits

UNIT IV 3D INTERACTION TECHNIQUES 9

3D Manipulation tasks – Manipulation techniques and input devices – Interaction techniques for 3D manipulation – Design guidelines – 3D travel tasks and travel techniques – Design guidelines – Theoretical foundations of way finding – Types of way finding's – Design guidelines – System control – Classification – Graphical menus – Design guidelines – Case study: Mixing system control methods – Symbolic input tasks – Symbolic input techniques

UNIT V AUGMENTED and MIXED REALITY 9

Augmented and Mixed Reality – Taxonomy – Technology and features of augmented reality – Difference between AR and VR – Challenges with AR - AR systems and functionality – Augmented reality methods – Visualization techniques – Wireless displays in educational augmented reality applications – Mobile projection interfaces – Marker-less tracking for augmented reality enhancing interactivity in AR environments – Evaluating AR systems

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", 1st edition, Morgan Kaufmann publishers", 2013
2. Alan B. Craig, William R. Sherman and Jeffrey D. Will, "Developing Virtual Reality Applications: Foundations of Effective Design", 1st edition, Morgan Kaufmann Publishers, 2009

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REFERENCES:

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005
2. Doug A. Bowman, Ernest Kuijff, Joseph J. LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley Ltd., 2005

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Explain the basic concept of virtual reality and its environment	Understand
CO2	Illustrate the 3D user interface hardware	Understand
CO3	Compare various kinds of software techniques	Understand
CO4	Classify the various types of 3D interface techniques	Understand
CO5	Summarize the basic concepts of augmented and mixed reality	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	1	-	-	-	1	-	-
CO2	3	2	1	-	1	-	-	1	-	-	-	1	-	-
CO3	3	2	1	-	1	-	-	1	-	-	-	1	-	-
CO4	3	2	1	-	1	-	-	1	-	-	-	1	-	-
CO5	3	2	1	-	1	-	-	1	-	-	-	1	-	-
CO	3	2	1	-	1	-	-	1	-	-	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19EEP38	EMBEDDED SYSTEMS DESIGN	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Embedded Systems

COURSE OBJECTIVES:

- To acquire knowledge on the hardware components and its performance issues of an embedded system
- To understand the role of firmware in embedded systems
- To apply programming knowledge for developing an embedded system

UNIT I EMBEDDED HARDWARE 9

General purpose and domain specific processors – ASIC – FPGA – Commercial off-the shelf components (CTOS) – Memory shadowing memory selection – Communication interface: Onboard and External communication interfaces – Embedded firmware design approaches and development languages

UNIT II PERFORMANCE ISSUES OF EMBEDDED SYSTEM 9

CPU performance – CPU power consumption – Program level performance analysis – Analysis and optimization of program size – Evaluating operating system performance, power management – Optimization strategies for processes – Multiprocessors – CPUs and accelerators, multiprocessor performance analysis

UNIT III EMBEDDED PROGRAMMING 9

C and assembly – Programming style – Arrays, qualifiers and reading numbers – Decision and control statements – Programming process – Control statements – Variable scope and functions – C-preprocessor – Simple pointers – Debugging and optimization – In-line assembly

UNIT IV EMBEDDED C 9

Adding structure to 'C' Code: Object oriented programming with C, Header files for project and port, Examples – Meeting real-time constraints: Creating hardware delays – Need for timeout mechanism – Creating loop timeouts – Creating hardware timeouts

UNIT V EMBEDDED APPLICATIONS 9

Case study: Industrial temperature control – Home automation – Adaptive cruise control – Mobile phone

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Steve Oualline, "Practical C Programming", 3rd edition, O'Reilly Media Inc., 2006
2. Michael J. Pont, "Embedded C", 2nd edition, Pearson Education, 2008.

REFERENCES:

1. Raj Kamal, "Embedded Systems Architecture Programming and Design", 2nd edition, Tata Mc Graw-Hill, 2011
2. Steve Heath, "Embedded Systems Design", 2nd edition, Newnes publications, 2003

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Describe about the hardware components in an Embedded System	Understand
CO2	Interpret the various performance issues of Embedded Systems	Understand
CO3	Infer the concepts of embedded programming	Understand
CO4	Develop programs for an embedded application	Apply
CO5	Demonstrate the various applications of embedded systems	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	2	1	-	1	1	-	-	-	-	1	1	-
CO	3	2	1.2	1	-	1	1	-	-	-	-	1	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19EEP39	DATA SCIENCE	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Data Structures in C

COURSE OBJECTIVES:

- To acquire the knowledge in data processing and data analysis
- To understand the data mining and data streams concepts
- To apply the data science concept in Map, Reduce and Hadoop

