Sri

SAI RAM INSTITUTE OF TECHNOLOGY

An Autonomous Institution

West Tambaram, Chennai - 44

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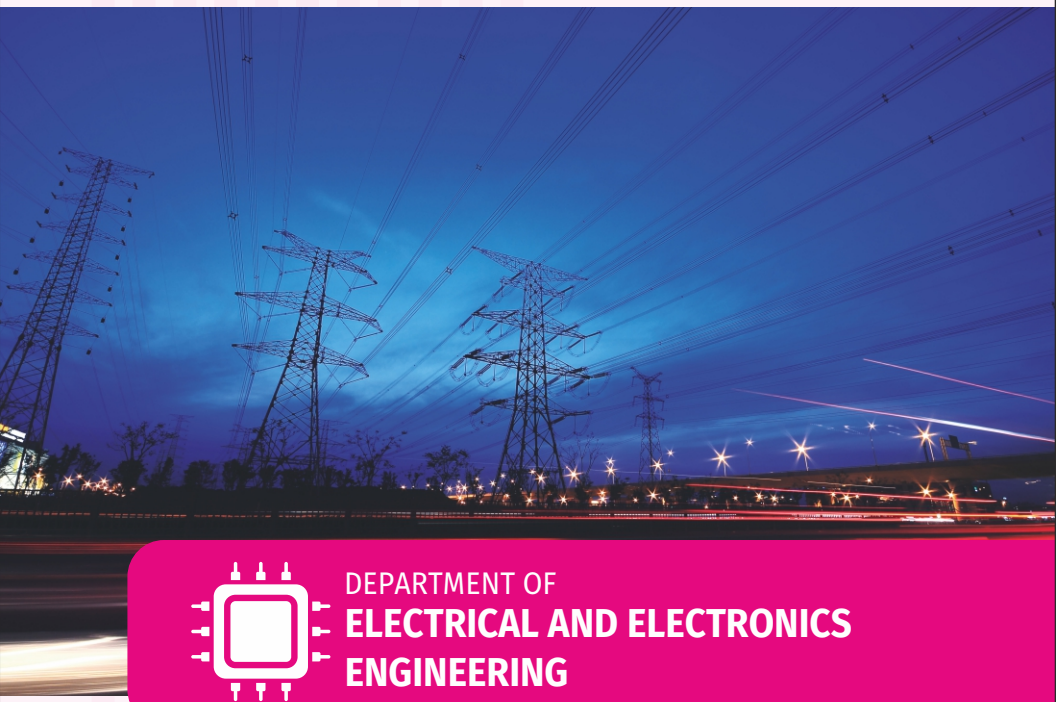
Approved by AICTE, New Delhi
Affiliated to Anna University



DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATIONS 2020

Academic Year 2020-21 onwards

AUTONOMOUS

CURRICULUM AND

SYLLABUS I - VIII

SEMESTERS

SRI SAIRAM INSTITUTE OF TECHNOLOGY

VISION

To be identified as a “Centre of Excellence” with high standards of Knowledge Dissemination and Research opportunities and to transform the students to imbibe qualities of technical expertise of international standards and high levels of ethical values, who in turn shall contribute to the advancement of society and human kind.

MISSION

We shall dedicate and commit ourselves to attain and maintain excellence in Technical Education through commitment and continuous improvement of infrastructure and equipment and provide an inspiring environment for Learning, Research and Innovation for our students to transform them into complete human beings with ethical and social values.

QUALITY POLICY

We at Sri Sai Ram Institute of Technology are committed to build a better nation through Quality Education with team spirit. Our students are enabled to excel in all values of Life and become Good Citizens. We continually improve the System, Infrastructure and Services to satisfy the Students, Parents, Industry and Society.

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

VISION

To become a front-runner, the department of Electrical and Electronics Engineering brings out competent engineers, innovators, researchers with human and ethical values, thereby contributing value to the knowledge based economy and society.

MISSION

The Electrical and Electronics Engineering department strives to develop talented professionals by providing high quality and effective education with commitment in the field of electrical engineering and an inspiring environment for innovation, research ideas to fulfill the needs of the public in an ethical and responsible manner. The department invokes the desire and ability of life-long learning, team spirit and leadership skills for pursuing successful career in electrical engineering

AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20BSMA101	Engineering Mathematics-I	3	1	0	4	4
2	20HSEN101	Technical English-I	3	0	0	3	3
3	20BSPH101	Engineering Physics	3	0	0	3	3
4	20BSCY101	Engineering Chemistry	3	0	0	3	3
5	20ESCS101	Problem Solving and Programming in C	3	0	0	3	3
6	20ESGE101	Engineering Graphics	1	2	0	3	3
PRACTICAL							
7	20BSPL101	Physics and Chemistry Laboratory	0	0	3	3	1.5
8	20ESPL101	Programming in C Laboratory	0	0	3	3	1.5
VALUE ADDITIONS - I							
9	20TPHS101	Skill Enhancement	0	0	2	2	1
10	20HSMG101	Personal Values	2	0	0	2	0
TOTAL						**29**	**23**

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20BSMA201	Engineering Mathematics -II	3	1	0	4	4
2	20HSEN201	Technical English - II	3	0	0	3	3
3	20ESIT201	Python Programming with Laboratory	3	0	2	5	4
4	20BSPH201	Physics of Electron Devices	3	0	0	3	3
5	20BSCY201	Environmental Science and Engineering	3	0	0	3	3
6	20EEPC201	Electric Circuit Analysis	2	1	0	3	3
PRACTICAL							
7	20ESGE201	Engineering Practices Laboratory	0	0	3	3	1.5
8	20EEPL201	Electric Circuits and Simulation Laboratory	0	0	3	3	1.5
VALUE ADDITIONS - II							
9	20TPHS201	Skill Enhancement	0	0	2	2	1
10	20HSMG201	Interpersonal Values	2	0	0	2	0
TOTAL						**31**	**24**

SEMESTER III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20EEPC301	Analog Electronics	3	0	0	3	3
2	20EEPC302	DC Machines and Transformers	2	1	0	3	3
3	20EEPC303	Electromagnetic Theory	3	1	0	4	4
4	20EEPC304	Digital Logic Circuits	3	0	0	3	3
5	20BSMA301	Linear Algebra, Partial Differential Equations and Transforms.	3	1	0	4	4
PRACTICAL							
6	20EEPL301	Analog and Digital Circuits Laboratory	0	0	3	3	1.5
7	20EEPL302	DC Machines & Transformers Laboratory	0	0	3	3	1.5
8	20EETE301	Live-in-Lab – I	0	0	2	2	1
VALUE ADDITIONS - III							
9	20EETP301	Skill Enhancement	0	0	2	2	1
10	20MGMC301	Constitution of India	2	0	0	2	0
TOTAL						**29**	**22**

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20EEPC401	Synchronous and Induction Machines	2	1	0	3	3
2	20EEPC402	Transmission and Distribution	3	0	0	3	3
3	20EEPC403	Measurements and Instrumentation	3	0	0	3	3
4	20EEPC404	Control Engineering	3	1	0	4	4
5	20BSMA403	Statistics and Numerical Methods	3	1	0	4	4
PRACTICAL							
6	20EEPL401	Synchronous & Induction Machines Lab	0	0	3	3	1.5
7	20EEPL402	Control Engineering & Instrumentation Lab	0	0	3	3	1.5
8	20EETE401	Live-in-Lab II	0	0	2	2	1
VALUE ADDITIONS - IV							
9	20EETP401	Skill Enhancement	0	0	2	2	1
TOTAL						**27**	**22**

SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20EEPC501	Power System Analysis	3	0	0	3	3
2	20EEPC502	Power Electronics	3	0	0	3	3
3	20EEPC503	Microprocessor and Microcontroller	2	1	0	3	3
4	20XXELXXX	Professional Elective-I	3	0	0	3	3
5	20XXOEXXX	Open Elective –I	3	0	0	3	3
PRACTICAL							
6	20EEPL501	Power Electronics Lab	0	0	3	3	1.5
7.	20EEPL502	Microprocessor & Microcontroller Lab	0	0	3	3	1.5
8.	20HSPL501	Communication and Soft Skills Lab	0	0	2	2	1
VALUE ADDITIONS - V							
9	20EETE501	Live-in-Lab III	0	0	4	4	2
10	20EETP501	Skill Enhancement	0	0	2	2	1
TOTAL						**29**	**22**

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20EEPC601	Solid State Drives and Control	3	0	0	3	3
2	20EEPC602	Power System Operation and Control	3	0	0	3	3
3	20EEPW601	Embedded Systems & IoT with Laboratory	3	0	2	5	4
4	20ITPC301	Data Structures	3	0	0	3	3
5	20XXELXXX	Professional Elective-II	3	0	0	3	3
6	20XXOEXXX	Open Elective – II	3	0	0	3	3
PRACTICAL							
7	20EEPL601	Power System Simulation Laboratory	0	0	3	3	1.5
8	20ITPL301	Data Structures Laboratory	0	0	3	3	1.5
9	20EEPJ601	Innovative Design Project	0	0	2	2	1
VALUE ADDITIONS - VI							
10	20EETP601	Skill Enhancement	0	0	2	2	1
TOTAL						**30**	**24**

SEMESTER VII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20EEPC701	Distributed Generation and Microgrid	3	0	0	3	3
2	20EEPC702	Electric Vehicles	3	0	0	3	3
3	20XXELXXX	Professional Elective-III	3	0	0	3	3
4	20XXELXXX	Professional Elective-IV	3	0	0	3	3
5	20HSMG601	Principles of Engineering Management	3	0	0	3	3
PRACTICAL							
6	20EEPL701	Renewable Energy Laboratory	0	0	4	4	2
7	20EEPJ701	Project Phase - I	0	0	4	4	2
VALUE ADDITIONS - VII							
8	20EETP701	Skill Enhancement	0	0	2	2	1
TOTAL						**25**	**20**

SEMESTER VIII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20XXELXXX	Professional Elective - V	3	0	0	3	3
PRACTICAL							
2	20EEPJ801	Project Phase - II	0	0	8	8	4
TOTAL						**11**	**7**

CREDIT DISTRIBUTION

Category	BS	ES	HS	EL	PC+PL	PW	OE	TE	PJ	TP	IS	MC	TOTAL
Credit	29.5	13	10	15	68.5	4	6	4	7	7	3	Y	**167**
Percentage	17.7	7.8	6.0	9.0	41.0	2.4	3.6	2.4	4.2	4.2	1.8	-	

*IS-Internship

PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CREDIT	STREAM
			L	T	P		
1.	20EEEL501	Electrical Energy Generation Systems	3	0	0	3	Power & Energy
2.	20EEEL502	Power Engineering & Instrumentation	3	0	0	3	Power & Energy
3.	20EEEL503	Solar and Wind Energy Systems	3	0	0	3	Power & Energy
4.	20EEEL504	Design of Electrical Machines	3	0	0	3	Electrical Machines & Control
5.	20EEEL505	Transducer Engineering	3	0	0	3	Electrical Machines & Control
6.	20EEEL506	Electrical Engineering Materials	3	0	0	3	Electrical Machines & Control
7.	20EEEL507	Discrete - Time Signal Processing	3	0	0	3	Electronics & Embedded
8.	20EEEL508	Arduino and Raspberry pi Based System Design	3	0	0	3	Electronics & Embedded
9.	20EEEL509	Internet of Things for Electrical Engineering	3	0	0	3	Computer Technology
10.	20EEEL510	Industrial Safety	3	0	0	3	Industrial & Management

PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CREDIT	STREAM
			L	T	P		
1	20EEEL601	Power System Transients	3	0	0	3	Power & Energy
2	20EEEL602	High Voltage Engineering	3	0	0	3	Power & Energy
3	20EEEL603	Electric Energy Utilization and Conservation	3	0	0	3	Power & Energy
4	20EEEL604	Modeling and Analysis of Electrical Machines	3	0	0	3	Electrical Machines & Control
5	20EEEL605	Advanced Control Systems	3	0	0	3	Electrical Machines & Control
6	20EEEL606	Digital Control Engineering Analysis and Design	3	0	0	3	Electrical Machines & Control
7	20ESEC307	Communication Engineering	3	0	0	3	Electronics & Embedded
8	20EEEL607	Electronic Product Design	3	0	0	3	Electronics & Embedded
9	20EEEL608	Industrial Data Communication	3	0	0	3	Computer Technology
10	20EEEL609	Digital Consumer Technology	3	0	0	3	Industrial & Management

PROFESSIONAL ELECTIVES - III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CREDIT	STREAM
			L	T	P		
1	20EEEL701	Power Electronics for Renewable Energy Systems	3	0	0	3	Power & Energy
2	20EEEL702	Power Quality	3	0	0	3	Power & Energy
3	20EEEL703	Energy Management and Auditing	3	0	0	3	Power & Energy
4	20EEEL704	Computer Aided Design of Electrical Machines	3	0	0	3	Electrical Machines & Control
5	20EEEL705	Medical Instrumentation	3	0	0	3	Electrical Machines & Control
6	20EEEL706	Microelectromechanical Systems	3	0	0	3	Electrical Machines & Control
7	20EEEL707	Electromagnetic Compatibility	3	0	0	3	Electronics & Embedded
8	20EEEL708	Nano Technology	3	0	0	3	Electronics & Embedded
9	20CSPC601	Artificial Intelligence	3	0	0	3	Computer Technology
10	20EEEL709	Industrial Control and Automation	3	0	0	3	Industrial & Management

PROFESSIONAL ELECTIVES - IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CREDIT	STREAM
			L	T	P		
1	20EEEL 710	Power System Protection and Switchgear	3	0	0	3	Power & Energy
2	20EEEL711	Restructured Power Systems	3	0	0	3	Power & Energy
3	20EEEL712	Energy Storage Technologies	3	0	0	3	Power & Energy
4	20EEEL713	Special Electrical Machines	3	0	0	3	Electrical Machines & Control
5	20EEEL714	Embedded Control of Electric Drives	3	0	0	3	Electrical Machines & Control
6	20EEEL715	Robotics and Control	3	0	0	3	Electrical Machines & Control
7	20EEEL716	Real Time Embedded Systems	3	0	0	3	Electronics & Embedded
8	20EEEL717	FPGA Based System Design	3	0	0	3	Electronics & Embedded
9	20ITPC303	Computer Organization and Architecture	3	0	0	3	Computer Technology
10	20EEEL718	Industrial Management	3	0	0	3	Industrial & Management

PROFESSIONAL ELECTIVES - V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CREDIT	STREAM
			L	T	P		
1	20EEEL801	FACTS and Custom Power Devices	3	0	0	3	Power & Energy
2	20EEEL802	Smart Grid Technologies	3	0	0	3	Power & Energy
3	20EEEL803	EHVAC& EHVDC Power Transmission	3	0	0	3	Power & Energy
4	20EEEL804	Soft Computing Techniques for Electrical Engineers	3	0	0	3	Electrical Machines & Control
5	20EEEL805	Automotive Electrical and Electronics Systems	3	0	0	3	Electrical Machines & Control
6	20EEEL806	Control of Electric Vehicle	3	0	0	3	Electrical Machines & Control
7	20EEEL807	Advanced Microprocessors	3	0	0	3	Electronics & Embedded
8	20EEPE808	High Speed Digital Design	3	0	0	3	Electronics & Embedded
9	20EEEL809	Big Data Analytics for Smart Grid	3	0	0	3	Computer Technology
10	20EEEL810	Work Ethics, Corporate Social Responsibility and Governance	3	0	0	3	Industrial & Management

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 Graduates are prepared to gain sound foundation in mathematical, scientific and engineering fundamentals necessary to analyze, formulate and solve electrical engineering problems.