UNIT I INTRODUCTION TO DATA SCIENCE 9

Data Science – Fundamentals and components – Data scientist – Terminologies used in big data environments – Types of digital data – Classification of digital data – Introduction to big data – Characteristics of data – Evolution of big data – Big data analytics – Classification of analytics – Top challenges facing big data – Importance of big data analytics – Data analytics tool

UNIT II DESCRIPTIVE ANALYTICS USING STATISTICS 9

Types of data - Mean, median and model – Standard deviation and variants – Probability – Probability Density function – Types of data distribution – Percentiles and moments – Correlation and covariance – Conditional probability – Baye's theorem – Introduction to univariate, bivariate and multivariate analysis – Dimensionality reduction using principal component analysis and LDA

UNIT III PREDICTIVE MODELING AND MACHINE LEARNING 9

Linear regression – Polynomial regression – Multivariate regression – Multilevel models – Data warehousing overview – Bias / variance trade off – K fold cross validation – Data cleaning and normalization – Cleaning web log data – Normalizing numerical data – Detecting outliers – Introduction to supervised and unsupervised learning – Reinforcement learning – Case studies: Electrical load forecasting, Fault classifier

UNIT IV MINING DATA STREAMS 9

Introduction to streams concepts – Stream data model and architecture – Stream computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window – Real Time Analytics Platform (RTAP) applications – Case studies: Temperature estimation

UNIT V DATA SCIENCE USING PYTHON 9

Introduction to essential data science packages: Numpy, Scipy, Jupyter, Statsmodels and Pandas package – Data munging: Introduction to Data munging, Data pipeline and Machine learning in Python – Data visualization using Matplotlib – Interactive visualization with advanced data learning representation in Python

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Michael Berthold and David J. Hand, "Intelligent Data Analysis", Springer, 2007
2. Seema Acharya and Subhashini Chellapan, "Big Data Analytics", Wiley, 2015

REFERENCES:

1. Alberto Boschetti and Luca Massaron, "Python Data Science Essentials", 2nd edition, Packt Publications, 2016

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2. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2014
3. Foster Provost and Tom Fawcet, "Data Science for Business", O'Reilly Publishers, 2013

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Describe the concept of data science and its types	Understand
CO2	Explore the models of various data analysis platforms	Understand
CO3	Apply the various regression methods for electrical engineering applications	Apply
CO4	Illustrate the different kinds of data mining streams for electrical engineering applications	Apply
CO5	Apply the concept of data analysis using python	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	2	-	-	-	-	-	3	1	2	-
CO2	3	2	1	-	2	-	-	-	-	-	3	1	2	-
CO3	3	2	1	-	2	-	-	1	-	-	3	1	2	-
CO4	3	2	1	1	2	-	-	1	-	-	3	1	2	-
CO5	3	2	1	-	2	-	-	-	-	-	3	1	2	-
CO	3	2	1	1	2	-	-	1	-	-	3	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19EEP40	DEEP LEARNING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Computational Thinking

COURSE OBJECTIVES:

- To acquire the basics knowledge on deep feed forward networks, convolutional networks, recurrent and recursive nets
- To understand the concept of various deep networks architecture
- To implement the deep networks model for electrical engineering applications

UNIT I INTRODUCTION 9

Need for ML and DL – Learning algorithms: supervised and unsupervised – Capacity, overfitting and under fitting – Hyper parameters and validation sets – Estimators, bias and variance – Maximum likelihood estimation

UNIT II DEEP FEEDFORWARD NETWORKS 9

XOR function – Gradient based learning – Hidden units – Architecture design – Back propagation algorithm – Case studies: Power load forecasting.

UNIT III REGULARIZATION AND OPTIMIZATION FOR DEEP MODELS 9

Norm penalties – Regularization – Dataset augmentation – Noise robustness – Early stopping – Parameter tying and parameter sharing – Bagging and ensemble methods – Dropout – Batch and mini batch algorithms – Basic algorithms

UNIT IV CONVOLUTIONAL NETWORKS 9

Convolution operation – Motivation – Pooling – Convolution and pooling as an infinitely strong prior – Variants of the basic convolution function – Structured outputs – Data type – Unsupervised features- Case studies: Smart city, Power quality issue

UNIT V RECURRENT AND RECURSIVE NETS 9

Recurrent neural networks – Encoder – decoder sequence to sequence architectures – Deep Recurrent networks – Recursive neural networks – Echo state networks – Leaky units and other strategies for multiple time scales – LSTM – Case studies: forecasting of wind power, EV charging station

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Bengio, Yoshua, Ian J. Goodfellow and Aaron Courville, "Deep Learning", MIT Press, 2015
2. Francois Chollet, "Deep Learning with Python", Manning Publications Co., 2017

REFERENCES:

1. Eugene Charniak, "Introduction to Deep Learning", MIT Press, 2018
2. Charu C. Aggarwal, "Neural Networks and Deep Learning", Springer, 2018
3. Josh Patterson and Adam Gibson, "Deep Learning A Practitioner's Approach", O'Reilly media Inc., 2017

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Infer the basic concept of deep learning and its necessary terminologies	Understand
CO2	Apply the deep feed forward network for load forecasting problems	Apply
CO3	Describe the concept of regularization and optimization for deep models	Understand
CO4	Implement the convolutional network concepts for smart city and power quality application	Apply
CO5	Implement the pre-trained model for power forecasting and EV charging station	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	1	1	1	1	-	1	-	-	1	1	1	-
CO3	3	2	1	1	-	-	-	-	-	-	-	1	1	-
CO4	3	2	1	1	1	1	-	1	-	-	1	1	1	-
CO5	3	2	1	1	1	1	-	1	-	-	1	1	1	-
CO	3	2	1	1	1	1	-	1	-	-	1	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

14/7/19

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PROFESSIONAL ELECTIVE

U19EEP41	TENSORFLOW FOR ENGINEERING APPLICATIONS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To acquire the basic knowledge of tensorflow implementation
- To apply the convolution and recurrent neural network for real time application
- To understand the various applications using tensorflow networks

UNIT I IMPLEMENTING NEURAL NETWORKS IN TENSORFLOW 9

Introduction to tensor flow: Computational graph – Key highlights – Creating a graph – Regression example – Gradient descent – tensor board, modularity – Sharing variables – Managing models over the CPU and GPU – Specifying the logistic regression model in tensorflow – Logging and training the logistic regression model

UNIT II CONVOLUTIONAL NEURAL NETWORKS 10

Introduction to convolution neural networks – CNN architecture – Convolution operation – Padding and stride – Transfer learning – Fine-tuning – Applications of convolution neural networks

UNIT III RECURRENT NEURAL NETWORKS 10

Fundamentals of recurrent neural network – Modelling sequencing– Types of RNNs – Long short–term memory – Gated recurrent unit – Recursive neural tensor network theory. Real-life examples: One-dimensional sequence processing – Recurrent neural network applications

UNIT IV KERAS AND TFLEARN 7

Introduction of Keras – Keras model building blocks – Different compositional layers – Process based use cases' implementations – Introduction of TFlearn – TFlearn model building blocks– Different compositional layers– Cases implementations

UNIT V CASE STUDY 9

Image classification – Image segmentation and instance segmentation – Object detection – Natural Language Processing – Sentiment analysis and data set – Wind energy forecasting – Stock price detection

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola. "Dive into Deep Learning", Release 0.15.1, 2020
2. Goodfellow I., Bengio, Y., and Courville, A., "Deep Learning", MIT Press, 2016

REFERENCES:

1. Golub G.H. and Van Loan C.F., "Matrix Computations", JHU Press, 2013
2. Nikhil Buduma and Nicholas Locascio, "Fundamentals of Deep Learning: Designing Next Generation Machine Intelligence Algorithms", O'Reilly Media, 2017
3. Josh Patterson and Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly, 2017

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COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Implement neural networks in tensorflow for solving problems	Apply
CO2	Apply the concept of convolution neural networks	Apply
CO3	Apply the concept to develop RNN, LSTM and GRU model for given problem	Apply
CO4	Build the various network using Keras and Tflearn	Understand
CO5	Understand the various real time applications of tensorflow	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	-	-	1	2	-
CO2	3	2	1	1	1	-	-	-	-	-	-	1	2	-
CO3	3	2	1	1	1	-	-	-	-	-	-	1	2	-
CO4	3	2	1	-	1	-	-	-	-	-	-	1	2	-
CO5	3	2	1	-	1	-	-	-	-	-	-	1	2	-
CO	3	2	1	1	1	-	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

14/3/24

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PROFESSIONAL ELECTIVE

U19EEP42	BIG DATA ANALYTICS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Data Base Management Systems

COURSE OBJECTIVES:

- To acquire the knowledge on big data, clustering and association rules
- To understand the concept of data stream, clustering and classification
- To implement the schema-less models and key value stores for electrical engineering applications

UNIT I INTRODUCTION 9

Evolution of Big data – Best practices for Big data analytics – Big data characteristics – Validating – Promotion of the value – Big data use cases - Perception and quantification of value – Big data storage – High-performance architecture – HDFS – Map reduce

UNIT II CLUSTERING AND CLASSIFICATION 9

Clustering – K-means – Use cases – Method – Determining the number of clusters – Diagnostics – Reasons to choose and cautions – Classification: Decision tree algorithms – Case studies: Load forecasting, weather monitoring

UNIT III ASSOCIATION AND RECOMMENDATION 9

Association rules – Apriori algorithm – Evaluation of candidate rules – Applications of association rules – Finding association and finding similarity – Recommendation system: Collaborative recommendation: Content based, Knowledge Based, Hybrid