PEO2 Graduates are employed to function effectively as an individual, as a team member and as a leader with analytical skills to meet the needs of electrical field.

PEO3 Graduates are motivated to understand the importance of life-long learning and professional development with the background that allows in pursuing advanced studies in electrical and electronics engineering or related fields.

PEO4 Graduates are equipped with the knowledge of electrical & electronics engineering in core as well as multidisciplinary areas in innovative, dynamic and challenging environment for the research based teamwork.

PEO5 Graduates are trained to possess knowledge to excel in the operation and maintenance of electrical systems in various industries.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1 Capable to acquire knowledge on use of modern engineering tools and equipments to analyze problems necessary for electrical engineering practice

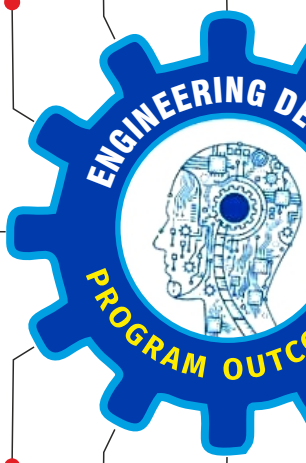
PSO2 Providing engineers with contemporary knowledge about electrical engineering and skills needed to fulfill the needs of society.

COMPONENTS OF THE CURRICULUM (COC)

Course Component	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total Number of credits
Basic Sciences(BS)	17.7	31	29.5
Engineering Sciences(ES)	7.8	17	13
Humanities and Social Sciences (HS)	6.0	15	10
Professional Electives(EL)	9.0	15	15
Program Core+Program Lab (PC+PL)	41.0	84	68.5
Program theory with Lab (PW)	2.4	5	4
Open Electives (OE)	3.6	06	6
Talent Enhancement (TE)	2.4	08	4
Project (PJ)	4.2	14	7
Training & Placement (TP)	4.2	14	7
Internships/Seminars (IS)	1.8	-	3
Mandatory Courses (MC)	NA	02	NA
Total number of Credits		211	167

PROGRAMME OUTCOMES(POs)

PROGRAM OUTCOME REPRESENTS THE KNOWLEDGE, SKILLS AND ATTITUDES THAT THE STUDENTS WOULD BE EXPECTED TO HAVE AT THE END OF THE 4 YEAR ENGINEERING DEGREE PROGRAM



01 Engineering knowledge

Apply the basic principle and knowledge of mathematics, science and engineering principles to solve technical problems.

02 Problem Analysis

Identify and analyze complex engineering problems reaching logical conclusions using the basic principles of mathematics, science and engineering.

03 Development of solutions

Design solutions for well-defined technical problems and assist with the design of systems, components or processes to meet specified needs.

04 Investigate complex problems

Perform investigations, use research based knowledge and conduct experiments, analyze and interpret the results to provide valid conclusions.

05 Modern tool usage

Create, select and apply the latest techniques, resources and modern engineering / IT tools to develop appropriate solutions with an understanding of the limitations.

06 The Engineer and Society

Apply reasoning based on contextual knowledge to assess societal, legal and cultural issues with competency in professional engineering practices.

07 Environment & Sustainability

Demonstrate professional skills, knowledge and contextual reasoning to assess / environmental / societal issues for sustainable development.

08 Apply ethical principles

Apply ethical principles and commit to professional ethics and responsibilities based on the norms of professional engineering pratices.

09 Individual & Teamwork

Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary professional settings.

10 Communicate effectively

Communicate effectively amongst the engineering community, being able to comprehend & write effective reports, make presentations & give/receive clear instructions.

11 Project management

Demonstrate knowledge and apply the principles of engineering & management in their own / team projects in multidisciplinary environments.

12 Life-long learning

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

SEMESTER - I

20BSMA101 SDG NO. 4 & 9	ENGINEERING MATHEMATICS-I	L	T	P	C
		3	1	0	4

OBJECTIVES:

The intent of the course is

- To understand and gain the knowledge of matrix algebra.
- To introduce the concepts of limits, continuity, derivatives and maxima and Minima
- To acquaint the concept of improper integrals and the properties of definite integrals.
- To provide understanding of double integration, triple integration and their application.
- To introduce the concept of sequence and series and impart the knowledge of Fourier series.

UNIT I MATRICES **12**

Symmetric, skew symmetric and orthogonal matrices; Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem (excluding proof) – Diagonalization of a Quadratic form using orthogonal transformation - Nature of Quadratic forms.

UNIT II DIFFERENTIAL CALCULUS **12**

Limits, continuity, Differentiation rules - Maxima and Minima of functions of one variable, partial derivatives (first and second order – basic problems), Taylor's series for functions of two variables, Jacobian, Maxima & Minima of functions of several variables, saddle points; Method of Lagrange multipliers.

UNIT III INTEGRAL CALCULUS **12**

Evaluation of definite integrals - Techniques of Integration-Substitution rule - Integration by parts, Integration of rational functions by partial fraction, Integration of irrational functions. Applications of definite integrals to evaluate surface area of revolution and volume of revolution. Evaluation of improper integrals.

UNIT IV MULTIPLE INTEGRALS **12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

UNIT V SEQUENCES AND SERIES **12**

Introduction to sequences and series – power series – Taylor's series – series for exponential, trigonometric, logarithmic, hyperbolic functions – Fourier series – Half range Sine and Cosine series – Parseval's theorem.

TOTAL: 60 PERIODS

TEXTBOOKS:

1. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
2. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 11th Reprint, 2010.

REFERENCES:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic Geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. T. Veerarajan, "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
4. N.P. Bali and Manish Goyal, "A text-book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
5. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2014.

WEB REFERENCES:

1. https://math.mit.edu/~gs/linearalgebra/ila0601.pdf
2. http://ocw.mit.edu/ans7870/18/18.013a/textbook/HTML/chapter30/
3. https://ocw.mit.edu/courses/mathematics/18-02sc-multivariable-calculus-fall-2010/2.-partial-derivatives/
4. http://ocw.mit.edu/ans7870/18/18.013a/textbook/HTML/chapter31/

ONLINE RESOURCES:

1. https://www.khanacademy.org/math/linear-algebra/alternate-bases/eigen-everything/v/linear-algebra-introduction-to-eigenvalues-and-eigenvectors
2. https://www.khanacademy.org/math/differential-calculus

OUTCOMES:

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

1. Diagonalize the matrix using orthogonal transformation and apply Cayley Hamilton Theorem to find the inverse and integral powers of a square matrix. (K3)
2. Evaluate the limit, examine the continuity and use derivatives to find extreme values of a function. (K3)
3. Evaluate definite and improper integrals using techniques of integration. (K3)
4. Apply double and triple integrals to find the area of a region and the volume of a surface. (K3)
5. Compute infinite series expansion of a function. (K3)

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	-	1
CO2	3	3	2	1	1	-	-	-	-	-	-	1
CO3	3	3	2	1	1	-	-	-	-	-	-	1
CO4	3	3	2	1	1	-	-	-	-	-	-	1
CO5	3	3	2	1	1	-	-	-	-	-	-	1

SEMESTER - I

20HSEN101 SDG NO. 4 & 9	TECHNICAL ENGLISH - I	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop the basic LSRW skills of the students
- To encourage the learners to adapt to listening techniques
- To help learners develop their communication skills and converse fluently in real contexts
- To help learners develop general and technical vocabulary through reading and writing tasks
- To improve the language proficiency for better understanding of core subjects

UNIT I INTRODUCTION 9

Listening – short texts – formal and informal conversations - **Speaking** – basics in speaking – speaking on given topics & situations – recording speeches and strategies to improve - **Reading –** critical reading – finding key information in a given text – shifting facts from opinions - **Writing –** free writing on any given topic – autobiographical writing - **Language Development** – tenses – voices- word formation: prefixes and suffixes – parts of speech – developing hints

UNIT II READING AND LANGUAGE DEVELOPMENT 9

Listening - long texts - TED talks - extensive speech on current affairs and discussions -Speaking – describing a simple process – asking and answering questions - **Reading** comprehension – skimming / scanning / predicting & analytical reading – question & answers – objective and descriptive answers –identifying synonyms and antonyms - process description - **Writing** instructions – **Language Development** – writing definitions – compound words.

UNIT III SPEAKING AND INTERPRETATION SKILLS 9

Listening - dialogues & conversations - **Speaking** – role plays – asking about routine actions and expressing opinions - **Reading** longer texts & making a critical analysis of the given text - **Writing** – types of paragraph and writing essays – rearrangement of jumbled sentences - writing recommendations - **Language Development** – use of sequence words - cause & effect expressions - sentences expressing purpose - picture based and newspaper based activities – single word substitutes

UNIT IV VOCABULARY BUILDING AND WRITING SKILLS 9

Listening - debates and discussions – practicing multiple tasks – self introduction – **Speaking** about friends/places/hobbies - **Reading** -Making inference from the reading passage – Predicting the content of the reading passage - **Writing** – informal letters/e-mails - **Language Development** - synonyms & antonyms - conditionals – if, unless, in case, when and others – framing questions.

UNIT V LANGUAGE DEVELOPMENT AND TECHNICAL WRITING 9

Listening - popular speeches and presentations - **Speaking** - impromptu speeches & debates - **Reading** - articles – magazines/newspapers **Writing** – essay writing on technical topics - channel conversion – bar diagram/ graph – picture interpretation - process description - **Language Development** – modal verbs - fixed / semi-fixed expressions – collocations

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Board of Editors. Using English: A Coursebook for Undergraduate Engineers and Technologists. Orient Blackswan Limited, Hyderabad: 2015.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai, 2011.

REFERENCES:

1. Anderson, Paul V. Technical Communication: A Reader – Centered Approach. Cengage, New Delhi, 2008.
2. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason, USA, 2007.
3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford, 2007.
4. Chauhan, Gajendra Singh and et.al.Technical Communication (Latest Revised Edition). Cengage Learning India Pvt. Limited, 2018.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_hs31/preview
2. http://engineeringvideolectures.com/course/696

ONLINE RESOURCES:

1. https://www.pearson.com/english/catalogue/business-english/technical-english.html
2. https://www.cambridgeenglish.org/learning-english/free-resources/

OUTCOMES:

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

1. Express and explain short texts on different topics with key information applying suitable vocabulary (K2)
2 Interpret and dramatize fluently in informal and formal contexts(K2)
3 Choose and apply the right syntax in comprehending diversified general and technical articles (K3)
4 Analyze and write technical concepts in simple and lucid style (K3)
5 Construct informal letters and e-mails thoughtfully (K2)
6 Demonstrate technical concepts and summaries in correct grammar and vocabulary (K2)

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	1	-	2	3	1	1
CO2	-	-	-	-	-	-	-	1	2	3	2	1
CO3	-	-	-	-	-	-	-	-	1	3	3	2
CO4	-	2	-	-	-	-	-	1	2	3	1	1
CO5	-	-	-	-	-	-	-	2	-	3	2	1
CO6	-	-	-	-	-	-	3	-	-	3	2	1

SEMESTER - I

20BSPH101 SDG NO. 4	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate and enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology

UNIT I CRYSTAL PHYSICS 9

Single crystalline, Polycrystalline and Amorphous materials - single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal - Miller indices - Interplanar distance - Powder diffraction method - Debye Scherer formula - Calculation of number of atoms per unit cell - Atomic radius - Coordination number - packing factor for SC, BCC, FCC and HCP structures - Polymorphism and allotropy - Diamond and Graphite structure (qualitative) - Growth of single crystals: Solution and Melt growth Techniques.

UNIT II PROPERTIES OF MATTER 9

Elasticity - Stress - strain diagram and its uses - Poisson's ratio - Relationship between three moduli of elasticity (qualitative) - Factors affecting elastic modulus and tensile strength - Twisting couple - shaft - Torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT III QUANTUM PHYSICS 9

Black body radiation - Planck's theory (derivation) - Compton effect: theory -

wave particle duality - electron diffraction - progressive waves - wave equation - concept of wave function and its physical significance - Schrödinger's wave equation - Time independent and Time dependent equations - particle in a box (one dimensional motion) - Tunneling (qualitative) - scanning tunneling microscope.

UNIT IV LASERS AND FIBER OPTICS **9**

Lasers: population of energy levels, Einstein's A and B coefficients derivation - pumping methods - resonant cavity, optical amplification (qualitative) - three level and four level laser - CO_2 laser - Semiconductor lasers: Homojunction and Heterojunction.

Fiber optics: Principle, Numerical aperture and Acceptance angle - Types of optical fibers (material, refractive index, mode) - Losses associated with optical fibers - Fiber Optical Communication system (Block diagram) - Fiber optic sensors: pressure and displacement.

UNIT V THERMAL PHYSICS **9**

Transfer of heat energy - thermal expansion of solids and liquids - bimetallic strips - thermal conduction, convection and radiation - heat conduction in solids (qualitative) - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) - thermal insulation - applications: heat exchangers, refrigerators and solar water heaters.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. D.K. Bhattachary & T.Poonam, "Engineering Physics". Oxford University Press, 2015.
2. R.K. Gaur& S.L. Gupta, "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. B.K. Pandey & S.Chaturvedi, "Engineering Physics", Cengage Learning India, 2017.
4. V. Rajendran, "Engineering Physics", Mc Graw Hill Publications Ltd. New Delhi, 2014.
5. M.N. Avadhanulu& P.G. Kshirshagar, "A textbook of Engineering Physics", S. Chand & Co Ltd. 2016.

REFERENCES:

1. D. Halliday, . Resnick & J. Walker, "Principles of Physics", Wiley, 2015.
2. R.A. Serway, & J.W. Jewett, "Physics for Scientists and Engineers", Cengage Learning, 2010.
3. N.K. Verma," Physics for Engineers", PHI Learning Private Limited, 2014.

4. P.A. Tipler & G. Mosca "Physics for Scientists and Engineers", W.H.Freeman, 2020.
5. Brijlal and Subramanyam, "Properties of Matter", S. Chand Publishing, 2018.
6. Shatendra Sharma & Jyotsna Sharma, "Engineering Physics", Pearson, 2018.