UNIT IV STREAM MEMORY 9

Streams concepts – Stream data model and architecture – Stream computing, Sampling data in a Stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window – Real time analytics platform (RTAP) applications – Case studies: Data stream

UNIT V NOSQL DATA MANAGEMENT FOR BIG DATA 9

Schema-less Models: Increasing flexibility for data manipulation - Key value stores - Document stores – Tabular stores – Object data stores – Graph databases hive – Sharding – Hbase – Big data analytics for power distribution

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis an Introduction", 2nd edition, Springer, 2007
2. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & Sons, 2012

REFERENCES:

1. Jimmy Lin and Chris Dyer, "Data-Intensive Text Processing with Map Reduce", Morgan Claypool publishers, 2010
2. Paul C. Zikopoulos, Chris Eaton, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw-Hill Education (India) Private Limited, 2011

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3. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann, 2013

COURSE OUTCOMES:

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

COs	Statements	K-Level
CO1	Infer the various types of use cases and best practices in Big data	Understand
CO2	Explain the clustering and its classification	Understand
CO3	Describe the association rules and recommendation system in Big data	Understand
CO4	Apply the data stream for real time analytics	Apply
CO5	Implement the NOSQL data management for Big data	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	1	-
CO3	3	2	2	1	1	-	-	1	-	-	1	1	1	-
CO4	3	2	2	1	1	-	-	1	-	-	1	1	1	-
CO5	3	2	2	1	1	-	-	1	-	-	1	1	1	-
CO	3	2	1.8	1	1	-	-	1	-	-	1	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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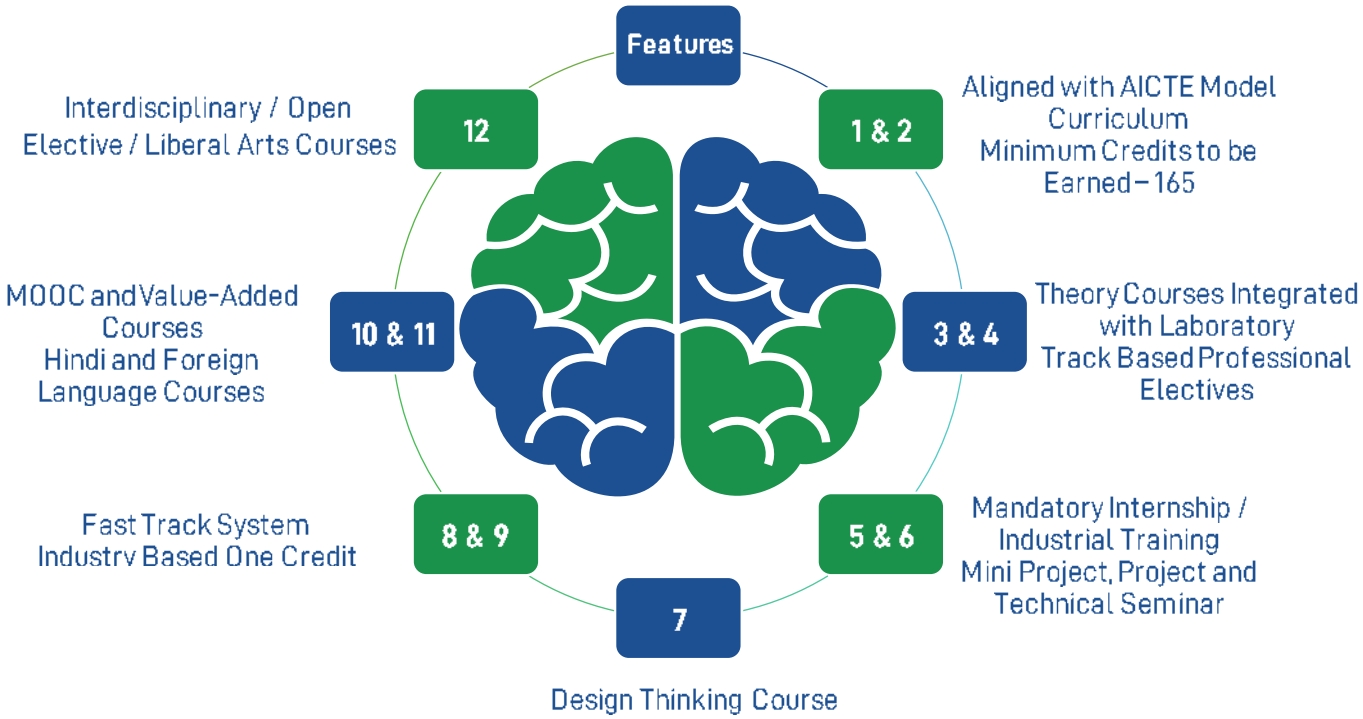
Curriculum Features



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