OUTCOMES :

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

1. To understand the crystal systems and elastic properties of Materials (K2)
2. To distinguish different crystal structures and heat conduction in conductor and insulators (K4)
3. To explain powder diffractionmethod-deformation of materials in response to action load,quantum mechanics to understand wave particle dualism (K2)
4. To apply quantum theory to set up one dimensional Schrodinger's wave equation and applications to a matter wave system and principle of laser action (K3)
5. To analyze bending of beams,types of optical fiber and modes of heat transfer (K4)
6. To discuss light propagation in optical fibers and transfer of heat energy in different measures and its applications (K2)

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	-	-	-	-	-	-	-	1
CO2	3	2	3	3	-	-	2	-	-	-	-	3
CO3	3	3	3	2	-	-	3	-	-	-	-	2
CO4	3	3	3	3	-	-	-	-	-	-	-	3
CO5	3	3	3	3	-	-	3	-	-	-	-	3
CO6	3	3	3	3	-	-	3	-	-	-	-	3

SEMESTER - I

20BSCY101 SDG NO. 4,6&7	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques
- To illustrate the principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials
- To categorize types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels
- To demonstrate the principles and generation of energy in batteries, nuclear reactors, solar cells, windmills and fuel cells
- To recognize the applications of polymers, composites and nano-materials in various fields

UNIT I WATER TECHNOLOGY AND SURFACE CHEMISTRY 9

Water Technology : Introduction – Hard water and Soft water. Hardness of water – types – expression of hardness (numerical problems). Boiler troubles – scale and sludge, priming and foaming, caustic embrittlement and boiler corrosion. Treatment of boiler feed water – Internal treatment (carbonate, phosphate, calgon, colloidal and sodium aluminate conditioning). External treatment – Ion exchange process, Zeolite process –Domestic water treatment (break point chlorination) –Desalination of brackish water – Reverse Osmosis.

Surface Chemistry: Adsorption – types – adsorption of gases on solids – adsorption of solutes from solution – applications of adsorption –role of adsorbents in catalysis and pollution abatement.

UNIT II ELECTROCHEMISTRY AND CORROSION 9

Electrochemistry: Cells – types (electrochemical and electrolytic cell) Redox reaction – single electrode potential (oxidation potential and reduction potential) – measurement and applications –Nernst equation (derivation and problems) – electrochemical series and its significance.

Corrosion: Causes, factors and types – chemical and electrochemical corrosion (galvanic, differential aeration). Corrosion control – material selection and design aspects, cathodic protection methods (sacrificial anodic and impressed current cathodic method) and corrosion inhibitors. Paints: Constituents and its functions. Electroplating of Copper and electroless plating of Nickel.

UNIT III FUELS AND COMBUSTION 9

Fuels: Introduction – classification of fuels – Coal – analysis of coal (proximate and ultimate). Carbonization – manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – manufacture of synthetic petrol (Bergius process). Knocking – octane number and cetane number – Gaseous fuels – Compressed natural gas (CNG), Liquefied petroleum gases (LPG). Biofuels – Gobar gas and Biodiesel.

Combustion of Fuels: Introduction – calorific value – higher and lower calorific values- theoretical calculation of calorific value – flue gas analysis (ORSAT Method).

UNIT IV ENERGY SOURCES AND STORAGE DEVICES 9

Energy sources: Nuclear fission – nuclear fusion – differences between nuclear fission and fusion – nuclear chain reactions – nuclear energy – light water nuclear power plant – breeder reactor – solar energy conversion – solar cells – wind energy.

Storage devices: Batteries – types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium–ion–battery), fuel cells – H_2 -O_2 fuel cell and super capacitors.

UNIT V POLYMERS AND NANOMATERIALS 9

Polymers: Classification – types of polymerization – mechanism (Free radical polymerization) –Engineering polymers: Nylon–6, Nylon–6,6, Teflon, Kevlar and PEEK – preparation, properties and uses – Plastic and its types - Conducting polymers – types and applications. Composites – definition, types, polymer matrix composites – FRP.

Nanomaterials: Introduction – Nanoparticles, Nanoclusters, Nanorods, Nanotubes (CNT: SWNT and MWNT) and Nanowires – Properties (surface to volume ratio, melting point, optical and electrical), Synthesis (precipitation, thermolysis, hydrothermal, electrodeposition, chemical vapour deposition, laser ablation, sol-gel process) and Applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015.
2. P. C. Jain and Monika Jain, "Engineering Chemistry" DhanpatRai Publishing Company (P) LTD, New Delhi, 2015.
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.
4. Ravikrishnan A, 'Engineering Chemistry', Sri Krishna Hitech Publishing Company Pvt. Ltd, New Edition 2021.

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

OUTCOMES

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

1. Identify the origin of water resources and develop innovative methods to produce soft water for industrial use and potable water at cheaper cost and recognize the basic design of adsorption systems and its industrial applications. (K2)
2. Recognize the basic concepts of electrochemistry and apply the principles of electrochemistry to corrosion process and the applications of protective coatings to overcome the corrosion. (K2)
3. Disseminating the importance of chemistry of fuels and combustion to enhance the fuel efficiency. (K2)
4. Acquire the basics of non-conventional sources of energy and illustrate the principles and the reaction mechanism of batteries and fuel cells. (K2)
5. Explain the synthesis and applications of polymers, composites and nano-materials. (K2)

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	1	2	-	-	-	-	1
CO2	3	2	3	2	2	1	2	-	-	-	-	3
CO3	3	2	3	2	-	1	2	-	-	-	-	1
CO4	3	2	3	2	-	1	2	-	-	-	1	3
CO5	3	2	3	1	2	1	1	-	-	-	1	3

SEMESTER - I

20ESCS101 SDG NO. 4&9	PROBLEM SOLVING AND PROGRAMMING IN C	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand about the programming language
- To develop C Programs using basic Programming Constructs, Loops Arrays and Strings
- To develop applications in C using Functions , Pointers and Structures
- To perform I/O operations and File Handling in C

UNIT I INTRODUCTION TO PROGRAMMING AND ALGORITHMS FOR PROBLEM SOLVING 10

The Basic Model of Computation, Programming Paradigms- Program Development Life Cycle - Algorithm –Pseudo Code – Flow Chart - Programming Languages - Compilation - Linking and Loading - Testing and Debugging - Documentation - Control Structures – Algorithmic Problem Solving- Problems Based on Sequential, Decision Making - Branching and Iteration.

UNIT II BASICS OF C PROGRAMMING 8

Structure of C program - C programming: Data Types – Storage Classes - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions – Input / Output Statements - Assignment Statements – Decision making Statements - Switch Statement - Looping Statements – Pre-Processor Directives - Compilation Process

UNIT III ARRAYS AND STRINGS 9

Introduction to Arrays: Declaration, Initialization – One Dimensional Array – Example Program: Computing Mean, Median and Mode - Two Dimensional Arrays – Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) - String Operations: Length, Compare, Concatenate - Copy – Selection Sort - Linear and Binary Search.

UNIT IV FUNCTIONS AND POINTERS 9

Introduction to Functions: Function Prototype, Function Definition, Function Call, Built-in Functions (String Functions, Math Functions) – Recursion – Example Program: Computation of Sine Series - Scientific Calculator using Built-in Functions - Binary Search using Recursive Functions – Pointers – Pointer Operators – Pointer Arithmetic – Arrays and Pointers –

Array of Pointers – Example Program: Sorting of Names – Parameter Passing: Pass by Value - Pass by Reference – Example Program: Swapping of Two Numbers using Pass by Reference.

UNIT V STRUCTURES and FILE PROCESSING 9

Structure - Nested Structures – Pointer and Structures – Array of Structures – Example Program using Structures and Pointers – Self Referential Structures – Dynamic Memory Allocation - Singly Linked List – Typedef.

Files – Types of File Processing: Sequential Access, Random Access – Sequential Access File - Example Program: Finding Average of Numbers stored in Sequential Access File - Random Access File - Example Program: Transaction Processing Using Random Access Files – Command Line Arguments.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2012.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program", Seventh edition, Pearson Publication.
2. Jeri R. Hanly & Elliot B. Koffman, "Problem Solving and Program Design in C", Pearson Education, 2013.
3. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
6. Kanetkar Y, "Let us C", BPB Publications, 2007.
7. Hanly J R & Koffman E.B, "Problem Solving and Programme design in C", Pearson Education, 2009.

WEB REFERENCES:

1. https://www.learn-c.org/
2. https://codeforwin.org/
3. https://www.cprogramming.com/

ONLINE RESOURCES:

1. https://www.linuxtopia.org/online_books/programming_books/gnu_c_programming_tutorial
2. https://nptel.ac.in/courses/106105171
3. https://swayam.gov.in/nd1_noc19_cs42/preview

OUTCOMES:

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

1. Develop efficient algorithms for solving a problem. (K2)
2. Use the various constructs in C to develop simple applications. (K3)
3. Design and Implement applications using Array & Strings. (K3)
4. Develop applications using Functions and Pointers. (K6)
5. Design and Develop applications using Structures. (K3)
6. Design and Develop applications using Files. (K4)

CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1	1	-	2	2	-	3	2	3
CO2	3	3	3	3	2	-	1	1	2	2	3	3	2	3
CO3	3	3	3	3	2	1	1	1	2	-	3	-	3	2
CO4	3	3	3	3	2	1	-	1	2	2	3	3	1	2
CO5	3	3	3	3	2	1	1	1	2	2	3	3	2	1
CO6	3	3	3	3	2	1	1	1	2	2	3	3	3	2

SEMESTER - I

20ESGE101 SDG NO. 4,6,7, 9, 12,14 &15	ENGINEERING GRAPHICS	L	T	P	C
		1	2	0	3

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products
- To visualize the job in three dimensions
- To have a clear conception and appreciation of the shape, size, proportion and design
- To expose the student community to existing national standards related to technical drawings

CONCEPTS AND CONVENTIONS (Not for Examination) 3

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning- Projection of Points

UNIT I PLANE CURVES AND FREEHAND SKETCHING 6+9

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid on Horizontal Surfaces – construction of involutes of circle for one complete revolution – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF LINES AND PLANE SURFACE 6+9

Orthographic projection- principles-Principal planes- Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method- Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 6+9

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+9

Sectioning of prisms, pyramids, cylinder and cone in simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and truncated solids in vertical position – Prisms, pyramids cylinder and cone.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+9

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinder, cone- Perspective projection of simple solids-Prisms, pyramids and cylinder by visual ray method.

TOTAL: 78 PERIODS

TEXT BOOKS:

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
2. T. Jeyapoovan, "Engineering Graphics using AUTOCAD", Vikas Publishing House Pvt Ltd, 7th Edition.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
3. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
4. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
5. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
6. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
7. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/103/112103019/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/104/105104148/

PUBLICATION OF BUREAU OF INDIAN STANDARDS:

1. IS10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods

OUTCOMES:

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

1. Relate thoughts and ideas graphically in a neat fashion and ability to perform sketching of engineering curves used in engineering practices, multiple views of objects. (K1)
2. Understand the concepts of orthographic projections for basic geometrical constructions. (K2)
3. Acquire the knowledge of orthographic projection in three dimensional object. (K2)
4. Develop knowledge about Sectioning and apply interior shapes of solids. (K3)
5. Analyze the concepts of design in developing various 3 dimensional projections. (K4)
6. Build a strong foundation to analyze the design in various dimensions. (K4)

CO - PO , PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO2	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO3	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO4	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO5	3	2	2	-	-	-	-	-	2	2	-	2	2	2
CO6	3	2	2	-	-	-	-	-	2	2	-	2	2	2

SEMESTER - I

20BSPL101 SDG NO. 4	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

PHYSICS LABORATORY

OBJECTIVES:

- To acquaint the students with practical knowledge of physics principles in various fields such as optics, thermal physics and properties of matter for developing basic experimental skills
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis

LIST OF EXPERIMENTS (Any 5 Experiments)

1. Determination of Young's modulus by non-uniform bending method.
2. Determination of rigidity modulus –Torsion pendulum.
3. Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
4. (a) Determination of wavelength and particle size using Laser.
   (b) Determination of acceptance angle in an optical fiber.
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of specific resistance of a given coil of wire – Carey Foster's bridge.
7. Determination of wavelength of mercury spectrum – spectrometer grating.
8. Determination of band gap of a semiconductor.
9. Determination of Hall coefficient by Hall Effect experiment.
10. Determination of solar cell characteristics.

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS / 6 (max.) STUDENTS PER EXPERIMENT

1. Young's modulus by non-uniform bending method-experimental set-up – 12 sets
2. Rigidity modulus - Torsion pendulum experimental set-up – 12 sets
3. Ultrasonic Interferometer to determine velocity of sound and compressibility of liquid – 6 sets
4. (a) Experimental set-up to find the wavelength of light, and to find particle size using Laser – 6 sets
   (b) Experimental set-up to find acceptance angle in an optical fiber – 6 sets
5. Lee's disc method- experimental set up to find thermal conductivity of a bad conductor – 6 sets
6. Experimental set-up to find specific resistance of a coil of wire-Carey Foster's Bridge – 6 sets
7. Experimental set-up to find the wavelength of mercury spectrum-spectrometer grating – 6 sets
8. Experimental set-up to find the band gap of a semiconductor – 12 sets
9. Experimental set-up to find the Hall coefficient by Hall Effect Experiment – 6 sets
10. Experimental set-up to study characteristics of solar cells – 6 sets

TEXTBOOKS:

1. J.D. Wilson& C.A. Hernandez Hall "Physics Laboratory Experiments" Houghton Mifflin Company, New York, 2010.
2. M.N. Srinivasan, S. Balasubramanian &R. Ranganathan, "Practical Physics", S. Chand & Sons educational publications, New Delhi, 2011.
3. R. Sasikumar, "Practical Physics", PHI Learning Pvt. Ltd., New Delhi, 2011.

CHEMISTRY LABORATORY

(Any five experiments to be conducted)

OBJECTIVES:

- To acquaint the students with practical knowledge of the basic concepts of chemistry, the student faces during the course of their study in the industry and engineering field
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis
- To understand and develop experimental skills for building technical competence

LIST OF EXPERIMENTS (Any five experiments to be conducted)

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water samples.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Conductometric titration of strong acid vs strong base.
7. Estimation of iron content of the given solution using potentiometer.
8. Estimation of iron content of the water sample using spectrophotometer (1, 10- Phenanthroline / thiocyanate method).
9. Estimation of sodium and potassium present in water using flame photometers.
10. Determination of molecular weights of polymers using Ostwald's Viscometer.

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS / 6 (MAX.) STUDENTS PER EXPERIMENT.

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample - 6 sets
2. Determination of total, temporary & permanent hardness of water by EDTA method - 6 sets
3. Determination of DO content of water sample by Winkler's method - 6sets
4. Determination of chloride content of water sample by argentometric method – 6 sets
5. Determination of strength of given hydrochloric acid using pH meter - 6 sets
6. Conductometric titration of strong acid vs strong base - 6 sets
7. Estimation of iron content of the given solution using potentiometer - 6 sets
8. Estimation of iron content of the water sample using spectrophotometer (1,10- Phenanthroline / thiocyanate method) - 2 sets
9. Estimation of sodium and potassium present in water using flame photometer - 2 sets
10. Determination of molecular weights of polymer using Ostwald's Viscometer. - 6 sets

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8th edition, 2014).

OUTCOMES:

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

1. Apply the principles of thermal physics and properties of matter to evaluate the properties of materials and to determine the physical properties of liquid using ultrasonic interferometer. (K1)
2. Understand measurement technique and usage of new instruments in optics for real time application in engineering. (K2)
3. Apply the knowledge of semiconductor materials to evaluate the band gap and Hall coefficient of materials and to study the characteristics of solar cell for engineering solutions. (K3)
4. Interpret quantitative chemical analysis to generate experimental skills in building technical competence. (K3)
5. Analyze the quality of water for domestic and industrial purpose. (K3)

6. Standardize the solutions using volumetric titrations, conductivity, pH, redox potential and optical density measurements. (K3)

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CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	3	3	2	2	1	1	3
CO2	3	3	3	3	3	3	3	2	2	2	2	3
CO3	3	3	3	3	3	3	3	2	1	1	2	3
CO4	3	2	3	3	1	1	2	2	2	2	3	2
CO5	3	2	3	3	1	1	2	2	2	2	3	2
CO6	3	2	3	3	1	1	2	2	2	2	3	2

SEMESTER - I

20ESPL101 SDG NO. 4&9	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To develop programs in C using basic Programming Constructs
- To develop applications in C using Arrays and Strings
- To design and implement applications in C using Functions, Structures
- To develop applications in C using Files

LIST OF EXPERIMENTS

1. Write a program using I/O statements and expressions.
2. Write programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Write a program to check whether a given number is Armstrong number or not?

6. Write a program tocheck whether a given number is odd or even?
7. Write a program to find the factorial of a given number.
8. Write a program to find out the average of 4 integers.
9. Write a program to display array elements using two dimensional arrays.
10. Write a program to perform swapping using function.
11. Write a program to display all prime numbers between two intervals using functions.
12. Write a program to reverse a sentence using recursion.
13. Write a program to get the largest element of an array using the function.
14. Write a program to concatenate two string.
15. Write a program to find the length of String.
16. Write a program to find the frequency of a character in a string.
17. Write a program to store Student Information in Structure and Display it.
18. The annual examination is conducted for 10 students for five subjects. Write a program to read the data and determine the following:
    (a) Total marks obtained by each student.
    (b) The highest marks in each subject and the marks of the student who secured it.
    (c) The student who obtained the highest total marks.
19. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
20. Count the number of account holders whose balance is less than the minimum balance using sequential access file.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C compiler 30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

OUTCOMES:

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

1. Solve some simple problems leading to specific applications. (K6)
2. Demonstrate C programming development environment, compiling, debugging, linking and executing a program. (K6)
3. Develop C programs for simple applications making use of basic constructs, arrays and strings. (K6)
4. Develop C programs involving functions and recursion. (K6)

5. Develop C programs involving pointers, and structures. (K6)
6. Design applications using sequential and random access file. (K6)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1	1	1	2	2	3	3	2	3
CO2	3	3	3	3	2	1	-	1	2	2	3	3	1	3
CO3	3	3	-	3	2	-	1	1	-	2	-	3	3	2
CO4	3	3	3	3	2	1	1	1	2	2	3	3	1	3
CO5	3	3	3	-	2	-	1	-	2	2	3	-	2	1
CO6	3	3	3	3	2	1	1	1	2	-	3	3	3	2

SEMESTER - I

20TPHS101 SDG NO. 4&5	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To enrich social network ethics
- To develop and enhance browsing culture
- To understand the concepts of networking
- To promote self professionalism
- To acquire knowledge about various digital identification procedures

UNIT I SOCIAL NETWORK ETIQUETTES **6**

Introduction to social network – Social Networking Etiquettes - Pros and Cons - Usage of Facebook, Instagram, WhatsApp , Telegram, Youtube, Evolution of Android and IOS, Introduction to Linkedin & Benefits. (Practicals – Official Mail id- Linkedin Id Creation, Linkedin Profile Bulilding , Facebook Id and Creation and Modifying the existing FB ID)

UNIT II BROWSING CULTURE **6**

Introduction to browsing – Search Engines-Google - Bing -Yahoo!-AOL -MSN –DuckDuckGo ,browsers, phishing – Cookies - URL – https:// extensions , browsing history, Incognito mode- VPN – Pros and Cons – Book mark.

UNIT III NETWORKING **6**

Basics of networking - LAN, MAN, WAN, Introduction to network topologies, Protocols , IP Commands (Command line prompt), Define online complier and editor (Practicals – Find Your System IP,Ping Command, Firewall Fortinet, Basic DOS Commands).

UNIT IV PROFESSIONALISM **6**

Dress Code, Body Language, Appropriate Attire ,Communication Skills, Interview preparation – Introducing yourself - How to greet Superiors, Importance of Eye Contact During conversation.

UNIT V DIGITAL IDENTIFICATION **6**

Introduction to NAD - Importance of Aadhar, PAN Card, Passport, Bank Account, Bar Code, QR scan, Payment Gateway (Gpay, Phone Pe, UPI, BHIM, Paytm), Mobile Banking (Practicals - NAD registration Step by Step, Linking bank account with netbanking , Register for payment gateway).

TOTAL : 30 PERIODS

WEB REFERENCES :

Unit I: Social Network Etiquettes:

1. https://sproutsocial.com/glossary/social-media-etiquette/
2. https://www.shrm.org/resourcesandtools/tools-and-samples/hr-qa/pages/socialnetworkingsitespolicy.aspx
3. https://www.frontiersin.org/articles/10.3389/fpsyg.2019.02711/full
4. https://medium.com/@sirajea/11-reasons-why-you-should-use-telegram-instead-of-whatsapp-ab0f80fbfa79
5. https://buffer.com/library/how-to-use-instagram/
6. https://www.webwise.ie/parents/what-is-youtube/
7. https://www.androidauthority.com/history-android-os-name-789433/
8. https://www.mindtools.com/pages/article/linkedin.htm

Unit II: Browsing Culture:

1. https://sites.google.com/site/bethanycollegeofteacheredn/unit--ict-connecting-with-world/national-policy-on-information-and-communication-technology-ict/accessing-the-web-introduction-to-the-browser-browsing-web
2. https://www.wordstream.com/articles/internet-search-engines-history
3. https://www.malwarebytes.com/phishing/
4. https://www.adpushup.com/blog/types-of-cookies/
5. https://www.eff.org/https-everywhere

6. https://www.sciencedirect.com/topics/computer-science/browsing-history\
7. https://www.vpnmentor.com/blog/pros-cons-vpn/
8. https://www.tech-wonders.com/2016/10/use-hush-private-bookmarking-extension-chrome.html

Unit III:Networking

1. https://www.guru99.com/types-of-computer-network.html
2. https://www.studytonight.com/computer-networks/network-topology-types
3. https://www.cloudflare.com/learning/network-layer/what-is-a-protocol/
4. https://www.howtogeek.com/168896/10-useful-windows-commands-you-should-know/
5. https://paiza.io/en

Unit IV : Professionalism

1. https://career.vt.edu/develop/professionalism.html
2. https://englishlabs.in/importance-dress-code/
3. https://www.proschoolonline.com/blog/importance-of-body-language-in-day-to-day-life
4. https://www.thespruce.com/etiquette-of-proper-attire-1216800
5. https://shirleytaylor.com/why-are-communication-skills-important/
6. https://www.triad-eng.com/interview-tips-for-engineers/
7. https://www.indeed.co.in/career-advice/interviewing/interview-question-tell-me-about-yourself
8. https://toggl.com/track/business-etiquette-rules/

Unit V: Digital Identification

1. https://nad.ndml.in/nad-presentation.html
2. https://www.turtlemint.com/aadhaar-card-benefits/
3. https://www.bankbazaar.com/pan-card/uses-of-pan-card.html
4. https://www.passportindex.org/passport.php
5. https://consumer.westchestergov.com/financial-education/money-management/benefits-of-a-bank-account
6. https://en.wikipedia.org/wiki/QR_code
7. https://www.investopedia.com/terms/p/payment-gateway.asp
8. https://www.paisabazaar.com/banking/mobile-banking/

OUTCOMES:

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

1. Learn and apply social network ethics. (K3)
2. Understand the browsing culture. (K2)
3. Analyze the networking concepts . (K4)
4. Develop self professionalism. (K3)
5. Gain hands-on experience in various digital identification procedures. (K2)
6. Analyse and apply the different digital payment gateway methods. (K4)

CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	3	2	-	3	2	3	-	2
CO2	-	-	-	-	3	2	-	3	2	3	-	2
CO3	-	-	-	-	3	2	-	-	1	3	-	2
CO4	-	-	-	-	3	2	-	3	3	3	-	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2
CO6	-	-	-	-	3	2	-	-	2	3	-	2

SEMESTER - I

20HSMG101 SDG NO. 4&5	PERSONAL VALUES	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Values through Practical activities

UNIT I SELF CONCEPT **6**

Understanding self Concept – Identify Yourself – Who am I – an individual, engineer, citizen – Attitude – Measuring Behaviour – Change of Behaviour – Personality – Characteristics in personal, professional life.

UNIT II INDIVIDUAL VALUES **6**

Personal Values – Attributes –Courage – Creativity, Honesty, Perfection, Simplicity, Responsibility – Measuring personal values

UNIT III MORAL VALUES **6**

Moral – Understanding right and wrong – Positive thoughts – Respect to others – Doing good to society.

UNIT IV PHYSICAL AND MENTAL WELL-BEING **6**

Health – Physical fitness –Mental vigour – Diet management – Yoga – Meditation – Peaceful life – Happiness in life

UNIT V DECISION MAKING **6**

Goal Setting – Decision making skill – Overcome of Barriers – Success – Mental strength and weakness

TOTAL: 30 PERIODS

Note:

Each topic in all the above units will be supplemented by practice exercises and classroom activities and projects.

REFERENCE BOOKS:

1. Barun K. Mitra, "Personality Development and Soft Skills", Oxford University Press, 2016.
2. B.N.Ghosh, "Managing Soft Skills for Personality Development" McGraw Hill India, 2012.

OUTCOMES:

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

1. Become an individual in knowing the self. (K4)
2. Acquire and express Personal Values, Spiritual values and fitness. (K4)
3. Practice simple physical exercise and breathing techniques. (K2)
4. Practice Yoga asana which will enhance the quality of life. (K1)
5. Practice Meditation and get benefitted. (K1)
6. Understanding moral values and need of physical fitness. (K2)

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	3	3	1	1	1
CO2	-	-	-	-	-	2	2	3	3	1	1	1
CO3	-	-	-	-	-	2	2	3	3	1	1	1
CO4	-	-	-	-	-	2	2	3	3	1	1	1
CO5	-	-	-	-	-	2	2	3	3	1	1	1
CO6	-	-	-	-	-	2	2	3	3	1	1	1

SEMESTER - II

20BSMA201 SDG NO. 4	ENGINEERING MATHEMATICS - II	L	T	P	C
		3	1	0	4

OBJECTIVES:

- The objective of this course is to familiarize the prospective engineers with techniques in Vector Calculus, Ordinary differential equations, Complex variables and Laplace transforms. It aims to equip the students to deal with advanced levels of Mathematics and applications that would be essential for their disciplines.

UNIT I VECTOR CALCULUS 12

Gradient and Directional derivatives - Divergence and Curl- Vector identities - Irrotational and Solenoidal vector fields - Line integral over a plane curve - Surface integral - Volume integral – Gauss divergence, Green's and Stoke's theorems - Verification and application in evaluating line, Surface and volume integrals.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 12

Second and higher order linear differential equations with constant coefficients - Method of variation of parameters - Homogeneous equation of Euler's and Legendre's types - System of simultaneous linear differential equations with constant coefficients.

UNIT III COMPLEX DIFFERENTIATION 12

Analytic functions- Necessary and sufficient conditions for analyticity in cartesian and polar coordinates (without proof) - Properties - Harmonic conjugate - construction of analytic functions- Conformal mapping - Mapping by functions $w = z+a, w=az, w=1/z, w=z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

Contour integrals, Cauchy- Goursat theorem (without proof) - Cauchy Integral formula (without proof) - Taylor's series - Zeroes of Analytic functions - Singularities - Laurent's Series - Residues – Cauchy Residue theorem (without proof) – Application of Residue theorem for evaluation of real integrals – use of circular contour and semicircular contour(without poles on real axis).

UNIT V LAPLACE TRANSFORM 12

Existence conditions – Transforms of elementary functions – Transform of Unit step function and Unit impulse function – Basic properties – Shifting

theorems – Transforms of derivatives and integrals – Initial and Final value theorems – Convolution theorem – Transform of Periodic functions – Application of solution of linear second order ordinary differential equations with constant coefficients.

TEXT BOOKS:

1. Erwin Kreyszig, Advance Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill Publishing Company, New Delhi, 2008.

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma, "Higher Engineering Mathematics", S.Chand Private Ltd., 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2010.
3. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
4. E.A.Coddinton, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
5. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, 2014.
6. N.P.Bali and Manish Goyal, "A text Book of Engineering Mathematics", Laxmi Publications, Reprint 2008.

WEB COURSES:

1. https://nptel.ac.in/courses/122107036/
2. https://nptel.ac.in/courses/111105134/
3. https://ocw.mit.edu/courses/mathematics/18-04-complex-variables-with-applications-spring-2018/
4. https://ocw.mit.edu/courses/mathematics/18-02-multivariable-calculus-fall-2007/
5. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/

ONLINE RESOURCES:

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/lecture-1-introduction/
2. http://www.nptelvideos.com/course.php?id=90

COURSE OUTCOMES:

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

1. Compute the derivatives of scalar and vector point functions. Use vector point function to establish a relation between line, surface and volume integrals. (K3)
2. Solve ordinary differential equations of second and higher order with constant coefficients, variable coefficients and simultaneous linear differential equations. (K3)
3. Construct an analytic function and apply the properties of analytic functions to check for harmonic and orthogonal functions and find the images of circle and straight lines under the standard transformations. (K3)
4. Use Cauchy's integral theorem, formula and Cauchy's Residue theorem to evaluate complex and real integrals, find the Taylor's and Laurent's series expansion. (K3)
5. Apply Laplace and inverse Laplace Transforms to solve the Linear ordinary differential equations with constant coefficients. (K3)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	-	-	-	-	-	-	1
CO2	3	3	2	1	-	-	-	-	-	-	-	1
CO3	3	3	2	1	-	-	-	-	-	-	-	1
CO4	3	3	2	1	-	-	-	-	-	-	-	1
CO5	3	3	2	1	-	-	-	-	-	-	-	1

SEMESTER - II

20HSEN201 SDG NO. 4	TECHNICAL ENGLISH - II	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To strengthen the listening skills for comprehending and critically analyzing passages
- To enhance students' ability with multiple strategies and skills for making technical presentations
- To participate in group discussions for developing group attitude
- To develop skills for preparing effective job application
- To write effective technical reports

UNIT I LANGUAGE DEVELOPMENT 9

Listening – Listening conversations involving two participants – multiple participants – **Speaking** – conversation methods in real life occurrences using expressions of different emotions and imperative usages – **Reading** passages and short stories - **Writing** – preparation of checklist – extended definition – **Language Development** – tenses - subject - verb agreement

UNIT II VOCABULARY BUILDING 9

Listening – listening formal and informal conversation and participative exercises – **Speaking** - creating greetings/wishes/excuses and thanks – **Reading** – articles/novels-**Writing** summary of articles and concise writing identifying new words – homonyms, homophones, homographs – one-word substitutions – easily confused words - creating SMS and using emoticons - sharing information in social media. **Language Development** - reported speeches – regular and irregular verbs - idioms & phrases

UNIT III WRITING TECHNICAL REPORTS 9

Listening – listening conversation – effective use of words and their sound aspects, stress, intonation & pronunciation – **Speaking** - practicing telephonic conversations – observing and responding. **Reading** – regular columns of newspapers/magazines - **Writing** – reports – feasibility, accident, survey and progress - preparation of agenda and minutes – **Language Development** - using connectives – discourse markers

UNIT IV TECHNICAL WRITING 9

Listening – Model debates & documentaries - **Speaking** – expressing

agreement/disagreement, assertiveness in expressing opinions – **Reading** biographies/autobiographies – **Writing** – note-making – formal letters – inviting guests – acceptance/declining letters - **Language Development** – degrees of comparison - numerical adjectives – embedded sentences

UNIT V GROUP DISCUSSION AND JOB APPLICATION 9

Listening – Listening - classroom lectures – recommending suggestions & solutions – **Speaking** – participating in group discussion – learning GD strategies – **Reading** – journal articles - Writing – Job application – cover letter - résumé preparation – **Language Development** – purpose statement – editing – verbal analogies.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Board of editors. Fluency in English: A Course book for Engineering and Technology. Orient Blackswan, Hyderabad 2016.
2. Ashraf Rizvi. M, Effective Technical Communication. 2nd ed. McGraw Hill, New Delhi, 2018.

REFERENCES

1. Bailey, Stephen. Academic Writing: A Practical Guide for Students. Routledge, New York,2011.
2. Raman, Meenakshi and Sharma, Sangeetha. Technical Communication Principles and Practice. Oxford University Press, New Delhi, 2014.
3. Muralikrishnan& Mishra Sunitha, Communication skills for Engineers 2nd ed. Pearson, Tamilnadu, India 2011. P. Kiranmai and Rajeevan, Geetha. Basic Communication Skills, Foundation Books, New Delhi, 2013.
4. Suresh Kumar, E. Engineering English. Orient Blackswan, Hyderabad, 2015
5. Richards, Jack C. Interchange Students' Book – 2. Cambridge University Press, New Delhi, 2015.

WEB REFERENCES :

1. https://swayam.gov.in/nd1_noc20_hs21/preview
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/109106122/lec1.pdf
3. https://freevideolectures.com/course/3250/introduction-to-film-studies/10

ONLINE RESOURCES

1. https://www.ef.com/wwen/english-resources/
2. https://www.smilesforlearning.org/gclid=EAIaIQobChMI49DF9bnd6AIVSY6PCh1d_gV9EAAYASAAEgIBPvD_BwE.

OUTCOMES:

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

1. Define technical terms with the correct use of grammar (K1)
2 Identify new words, phrases, idioms and summarize articles/ write ups effectively (K2)
3 Pronounce words correctly, speak fluently and share opinions and suggestions effectively in conversations, debates and discussions (K3)
4 Construct reports convincingly and write official letters emphatically (K3)
5 Communicate confidently while speaking and writing by employing language strategies (K2)
6 Adapt group behavior, execute their role as a contributing team member and prepare winning job applications (K3)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	2	3	1	2
CO2	-	2	-	-	-	-	-	-	2	3	1	1
CO3	-	-	-	1	-	-	-	2	2	3	1	1
CO4	-	-	-	-	-	2	-	3	2	3	2	2
CO5	-	-	-	-	-	-	-	-	2	3	2	2
CO6	-	-	-	-	-	-	-	2	2	3	1	2

SEMESTER - II

20ESIT201 SDG NO. 4	PYTHON PROGRAMMING WITH LABORATORY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To Develop Python Programs with Conditionals and Loops
- To Use Python Data Structures – Lists, Tuples, Dictionaries, Sets
- To Define Python Functions and Work with Modules and Packages
- To Work with Python Classes, Objects and Handling Exceptions

UNIT I BASICS OF PYTHON PROGRAMMING 9

Python Interpreter and Interactive Mode - Features – History of Python – Literals – Variables and Identifiers – Data Types – Input Operation – Comments – Reserved Words – Indentation – Operators and Expressions – Operator Precedence– Operations on Strings – Other Data types – Type Conversion - Illustrative Programs: Use of various Operators, Evaluation of expressions, String Operations.

UNIT II DECISION CONTROL STATEMENTS 9

Conditionals: Boolean Values and Operators, Conditional (if) - Alternative (if-else) - Chained Conditional (if-elif-else) - Iteration: state - while - for - break - continue - pass - Illustrative Programs: Exchange the Values of Two Variables - Circulate the values of N Variables - Distance Between Two Points - Square Root - GCD - Exponentiation - Sum and Array of Numbers.

UNIT III STRING, LISTS, TUPLES, DICTIONARIES, SETS 9

Strings: String Slices - Immutability - String functions and methods - String Module - Lists: List Operations - List Slices - List methods - List Loop - Mutability - Aliasing - Cloning lists - List Parameters - Tuples: Tuple Assignment - Tuple as return value - Dictionaries: Operations and Methods - Advanced List Processing - List Comprehension - Sets: Creating Sets – Operations and Methods – Set Comprehension - Illustrative programs: Linear Search - Binary Search - Selection Sort - Insertion Sort - Merge Sort - Histogram.

UNIT IV FUNCTIONS, MODULES AND PACKAGES 9

Functions - Function Definition and Use - Flow of Execution - Parameters and Arguments - Fruitful Functions: Return values - Parameters - Local and Global

Scope - Function Composition - Recursion - Modules – from-import Statement – Name of Module – Making your own modules - Packages - Standard Library Modules – globals(), locals() and reload() - Illustrative programs: Fibonacci Series using functions - Arithmetic Operations using Module - Area of different shapes using Packages.

UNIT V CLASSES, OBJECTS AND EXCEPTION HANDLING 9

Classes and Objects – Defining Classes – Creating Objects – Data Abstraction and Hiding through Classes - init() method – Class Variables and Object Variables – Introduction to Errors and Exception Handling – Handling Exceptions – Multiple Except Blocks – else Clause – Raising Exceptions – Built-in and User-defined Exceptions – Finally Block.

LIST OF EXPERIMENTS 15

1. Write a Python program to perform
   a. Linear Search
   b. Binary Search
2. Write a Python program to perform Selection Sort.
3. Write a Python program to sort the given numbers using Insertion Sort.
4. Write a Python program to do sorting using Merge sort.
5. Write a Python program to find first n prime numbers.
6. Write a Python program to Multiply two matrices.
7. Write a Python program to create Student class and instantiate its Object.
8. Write a Python License verification process using Exception handling.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. ReemaThareja. "Python Programming Using Problem Solving Approach", Oxford University Press 2018.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, O'Reilly Publishers, 2016.

REFERENCES:

1. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python" Revised and updated for Python 3.2, Network Theory Ltd., 2011.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-Disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.

4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
6. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2013.
7. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

WEB REFERENCES:

1. http://greenteapress.com/wp/think-python/
2. www.docs.python.org
3. https://nptel.ac.in/courses/106/106/106106182/

OUTCOMES:

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

1. Describe the syntax, semantics and control flow statements of Python programming. (K2)
2. Implement simple programs using control structures in Python. (K3)
3. Explain the methods to create and manipulate strings, lists, dictionaries, tuples and sets. (K2)
4. Articulate the concepts of functions, modules and packages in Python. (K2)
5. Implement simple programs using Python Data types and functions. (K3)
6. Apply the concepts of Exception handling, classes and objects. (K3)

CO - PO, MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	1	2	-	-	-	1	-	3	3
CO2	1	2	3	3	3	2	1	1	1	1	1	3
CO3	-	1	3	3	2	1	-	-	-	-	1	3
CO4	1	2	3	3	2	-	-	-	-	-	1	3
CO5	2	3	3	3	3	1	1	2	2	1	2	3
CO6	2	3	3	3	3	1	1	2	2	1	2	3

SEMESTER - II

20BSPH201 SDG NO. 4	PHYSICS OF ELECTRONIC DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquaint the electrical properties of materials.
- To present the principles of semiconductor physics and its applications.
- To educate the properties of magnetic and dielectric materials and their uses.
- To introduce the bipolar junction transistors.
- To explicit the field effect transistors, power and display devices.

UNIT I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity expression - Wiedemann-Franz law - Success and failures - electrons in metals - Particle in a three dimensional box - degenerate states - Fermi- Dirac statistics - Density of energy states - Electron in periodic potential- Energy bands in solids - Tight binding approximation - Electron effective mass- concept of hole.

UNIT II SEMICONDUCTOR DIODES 9

Semiconductors - Intrinsic, Extrinsic semiconductor, Carrier concentration, PN junction diode- Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes, Special purpose diodes - Schottky barrier diode, Zener diode, Varactor diode ,Tunnel diode, LASER diode and LDR.

UNIT III MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS 9

Magnetism in materials - magnetic field and induction - magnetization - magnetic permeability and susceptibility - types of magnetic materials - microscopic classification of magnetic materials - Ferromagnetism: origin and exchange interaction - saturation magnetization and Curie temperature - Domain Theory - Hysteresis phenomenon - Ferrites. Dielectric materials: Polarization processes - dielectric loss - internal field - Clausius-Mosotti relation - dielectric breakdown.

UNIT IV BIPOLAR JUNCTION TRANSISTOR 9

NPN -PNP -Operations-Early effect-Current equations – Input and Output characteristics of CE, CB, CC - Hybrid -π model - h-parameter model, Ebers

Moll Model- Gummel Poon- model, Multi Emitter Transistor.

UNIT V FIELD EFFECT TRANSISTORS, POWER AND DISPLAY DEVICES 9

JFETs – Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage - Channel length modulation, D- MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with JFET. Power Devices-UJT, SCR, Diac, Triac, Display Devices-LED, LCD, Photo transistor, Opto Coupler, Solar cell, CCD.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Donald A Neaman, "Semi-conductor Physics and Devices", Fourth Edition, TataMcGrawHill Inc.2012.
2. Salivahanan.S, Suresh Kumar. N, Vallavaraj.A, "Electronic Devices and circuits", Third Edition, Tata McGraw- Hill,2008.

REFERENCES:

1. Robert Boylestadand Louis Nashelsky, "Electron Devices and Circuit Theory", Pearson Prentice Hall, 10th edition, July2008.
2. R.S.Sedha, "A Text Book of Applied Electronics" S.Chand Publications, 2006.
3. Yang, "Fundamentals of Semiconductor Devices", McGraw Hill International Edition, 1978.

OUTCOMES:

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

1. To acquire knowledge on electron theory of solids and apply it to determine the electrical properties of solids (K3)
2. To understand the origin of magnetism and to classify the magnetic materials based on their electron spin(K2)
3. To explain different polarisation and breakdown mechanisms in dielectric materials (K2).
4. "To understand the basic concepts of semiconducting material fundamentals and apply it to understand the principles of working of various diodes. (K3)
5. To characterize the various configurations and models of bipolar junction transistor(K3)
6. To describe the behaviour of field effect transistors, power and display devices for special applications (K2)

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	-	1	-	-	-	-	-	1
CO2	3	3	1	2	3	1	1	-	-	-	-	2
CO3	3	3	-	2	2	-	1	1	-	-	-	1
CO4	3	3	1	2	2	2	2	-	-	-	-	3
CO5	3	3	2	2	2	-	-	-	-	-	-	2
CO6	3	3	3	2	3	3	2	-	-	-	-	2

SEMESTER - II

20BSCY201 SDG NO. 4,17	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the nature and facts about environment
- To find and implement scientific, technological, economic and political solutions to environmental problems
- To study the interrelationship between living organism and environment
- To provide the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition, scope and importance of environment – need for public awareness – Ecosystem: concept of an ecosystem – structure and functions of an ecosystem – Biotic and abiotic components – Biogeochemical cycle (C, N & P) – energy flow in the ecosystem – food chains, food webs and ecological pyramids – ecological succession - keystone species. Introduction to biodiversity definition: genetic, species and ecosystem diversity – values of biodiversity – IUCN Red list species classification - endemic, endangered, rare, vulnerable, extinct and exotic species – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity – man-wildlife conflicts. Conservation of biodiversity: In-situ and

ex-situ conservation of biodiversity. Field study of Terrestrial (Forest, Grassland, Desert) and Aquatic ecosystem (Pond, Lake, River, Estuary and Marine)

UNIT II ENVIRONMENTAL POLLUTION 9

Definition – causes, effects and control measures of: Air pollution, Water pollution, Soil pollution Marine pollution, Noise pollution, Thermal pollution and Nuclear pollution – solid waste management: causes, effects and control measures of municipal solid wastes (MSW) – role of an individual in prevention of pollution – Case studies related to environmental pollution.

Disaster management: floods, earthquake, cyclone and landslides – nuclear holocaust – Case studies.

UNIT III NATURAL RESOURCES 9

Forest resources: Use and over – exploitation, deforestation – Land resources: land degradation, man induced landslides, soil erosion and desertification – Water resources: Use and over- utilization of surface and groundwater – dams-benefits and problems, conflicts over water – Mineral resources: Environmental effects of extracting and using mineral resources – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture – fertilizer – pesticide problems, water logging and salinity. Energy resources: Renewable energy (Solar energy, Wind energy, Tidal energy, Geothermal energy, OTE, Biomass energy) and non renewable energy (Coal, Petroleum, Nuclear energy) sources. – role of an individual in conservation of natural resources. Case studies – timber extraction, mining, dams and their effects on forests and tribal people.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 10

Atmospheric Chemistry - Composition and structure of atmosphere. Climate change - greenhouse effect- role of greenhouse gases on global warming. Chemical and photochemical reactions in the atmosphere - Formation of smog, PAN, acid rain (causes, effect and control measures). Oxygen and ozone chemistry - Ozone layer depletion (causes, effect and control measures). environmental ethics: Issues and possible solutions – Green chemistry - 12 principles of green chemistry.

Urbanisation - Urban problems related to energy - Water conservation: rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns - case studies. Environment Legislations and Laws : Environment (protection) act – 1986. Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act. Biomedical Waste(Management and Handling rules):1998 and amendments- scheme of labelling of

environmentally friendly products (Ecomark) - Issues involved in enforcement of environmental legislation - central and state pollution control boards, role of non-governmental organization – Public awareness - Environmental Impact Assessment (EIA).

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 8

Population growth, variation among nations – population explosion – family welfare programme – women and child welfare environment and human health – HIV / AIDS – Role of Information Technology in environment and Human health – Case studies – human rights – value education – Sustainable Development – Need for sustainable development – concept – 17 SDG goals – 8 Millennium Development Goals(MDG).

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
3. Ravikrishnan A, 'Environmental Science and Engineering', Sri Krishna Hitech Publishing Company Pvt. Ltd, Revised Edition 2020.

REFERENCES :

1. Dharmendra S. Sengar, "Environmental law", Prentice hall of India Pvt Ltd, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) Pvt Ltd., Hydrabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd., Delhi, 2014.
4. Rajagopalan. R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.

OUTCOMES:

Upon successful completion of this course, student should be able to

1. Explain the different components of environment, structure and function of an ecosystem, importance of biodiversity and its conservation. (K1)
2. Aware about problems of environmental pollution, its impact on human and ecosystem, control measures and basic concepts in Disaster Management. (K2)
3. Disseminate the need for the natural resources and its application to meet the modern requirements and the necessity of its conservation. (K2)

4. Illustrate the various aspects of atmospheric chemistry with a focus on climate change and recognize the principles of green chemistry. Describe suitable scientific, technological solutions and Protection Acts to eradicate social and environmental issues. (K2)
5. Recognize the need for population control measures and the environmental based value education concepts to achieve the Sustainable Development Goals. (K2)

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	-	1	2	-	1	1	-	2
CO2	2	2	2	-	2	2	3	1	2	2	-	2
CO3	1	1	1	1	-	1	1	-	1	2	-	1
CO4	2	2	2	1	2	1	1	-	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1

SEMESTER - II

20EEPC201 SDG NO. 4 & 9	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
		2	1	0	3

OBJECTIVES:

- To impart knowledge on electric circuits and solving circuit equations using network theorems
- To educate on obtaining the transient response of circuits and phenomenon of resonance and coupled circuits
- To introduce Phasor diagrams and analysis of three phase circuits

UNIT I BASIC CIRCUITS ANALYSIS **6 +3**

Resistive elements - Ohm's Law Resistors in series and parallel circuits – Kirchoff's law, Network reduction: voltage and current division, Source transformation – Star Delta conversion. AC Fundamentals- Average and RMS value - Phasor Diagram – Power, Power Factor and Energy – Mesh current and node voltage - methods of analysis

UNIT II NETWORK THEOREMS FOR DC AND AC CIRCUITS 6+3

Superposition Theorem - Thevenin's and Norton's Theorems – Maximum power transfer theorem– Reciprocity Theorem – Millman's theorem.

UNIT III TRANSIENT RESPONSE ANALYSIS 6+3

R, L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

UNIT IV RESONANCE AND COUPLED CIRCUITS 6+3

Series and parallel resonance– their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

UNIT V POLY PHASE CIRCUITS 6+3

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power and power factor measurement in three phase circuits.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. SudhakarA and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", McGraw Hill, Fifth Edition, June 2015.
2. Charles K.Alexander,Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", Sixth Edition, McGraw Hill, February 14, 2019.
3. Joseph A.Edminister, Mahmood Nahri, "Electric circuits",(Schaum's outline series), Mc Graw- Hill, New Delhi, Fifth edition, February 5 2010.

REFERENCES

1. Chakrabarti A, "Circuits Theory Analysis and Synthesis", Dhanpath Rai & Sons,New Delhi, Seventh edition, 2015
2. A Nagoor kani, "Circuit Analysis," McGraw Hill,3rd January 11, 2016
3. William H. Hayt, Jack Kemmerly, Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill, eighth edition, July10 2013.
4. Mahadevan K ,Chitra C., "Electric Circuits Analysis," Prentice-Hall of India Pvt Ltd., New Delhi, Second edition, 2015.
5. Richard C. Dorf and James A.Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley & Sons, Inc., 9th edition, August 2014.

WEB RESOURCES:

1. https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic

2. http://homepages.wmich.edu/~miller/ECE2100.html
3. https://engineering.purdue.edu/~ee202https://engineering.purdue.edu/~ee202

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc17_ee13/preview
2. https://www.coursera.org/learn/linear-circuits-dcanalysis
3. https://onlinecourses.nptel.ac.in/noc17_ee15/preview
4. https://swayam.gov.in/course/218-networks-and-systems

OUTCOMES:

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

1. Apply Kirchhoff's laws, star-delta conversion, mesh and nodal techniques for analysis of DC and AC Circuits. (K2)
2. Apply Superposition, Thevenin's, Norton's, Reciprocity, Millman's, and Maximum power transfer theorems for network reduction of DC and AC circuits. (K3)
3. Derive the transient response of RL, RC & RLC circuits using Laplace transforms for DC and AC inputs. (K3)
4. Characterize the frequency response of series & parallel resonance circuits and single tuned circuits. (K2)
5. Illustrate the performance parameters of three phase three wire and four wire circuits for various conditions.(K2)

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Co1	3	3	2	2	-	1	-	-	-	-	-	2
CO2	3	3	2	2	-	1	-	-	-	-	-	2
CO3	3	3	2	2	-	1	-	-	-	-	-	2
CO4	3	3	2	2	-	1	-	-	-	-	-	2
CO5	3	3	2	2	-	1	-	-	-	-	-	2

SEMESTER - II

20ESGE201 SDG NO. 4,9,12	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Electrical and Electronics Engineering, Civil and Mechanical Engineering

ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

CIVIL ENGINEERING PRACTICE

Buildings:

Study of plumbing and carpentry components of residential and industrial buildings, safety aspects.

Plumbing Works:

1. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
2. Study of pipe connections requirements for pumps and turbines.
3. Preparation of plumbing line sketches for water supply and sewage works.

4. Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
5. Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

1. Study of the joints in roofs, doors, windows and furniture.
2. Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

MECHANICAL ENGINEERING PRACTICE

Welding:

1. Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
2. Gas welding practice.

Basic Machining:

1. Simple Turning and Taper turning.
2. Drilling Practice.

Sheet Metal Work:

1. Forming & Bending.
2. Model making – Trays and funnels.
3. Different type of joints.

Machine assembly practice:

1. Study of centrifugal pump.
2. Study of air conditioner.

Demonstration on:

1. Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
2. Foundry operations like mould preparation for gear and step cone pulley.
3. Fitting – Exercises – Preparation of square fitting and V – fitting models.

Total : 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Electrical

1	Assorted electrical components for house wiring	15 Sets
2	Electrical measuring instruments	10 Sets
3	Study purpose items:	

	Iron box, fan and regulator, emergency lamp	1 Each
4	Megger (250V/500V)	1 No
5	Power Tools:	
	Range Finder	2 Nos
	Digital Live-wire detector	2 Nos

2. Electronics

1	Soldering guns	10 Nos
2	Assorted electronic components for making circuits	50 Nos
3	Small PCBs	10 Nos
4	Multimeters	10 Nos

3. Civil

1	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets
2	Carpentry vice (fitted to work bench)	15 Nos
3	Standard woodworking tools	15 Sets
4	Models of industrial trusses, door joints, furniture joints	5 each
5	Power Tools:	
	Rotary Hammer	2 Nos
	Demolition Hammer	2 Nos
	Circular Saw	2 Nos
	Planer	2 Nos
	Hand Drilling Machine	2 Nos
	Jigsaw	2 Nos

4. Mechanical

1	Arc welding transformer with cables and holders	5 Nos
2	Welding booth with exhaust facility	5 Nos
3	Welding accessories like welding shield, chipping hammer, wire brush, etc	5 Sets
4	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5	Centre lathe	2 Nos
6	Hearth furnace, anvil and smithy tools	2 Sets
7	Moulding table, foundry tools	2 Sets
8	Power Tool: Angle Grinder	2 Nos
9	Study-purpose items: centrifugal pump, air-conditioner	1 each

OUTCOMES:

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

1. Elaborate on the components, gates, soldering practices. Calculate electrical parameters such as voltage, current, resistance and power. (K1)
2. Design and implement Rectifier and Timer circuits (K2)
3. Measure the electrical energy by single phase and three phase energy meters. (K2)
4. Prepare the carpentry and plumbing joints. (K2)
5. Perform different types of welding joints and sheet metal works (K2)
6. Perform different machining operations in lathe and drilling. (K2)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	1	-	-	1	1	1	1
CO2	3	2	1	1	2	1	-	-	1	1	1	1
CO3	2	2	1	1	1	1	-	-	1	1	1	1
CO4	1	1	1	-	-	2	-	-	1	1	1	2
CO5	2	1	1	-	-	1	1	1	1	1	1	2
CO6	2	1	1	-	-	1	-	1	1	1	1	2

SEMESTER - II

20EEPL201 SDG NO. 4&9	ELECTRIC CIRCUITS AND SIMULATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To simulate various electric circuits using Pspice/ Matlab/e-Sim /Scilab
- To gain practical experience on electric circuits and verification of theorems
- To gain practical Knowledge on electric circuits transients and resonance

LIST OF EXPERIMENTS

1. Simulation and experimental solving of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Simulation and experimental solving of electrical circuit problems using Thevenin's theorem.

3. Simulation and experimental solving of electrical circuit problems using Norton's theorem.
4. Simulation and experimental solving of electrical circuit problems using Superposition theorem.
5. Simulation and experimental verification of Maximum Power transfer Theorem.
6. Study of Analog and digital oscilloscopes and measurement of sinusoidal voltage, frequency and power factor.
7. Simulation and Experimental validation of R-L & R-C electric circuit transients.
8. Simulation and Experimental validation of frequency response of RLC electric circuit.
9. Design and Simulation of series resonance circuit.
10. Design and Simulation of parallel resonance circuits.
11. Simulation of three phase balanced and unbalanced star, delta networks circuits.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1	Regulated Power Supply: 0 – 15 V D.C / Distributed PowerSource.	- 10 Nos
2	Function Generator (1 MHz)	- 10Nos.
3	Single Phase Energy Meter	- 1 No.
4.	Oscilloscope (20MHz)	- 10 Nos.
5.	Digital Storage Oscilloscope (20 MHz)	– 1 No.
6.	10 Nos of PC with Circuit Simulation Software (min 10 Users) (e-Sim / Scilab/ Pspice / Matlab /other Equivalent software Package) and Printer (1No.)	
7.	AC/DC - Voltmeters (10 Nos.), Ammeters (10 Nos.) and Multi-meters (10 Nos.) 8 Single Phase Wattmeter	– 3Nos.
9	Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box Each	- 6 Nos.
10	Circuit Connection Boards	- 10Nos.

Necessary Quantities of Resistors, Inductors, Capacitors of various capacities.

OUTCOMES:

On completion of the course on Electric circuit laboratory, the students should be able to

1. Use laboratory equipment and techniques to measure electrical quantities using multi-meters, power supplies and oscilloscopes and apply basic circuit laws. (K1)

2. Examine the DC and AC Network theorems and apply to them in laboratory measurements. (K2)
3. Analyze the transient response of series RL and RC electric circuits. (K4)
4. Simulate the frequency behaviour of RLC electric circuits. (K5)
5. Design and simulate the resonance circuits. (K6)
6. Design and simulate the balanced and unbalanced three phase circuits. (K6)

PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	2	-	1	2	3	2
CO2	3	3	2	1	-	-	-	-	2	-	1	1	2	2
CO3	3	3	2	2	-	-	-	-	2	-	1	2	2	2
CO4	3	3	2	2	-	-	-	-	2	-	1	2	2	2
CO5	3	3	2	1	-	-	-	-	2	-	1	-	2	2
CO6	3	3	2	1	-	-	-	-	2	-	1	-	2	2

SEMESTER - II

20TPHS201 SDG NO. 4&5	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the nuances in resume building
- To explore various virtual meeting tools
- To gain knowledge about online certification courses
- To develop knowledge in Google Suite products
- To enhance presentation skills

UNIT I RESUME BUILDING **6**

Your Strength, Projects, Internship, Paper Presentation, uploading your coding in github, Introduction to HackerRank, HackerEarth virtual online assessment (Auto Proctored) (Practicals - Construct a resume, Register for a online Mock Assessment / Contest)

UNIT II VIRTUAL MEETINGS **6**

Basic Etiquette of virtual meeting – Introduction to Skype - Zoom - Webex - Google Meet - Gotowebinar - Jio meet – Screen Share - Jamboard - Feedback polling - Chatbox

(Practicals - Accept and Register for a mock class to attend - How to host a meeting).

UNIT III ONLINE LEARNING **6**

Online Certification - Coursera – Udemy – Edx – Cisco – Online Practice Platforms - SkillRack – Myslate - FACEprep - BYTS - aptimithra - Contest Registrations - TCS Campus Commune - HackwithInfy, InfyTQ - Virtusa NurualHack - Mindtree Osmosis – Online assessment - AMCAT-PGPA.

(Practicals - Campus Commune Registration , Coursera registration - Mock Registration (KAAR Technologies as sample).

UNIT IV GOOGLE SUITE **8**

Define google suite - Benefits of google suite - Google Search - Sheet - Docs - Forms - Calender - Drive - Slide - Translate - Duo - Earch - Maps - Hangouts- Sites - Books - Blogger

(Practicals – Create google sheets and share - Create google Forms and share, Create Google Slide and share , Google drive creation and share (Knowledge of Rights), Create poll and share.

UNIT V PRESENTATION SKILLS **4**

Email Writing – Group Discussion - Power Point Presentation

(Practicals- Create a self SWOT Analysis report. A PowerPoint Slide Preparation)

TOTAL : 30 PERIODS

WEB REFERENCES :

Unit I: Resume Building:

1. https://zety.com/blog/resume-tips
2. https://resumegenius.com/blog/resume-help/how-to-write-a-resume
3. https://www.hackerearth.com/recruit/
4. https://www.hackerrank.com/about-us

Unit – II:Virtual Meetings

1. https://www.claphamschool.org/our-community/blog/online-learning-etiquette-guide-14-principles-to-guide-students
2. https://online.hbs.edu/blog/post/virtual-interview-tips?c1=GAW_SE_NW&source=IN_GEN_DSA&cr2=search__-__nw__-__in__-__dsa__-__general&kw=dsa__-__general& cr5=459341920955&cr7

=c&gclid=Cj0KCQjw8fr7BRDSARIsAK0Qqr4dRRbboL3kltrwDsr7hm8oIHtN5dfjD3NIFZULuzNwEXxhjpNFQ2caApn5EALw_wcB

3. https://hygger.io/blog/top-10-best-group-meeting-apps-business/
4. https://www.zdnet.com/article/best-video-conferencing-software-and-services-for-business/

Unit – III:Online Learning

1. https://www.coursera.org/browse
2. https://support.udemy.com/hc/en-us/articles/229603868-Certificate-of-Completion
3. https://www.edx.org/course/how-to-learn-online
4. https://www.cisco.com/c/en/us/training-events/training-certifications/certifications.html
5. https://campuscommune.tcs.com/en-in/intro
6. https://www.freshersnow.com/tcs-campus-commune-registration/
7. https://www.infosys.com/careers/hackwithinfy.html
8. https://www.mindtree.com/blog/osmosis-2013-my-experiences
9. https://www.myamcat.com/knowing-amcat
10. https://www.admitkard.com/blog/2020/02/06/amcat/

Unit IV: Google Suite

1. https://www.inmotionhosting.com/blog/what-is-g-suite-and-why-should-i-consider-using-it/
2. https://en.wikipedia.org/wiki/G_Suite
3. https://blog.hubspot.com/marketing/google-suite
4. https://kinsta.com/blog/g-suite/

Unit V: Presentation Skills

1. https://www.mindtools.com/CommSkll/EmailCommunication.htm
2. https://www.grammarly.com/blog/email-writing-tips/
3. https://business.tutsplus.com/articles/how-to-write-a-formal-email--cms-29793
4. https://www.softwaretestinghelp.com/how-to-crack-the-gd/
5. https://www.mbauniverse.com/group-discussion/tips
6. https://slidemodel.com/23-powerpoint-presentation-tips-creating-engaging-interactive-presentations/
7. https://business.tutsplus.com/articles/37-effective-powerpoint-presentation-tips--cms-25421
8 https://blog.prezi.com/9-tips-on-how-to-make-a-presentation-a-success/
9. http://www.garrreynolds.com/preso-tips/design/

OUTCOMES:

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

1. Construct a suitable resume and registration procedure for online mock assessments. (K1)
2. Handle various virtual meeting tools. (K3)
3. Acquire exposure about online certification courses. (K4)
4. Get involved and work in a collaborative manner. (K2)
5. Gain knowledge in various presentation methodologies. (K1)
6. Apply knowledge to practice Google suite features and SWOT analysis. (K3)

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	3	2	-	3	2	3	-	2
CO2	-	-	-	-	3	2	-	3	2	3	-	2
CO3	-	-	-	-	3	2	-	-	1	3	-	2
CO4	-	-	-	-	3	2	-	3	3	3	-	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2
CO6	-	-	-	-	3	2	-	-	2	3	-	2

SEMESTER - II

20HSMG201 SDG NO. 4 & 5	INTERPERSONAL VALUES	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Values through Practical activities

UNIT I INTERPERSONAL VALUES **6**

Interpersonal Relationships and Values – Importance and Barriers – Building and maintain relationships – Mutual understanding – Respect to others.

UNIT II EFFECTIVE COMMUNICATION **6**

Communication skills –Importance and Barriers - Impressive formation and management – Public speaking

UNIT III GROUP DYNAMICS **6**

Group formation –Teamwork – Identify others attitude and behaviour – Formation of relationship – Personal and professional.

UNIT IV MUTUAL RELATIONSHIP **6**

Building mutual understanding and cooperation – Enhancing decision making skills – Problem solving skills – Comparative Appraisal – Interpersonal needs.

UNIT V POSITIVE ATTITUDE **6**

Fostering trust and cooperation – Developing and maintain positive attitude – Improving socialization – Development of security and comfort.

TOTAL: 30 PERIODS

Note: Each topic in all the above units will be supplemented by practice exercises and classroom activities and projects.

REFERENCE BOOKS:

1. Barun K. Mitra, "Personality Development and Soft Skills", Oxford University Press, 2016.
2. B.N.Ghosh, "Managing Soft Skills for Personality Development", McGraw Hill India, 2012.

OUTCOMES:

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

1. Develop a healthy relationship & harmony with others. (K1)
2. Practice respecting every human being. (K3)
3. Practice to eradicate negative temperaments. (K3)
4. Acquire Respect, Honesty, Empathy, Forgiveness and Equality. (K4)
5. Manage the cognitive abilities of an Individual. (K5)
6. Understanding the importance of public speaking and teamwork. (K2)

CO – PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	3	3	1	1	1
CO2	-	-	-	-	-	2	2	3	3	1	1	1
CO3	-	-	-	-	-	2	2	3	3	1	1	1
CO4	-	-	-	-	-	2	2	3	3	1	1	1
CO5	-	-	-	-	-	2	2	3	3	1	1	1
CO6	-	-	-	-	-	2	2	3	3	1	1	1

SEMESTER - III

20EEPC301 SDG NO. 4	ANALOG ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the operation and applications of FET and differential amplifier
- To learn the Design of power amplifiers,feed backamplifier,oscillators
- To Understand the Characteristics of op-amp
- To gain knowledge on Design,construction,application circuits using op-amp
- To understand Functional blocks and applications of special Ics like Timer And regulator Ics

UNIT I FET AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

BJT - Biasing circuits, FET: JFET and MOSFET, Characteristics of CS, CG and CD amplifier configurations Biasing circuits – IGBT- Differential amplifier – Common mode and Difference mode analysis.

UNIT II POWER AMPLIFIERS AND OSCILLATORS 9

Classification of Power amplifiers:- Class A, B, AB and C Power amplifiers- Push-Pull and Complementary Symmetry Push-Pull amplifiers - Design of power output, efficiency and cross-over distortion- Advantages of negative feedback – Condition for oscillations, RC phase shift, wein bridge , Crystal oscillators.

UNIT III CHARACTERISTICS OF OPAMP 9

OP-AMP characteristics - DC characteristics, AC characteristics. Basic applications of op-amp – Comparators, Inverting and Non-inverting Amplifiers, differential amplifier, summer, differentiator and integrator, V/I and I/V converter.

UNIT IV APPLICATIONS OF OPAMP 9

Instrumentation amplifier, Multivibrators, Waveform generators, peak detector, clippers, S/H circuit - D/A converter (weighted resistor and R- 2R ladder types), A/D converters (flash type, dual slope type and successive approximation type) using opamp.

UNIT V ANALOG Ics **9**

Functional block, characteristics and applications - 555 Timer, IC voltage regulators – Fixed voltage regulators LM78XX, LM79XX, its application as Linear power supply - Variable voltage regulator 723, Switching regulator - ICL8038 function generator IC.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. David A. Bell,"Electronic devices and circuits", Oxford University higher education,5th edition 2008.
2. . D.Roy Choudhary, Shail Bala Jain, "Linear Integrated Circuits", Fifth edition, New Age International Publishers, 2018.

REFERENCES

1. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
2. Robert L.Boylestad, "Electronic devices and circuit theory", 2002
3. S.Salivahanan, V.S.Kanchana Bhaaskaran, "Linear Integrated Circuits and Applications", First edition, 2018, McGraw Hill Education.
4. David A. Bell, "Op-amp & Linear Ics", Third edition, Oxford Higher Education, 2013.
5. Ramakant A.Gayakward, "Op-amps and Linear Integrated Circuits", Fourth edition (25 May 2015), Pearson Education.
6. Sedra and Smith, "Microelectronic circuits", 7th Ed., Oxford University Press.

WEB RESOURCES:

1. https://www.electronics-tutorials.ws/
2. https://www.tutorialspoint.com/linear_integrated_circuits_applications/linear_integrated_circuits_applications_comparators.htm
3. https://www.khanacademy.org/science/electrical-engineering/ee-amplifiers
4. https://nptel.ac.in/courses/117107094/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/117103063/
2. https://www.coursera.org/specializations/semiconductor-devices
3. http://www.nptelvideos.in/2012/11/digital-integrated-circuits.html
4. https://nptel.ac.in/courses/108/108/108108111/

COURSE OUTCOMES:

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

1. Illustrate Semiconductor devices such as FET, BJT and IGBT for various biasing circuits (K2)
2. Explain the various types of Power Amplifiers and Oscillators using Semiconductor devices(K2)
3. Outline the Characteristics of OPAMP and its applications(K2)
4. Develop different types of wave form generators using OPAMP and study the A/D converters & D/A converters(K3)
5. Summarize the functional block, characteristics and applications of 555 Timer and voltage regulator ICs(K2)

CO - PO, PSO MAPPING:

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

SEMESTER - III

20EEPC302 SDG NO. 4,7,11	DC MACHINES AND TRANSFORMERS	L	T	P	C
		2	1	0	3

OBJECTIVES:

To impart knowledge on the following Topics

- Derive expressions for generated voltage and torque developed in Electrical Machines.
- Working principles of DC machines, determination of their no- load/load characteristics, starting and methods of speed control of DC motors.
- Constructional details, principle of operation, prediction of performance, the methods of testing the transformers.

UNIT I MAGNETIC CIRCUITS AND CONCEPTS IN ROTATING MACHINES **6+3**

Magnetic circuits –Laws governing magnetic circuits - Flux linkage, Inductance and energy – Statically and Dynamically induced EMF - Hysteresis

and Eddy Current losses - Field energy and co energy-force and torque equations – singly and multiply excited magnetic field systems

UNIT II DC GENERATORS **6+3**

Construction and components of DC Machines – Principle of operation - Lap and wave windings-EMF equations– circuit model – Armature reaction –Methods of Excitation- Commutation –Methods of improving commutation-Interpoles - compensating winding –Characteristics of DC generators.

UNIT III DC MOTORS **6+3**

Principle and operations - Types of DC Motors – Electrical and Mechanical Characteristics - Applications of DC Motor.

UNIT IV STARTERS, SPEED CONTROL AND TESTING OF DC MOTORS **6+3**

Starters and its types, speed control of DC motors – Braking of DC Motors - Plugging, Dynamic and Regenerative braking- Testing and Efficiency – Retardation test- Swinburne's test and Hopkinson's test.

UNIT V TRANSFORMERS **6+3**

Construction – principle of operation – Equivalent circuit parameters – Phasor diagrams -Losses – Testing – Efficiency and Voltage regulation-All day Efficiency-Sumpner's test –Parallel operation of Transformers-Auto transformer – Three Phase Transformer - Tap changing transformers-Protective Devices of Transformers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. J.B.Gupta, "Theory and Performance of Electrical Machines", S.K.Kataria & Sons , 15th Edition 2015
2. B.L.Theraja and A.K.Theraja, "A Textbook of Electrical Technology", S.Chand,2012

REFERENCES

1. P.S.Bimbhra, "Electrical Machinery", Khanna Publishers,7th Edition, Reprint 2015.
2. B.R. Gupta, "Fundamental of Electric Machines", New age International Publishers, 3rd Edition,Reprint 2015.
3. S.K. Bhattacharya, "Electrical Machines" McGraw - Hill Education, New Delhi, 4th Edition, 2014.
4. Nagrath, I.J. and Kothari.D.P.,' Electric Machines', McGraw-Hill Education, 5th Edition, 2017.

5. Er.R.K.Rajput, "Electrical Machines"', Laxmi Publications, 6th Edition,2016.

WEB RESOURCES:

1. www.electricaleasy.com
2. www.electrical4u.com
3. www.electricaltechnology.org

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108/102/108102146/
2. https://nptel.ac.in/courses/108/105/108105155/
3. https://nptel.ac.in/courses/108/105/108105017/
4. https://nptel.ac.in/courses/108/106/108106071/
5. https://www.sciencedirect.com
6. https://www.btechguru.com

OUTCOMES:

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

1. Outline the concepts of electromechanical energy conversion in electrical machines. (K2)
2. Explain the constructional features, principle of operation and types with commutations of DC Generators. (K2)
3. Interpret the principle of operation, types, characteristics and applications of DC motor. (K2)
4. Illustrate the methods of starting, speed control, braking of DC motors and testing of DC machines. (K2)
5. Summarize the construction, working principle of transformer, types and the performance characteristics of the transformer. (K2)

CO- PO, PSO MAPPING:

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

SEMESTER - III

20EEPC303 SDG NO. 3,4,9,13	ELECTROMAGNETIC THEORY	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To introduce the basic mathematical concepts related to electromagnetic vector fields.
- To impart knowledge on the concepts of Electrostatic fields, electrical potential, energy density and their applications.
- To impart knowledge on the concepts of Magneto static fields, magnetic flux density, vector potential and its applications.
- To impart knowledge on the concepts of Different methods of emf generation and Maxwell's equations.
- To impart knowledge on the concepts of Electromagnetic waves and characterizing parameters.

UNIT I ELECTROSTATICS– I **6+6**

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and its applications.

UNIT II ELECTROSTATICS– II **6+6**

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field – Electric field in free space, conductors, dielectrics - Dielectric polarization – Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

UNIT III MAGNETOSTATICS **6+6**

Lorentz force, Magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuital Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

UNIT IV ELECTRODYNAMIC FIELDS **6+6**

Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.

UNIT V ELECTRO MAGNETIC WAVES **6+6**

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector – Plane wave reflection and refraction.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition,2015.
2. William H. Hayt and John A. Buck and Jaleel M. Akhtar 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2020.

REFERENCES

1. V.V.Sarwate, "Electromagnetic fields and waves", First Edition, New age Publishers, 1993.
2. J.P.Tewari, "Engineering Electromagnetics - Theory, Problems and Applications", Second Edition, Khanna Publishers.
3. Joseph. A.Edminister, "Schaum's Outline of Electromagnetics", Third Edition (Schaum's Outline Series), McGraw Hill, 2010.
4. K A Gangadhar, "Electromagnetic Field Theory", Khanna Publishers; Eighth Reprint: 2015.

WEB REFERENCES:

1. https://www.britannica.com/science/electrostatics
2. https://www.britannica.com/science/magnetostatics
3. http://www.clerkmaxwellfoundation.org/

OUTCOMES:

At the end of the course, the student should be able to

1. Outline the Scalar and Vector quantities with electromagnetic field concepts (K2)
2. Utilize the concepts of electrostatic fields, electrical potential and energy density (K3)
3. Utilize the concepts of magneto static fields, magnetic flux density and vector potential (K3)
4. Apply the Electromagnetic concepts to the elements in relation with various forms of Maxwell's equations (K3)
5. Develop electromagnetic wave equations and Poynting Vector using Maxwell's equations (K3)

CO- PO, PSO MAPPING

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

SEMESTER - III

20EEPC304 SDG NO. 4	DIGITAL LOGIC CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

- To study various number systems and simplify the logical expressions using Boolean functions.
- To study combinational circuits.
- To design various synchronous and asynchronous circuits.
- To introduce asynchronous sequential circuits and PLDs.
- To introduce digital simulation for development of application oriented logic circuits.

UNIT I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 9

Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code) - Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families -operation, characteristics of digital logic family.

UNIT II COMBINATIONAL CIRCUITS 9

Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, subtractors.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering -

counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Melay models, state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Asynchronous sequential logic circuits-Transition stability, flow stability-race conditions, hazards & errors in digital circuits; analysis of asynchronous sequential logic circuits.

UNIT V PROGRAMMABILITY LOGIC DEVICES AND DIGITAL SIMULATION 9

Introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA. RTL Design – Introduction to VHDL - Operators - Simple coding for combinational logic circuit and Sequential circuit (example : Added, Counter, Flipflop, Multiplexer and De-multiplexer).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.K Mandal, "Digital Electronics Principles & Application", Mc Graw Hill, 2017
2. M. Morris Mano and Michael D Ciletti, " Digital Design With an Introduction to Verilog HDL", Pearson Education, 2015.

REFERENCES

1. William Keitz, "Digital Electronics - A Practical Approach with VHDL", Pearson, 2013.
2. Thomas L.Floyd, "Digital Fundamentals", 11th edition, Pearson Education, 2015.
3. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
4. D.P.Kothari,J.S.Dhillon, "Digital Circuits and Design", Pearson Education, 2016.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/105/108105132/
2. https://nptel.ac.in/courses/108/105/108105113/

ONLINE MATERIALS

1. https://www.coursera.org/learn/digital-systems
2. https://www.udemy.com/course/digital-electronics-logic-design/

OUTCOMES:

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

1. Solve various number systems, coding systems and implementation of various digital logic functions using DTL, TTL, RTL, ECL and CMOS. (K3)
2. Build various Combinational logic circuits and minimize the Boolean functions using K-Map (K3)
3. Interpret the synchronous sequential circuits by extending the principle of operation of Flipflops. (K2)
4. Construct asynchronous sequential circuits and identify various hazards & errors in digital circuits (K3)
5. Develop VHDL Coding for digital logic circuits and explain various Programmable logic devices. (K3)

CO- PO, PSO MAPPING :

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

SEMESTER - III

20BSMA301 SDG NO. 4	LINEAR ALGEBRA, PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- The aim of this course is to impart knowledge in the concepts of linear algebra as a prerequisite for the recent thrust areas of technological advancement
- To know the importance of partial differential equations in modeling various engineering problems
- To introduce the techniques of Fourier transform and Z- Transforms to analyze continuous and discrete signals

UNIT I VECTOR SPACES 15

Vector spaces – Subspaces – Linear combinations– Linear independence and linear dependence – Bases and dimensions.

UNIT II LINEAR TRANSFORMATION AND INNER PRODUCT SPACES 15

Linear transformation - Null and range spaces - Dimension theorem (Statement only) - Matrix of a linear transformation - Inner product - Norm - Gram Schmidt orthogonalization process.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT IV FOURIER TRANSFORMS 9

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9

Z-transforms - Elementary properties – Inverse Z-transform (using partial fractions and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL: 60 PERIODS

TEXTBOOKS:

1. Friedberg A.H., Insel A.J. and Spence L., "Linear Algebra", Prentice Hall of India, New Delhi, 2004. Unit I (Sec. 1.2, 1.3, 1.4 (linear combinations only), 1.5 & 1.6), Unit II (Sec. 2.1, 2.2, 6.1 & 6.2) (In Units I & II to include theorem statements only).
2. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., 3rd Edition, New Delhi. Unit III (Sec. 1.2, 1.5, 1.7, 1.11, 1.13, 1.14), Unit IV (Sec. 4.1, 4.2, 4.3, 4.6), Unit V(Sec. 5.1, 5.2, 5.3, 5.4, 5.5).

REFERENCES:

1. Strang G., "Linear Algebra and its applications", Thomson (Brooks/Cole), New Delhi, 2005.
2. Lay D. C., "Linear Algebra and its Applications", 5th Edition, Pearson Education, 2015.

3. Kumaresan S., "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.
4. James G., "Advanced Modern Engineering Mathematics", Pearson Education, 2007.
5. O'Neil, P.V., "Advanced Engineering Mathematics", Cengage Learning, 2011.

WEB RESOURCES

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/
2. https://nptel.ac.in/courses/111/106/111106135/
3. https://nptel.ac.in/courses/111/103/111103021/

ONLINE RESOURCES:

1. https://www.khanacademy.org/math/linear-algebra
2. https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/
3. https://freevideolectures.com/course/3244/advanced-engineering-mathematics

OUTCOMES:

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

1. Identify a vector space, subspace and construct the basis and dimension of a vector space. (K3)
2. Compute the rank and nullity of a linear transformation and construct an orthonormal basis using the Gram Schmidt orthogonalization process. (K3)
3. Solve first order linear partial differential equations and higher order homogeneous and non - homogeneous partial differential equations. (K3)
4. Find Fourier transforms and Fourier sine and cosine transforms of simple functions. (K3)
5. Solve difference equations using Z-transforms. (K3)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	-	1
CO2	3	3	2	1	1	-	-	-	-	-	-	1
CO3	3	3	2	1	1	-	-	-	-	-	-	1
CO4	3	3	2	1	1	-	-	-	-	-	-	1
CO5	3	3	2	1	1	-	-	-	-	-	-	1

SEMESTER - III

20EEPL301 SDG NO. 4&9	ANALOG AND DIGITAL CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To construct the characteristics of FET devices and to design a oscillator circuit
- To analyse the response of various digital circuits like Adder, subtractor, code converters, shift registers and counters
- To design and test the characteristics of timer, Op-amp and voltage regulator

LIST OF EXPERIMENTS :

1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice- versa.
3. Parity generator and parity checker
4. Encoders and Decoders
5. Counters: Design and implementation of 3-bit modulo counters as Asynchronous types using FF ICs and specific counter IC.
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
7. Study of multiplexer and de multiplexer
8. Timer IC application: Study of NE/SE 555 timer in Astable and Monostable mode operations.

9. Application of Op-Amp: inverting and non-inverting amplifier, Integrator and Differentiator.
10. Variability Voltage Regulator using IC LM317.
11. ExperimentalCharacterizationofMOSFET, BJT, PN diode.
12. ExperimentaldesignofRCphaseshiftoscillator using BJT.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl No.	Name of the equipment / component	Quantity	Remarks
1	Dual,(0-30V)variable Power Supply	10	-
2	CRO	9	30MHz
3	Digital Multimeter	10	Digital
4	Function Generator	8	1MHz
5	IC Tester (Analog)	2	
6	Breadboard	10	
7	Computer(PSPICE installed)	1	
8	IC741/ICNE555/566/565		
9	Digital IC types		
10	LED		
11	LM317		
13	ICSG3524/SG3525		
14	Transistor-2N3391		
15	Diodes,IN4001,BY126		
16	Zener diodes		
17	Potentiometer		
18	Step-downtransformer230V/12-0-12V		
19	Capacitors		
20	JFET semiconductor device		
21	Storage Oscilloscope		
22	Resistors		
23	Single Strand Wire		
24	Consumables (Sufficient quantity)		

OUTCOMES:

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

1. Derive the logical expression and execute the combinational logic circuits. (K5)
2. Realize the operation of flip-flops and design the sequential logic circuits. (K4)

3. Design the timer in astable and monostable mutivibrator using the appropriate IC. (K6)
4 Evaluate the necessary parameter to design the analog circuits. (K5)
5 Infer the characteristics of electronic devices like diode, BJT and MOSFET. (K2)
6 Analyze the applications of different electronics devices by conducting suitable experiments. (K4)

CO- PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	-	-	-	-	-	-	3	3
CO2	2	3	3	3	2	2	-	-	-	-	-	-	3	3
CO3	1	2	3	3	3	2	-	-	-	-	-	-	2	2
CO4	1	2	3	3	3	2	-	-	-	-	-	-	2	2
CO5	-	1	2	1	3	2	-	-	-	-	-	-	-	-
CO6	2	2	3	3	3	1	-	-	-	-	-	-	3	3

SEMESTER - III

20EEPL302 SDG NO. 4	DC MACHINES AND TRANSFORMERS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

To expose the students to the following experimental skills

- Performing load tests on DC Generators / DC Motors
- Conducting tests in Transformers to determine equivalent circuit and separate the no-load losses
- Different types of starters for DC Motors

LIST OF EXPERIMENTS:

1. Open circuit and load characteristics of DC shunt generator - critical resistance and critical speed.
2. Load characteristics of DC compound generator with differential and cumulative connections.
3. Load test on DC shunt motor.
4. Load test on DC compound motor.

5. Load test on DC series motor.
6. Swinburne's test and speed control of DC shunt motor.
7. Hopkinson's test on DC motor – generator set.
8. Load test on single-phase transformer.
9. Open circuit and short circuit tests on single phase transformer.
10. Sumpner's test on single phase transformers.
11. Separation of no-load losses in single phase transformer.
12 Study of starters for DC motors.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	DC Shunt Motor with Loading Arrangement	– 3nos
2.	Single Phase Transformer	– 4nos
3.	DC Series Motor with Loading Arrangement	– 1 No.
4.	DC compound Motor with Loading Arrangement	– 1 No.
5.	DC Shunt Motor Coupled With DC Compound Generator	– 2nos
6.	DC Shunt Motor Coupled With DC Shunt Generator	– 2nos
7.	Tachometer -Digital/Analog	– 8nos
8.	Single Phase Auto Transformer	– 2nos
9.	Single Phase Resistive Loading Bank	– 2nos

OUTCOMES:

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

1. Practice the performance of DC Machines by conducting direct load test experimentally. (K3)
2. Analyze the performance of transformer by conducting suitable test experimentally. (K4)
3. Compare the performance characteristics obtained experimentally on various DC machines and select suitable DC machines for industrial applications. (K4)
4. Predict the performance characteristics of the transformer by conducting open circuit and short circuit tests (K4)
5. Discuss the operating principle of different types of starters in DC Motor (K2)

CO- PO,PSO MAPPING :

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

SEMESTER - III

20EETE301 SDG NO. 4,11,15	LIVE-IN-LAB - I	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To provide opportunities for the students, expose to Industrial environment and real time work
- To enable hands-on experience in the electronics hardware/Software domain
- To enable development of skill set for designing and realizing prototype electronic systems/simulation model

COURSE METHODOLOGY

- This initiative is designed to inculcate ethical principles of research and to get involve in life-long learning process for the students.
- The project work must involve engineering design with realistic constraints. It must also include appropriate elements of the following: Engineering standards, design analysis, modeling, simulation, experimentation, prototyping, fabrication, correlation of data, and software development.
- Project can be individual work or a group project, with maximum of 3 students. In case of group project, the individual project report of each student should specify the individual's contribution to the group project.
- On completion of the project, the student shall submit a detailed project report. The project should be reviewed and the report shall be evaluated and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

EVALUATION

- First evaluation (Immediately after first internal examination) : 20 marks
- Second evaluation (Immediately after second internal examination): 30marks
- Final evaluation Last week of the semester) : 50marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade

TOTAL: 45 PERIODS

OUTCOMES:

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

1. List the problems and conduct literature survey to identify the gap and come up with an application oriented research problem in the specific domain.(K1)
2. Understand the project characteristics and explore necessary tools and components needed at various stages of the project(K2)
3. Design and validate the proposed system using simulation.(K3)
4. Develop the Prototype of the proposed system by adapting Industrial safety standards and best financial management practices(K5)
5. Analyze the obtained results and prepare a technical report.(K4)
6. Evaluate the project and go for journals and patents publication.(K5)

CO- PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO4	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO5	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO6	2	2	2	1	2	1	1	1	3	2	3	3	3	2

SEMESTER - III

20EETP301 SDG NO. 4	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

APTITUDE & COGNITIVE SKILLS – PHASE 1

COURSE OBJECTIVE:

- To educate and enrich the students on quantitative ability, reasoning ability, and verbal ability.

UNIT I QUANTITATIVE ABILITY – I **6**

Problems on Trains - Time and Distance - Height and Distance - Time and Work.

UNIT II QUANTITATIVE ABILITY – II **6**

Problems on Ages - Alligation or Mixture - Chain Rule - Simple Interest - Simple Equation - Theory Of Equation.

UNIT III REASONING ABILITY – I **6**

Analytical Reasoning - Pipes and Cistern - Logical Problems - Logical Games - Logical Deduction - Data Sufficiency - Arithmetic Reasoning.

UNIT IV VERBAL ABILITY – I **6**

Idioms & Phrases - Synonyms - Antonyms - Classification.

UNIT V CREATIVITY ABILITY – I **6**

Venn Diagrams, Cube and Cuboids, Dice, Cubes and Dice, Figure Matrix

TOTAL : 30 PERIODS

REFERENCES:

1) R. S. Agarwal, "Quantitative Aptitude for Competitive Exams"
2) Sarvesh Verma, "Quantum CAT"
3) R. S. Agarwal, "A Modern Approach to Logical Reasoning"
4) Arun sharma, "Verbal Ability and Reading Comprehension"

PROBLEM SOLVING USING C PROGRAMMING AND INTRODUCTION TO MATLAB & PSPICE

COURSE OBJECTIVE:

- The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves a lab component which is designed to give the student hands-on experience with the concepts.

UNIT I INTRODUCTION TO PRINCIPLES OF PROGRAMMING 6

Introduction to Programming - Programing Domain : Artificial Intelligence-Systems Programming - Assembly Level Languages - Problem solving using Algorithms and Flowcharts.

UNIT II INTRODUCTION TO C PROGRAMMING 6

Features of C and its Basic Structure - Simple C programs - Constants - Integer Constants - Real Constants - Character Constants - String Constants Floating-point Numbers - The type cast Operator - Interactive Programming.

Operators Expressions and Control statement - The goto statement - The if statement - The if-else statement - Nesting of if statements - The conditional expression - The break statement and continue statement.

UNIT III ARRAYS, STRINGS AND POINTERS 6

Arrays - Multidimensional Arrays - Strings, Basics of Pointers - Pointer Arithmetic - Similarities between Pointers and One-dimensional Arrays Structures - Unions And Functions - Basics of Structures - Arrays of Structures - Pointers to Structures - Function Basics - Function Prototypes and Passing Parameters - Structures and Functions Recursion.

UNIT IV INTRODUCTION TO MATLAB 6

Introduction, Basic features, Starting MATLAB, Using MATLAB as a calculator, Creating MATLAB variables, Overwriting variable, Error messages, Making corrections, Controlling the hierarchy of operations or precedence, Controlling the appearance of floating point number, Managing the workspace Entering multiple statements per line, Miscellaneous commands, Exercises.

UNIT V INTRODUCTION TO PSPICE 6

Introduction - Installation - Preparing a circuit for simulation - Simulation using PSPICE Bias point details - DC sweep analysis - AC sweep analysis - Transient analysis - Frequency response.

TOTAL : 30 PERIODS

REFERENCES:

1. Programming in ANSI C - Balagurusamy - Tata McGraw-Hill Education, 2008
2. Programming in C (3rd Edition), by Stephen G. Kochan, Sams, 2004
3. Programming in C - Stephen G. Kochan, III Edition, Pearson Education.
4. Modeling and Simulation of Systems Using MATLAB and Simulink, Devendra K. Chaturvedi, CRC Press, 2010, ISBN 10: 1439806721
5. Learning to Program with MATLAB: Building GUI Tools,Wiley, 2013, ISBN 10: 0470936444
6. SPICE A Guide to Circuit Simulation and Analysis using Pspice, Tuinenga, Paul W. Prentice Hall PTR, 1992,
7. PSpice: a tutorial, Prentice Hall College Div, L. H. Fenical, 1992, ISBN 10: 0136811493

ONLINE RESOURCES

1. https://matlabacademy.mathworks.com/
2. https://www.tutorialspoint.com/matlab/index.htm
3. https://medium.com/quick-code/top-tutorials-to-learn-matlab-for-beginners-d19549ecb7b7
4. https://nptel.ac.in/courses/103/106/103106118/
5. https://www.youtube.com/watch?v=s4BuSwdT0j0
6. https://www.youtube.com/watch?v=6R_cf-QdLYs

WEB RESOURCES

1. https://www.mathworks.com/academia/books.html
2. https://in.mathworks.com/support/learn-with-matlab-tutorials.html
3. https://www.seas.upenn.edu/~jan/spice/PSpice_UserguideOrCAD.pdf

COURSE OUTCOMES :

Upon completion of this course, the students should be able to:

1. Analyze their quantitative ability. (K4)
2. Understand the ability of arithmetic reasoning along with creative thinking and problem solving skills. (K2)
3. Create their verbal ability through vocabulary building and grammar. (K6)
4. Evaluate the situations to analyse the computational methods in order to identify and abstract the programming task involved. (K5)
5. Apply working knowledge of MATLAB/ SCI LAB package to simulate and solve Electrical and Electronics Applications(K3)
6. Develop the knowledge of Electrical based system design using PSPICE (K6)

CO- PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO2	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO3	-	-	-	-	3	2	-	-	1	3	-	2	-	-
CO4	-	-	-	-	3	2	-	3	3	3	-	2	2	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2	2	2
CO6	-	-	-	-	3	2	-	-	2	3	-	2	2	2

SEMESTER - III

20MGMC301 SDG NO. 4	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

At the end of the course, the student is expected to

- To know about Indian constitution
- To know about central government functionalities in India
- To know about state government functionalities in India
- To know about Constitution function
- To Know about Constitutional remedies

UNIT I INTRODUCTION 6

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties

UNIT II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT 6

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India.

UNIT III STRUCTURE AND FUNCTION OF STATE GOVERNMENT 6

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV CONSTITUTION FUNCTIONS 6

Indian Federal System – Centre – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries.

UNIT V CONSTITUTIONAL REMEDIES 6

Enforcement of fundamental rights - Power of parliament to modify the rights the conferred by this part in their application to forces.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.
2. R.C. Agarwal, (1997) "Indian Political System", S. Chand and Company, New Delhi.
3. M.V. Pyle (2019) , "An Introduction to The Constitution of India, 5/e", Vikas Publishing, New Delhi.
4 P.M. Bakshi, (2018) , "Constitution of India", Universal Law Publishing, New Delhi.

REFERENCES:

1. Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi.
2. U.R.Gahai, "Indian Political System", New Academic Publishing House, Jalandhar.

OUTCOMES:

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

1. Explain the Constitution and Fundamental rights of citizens (K2)
2. Discuss the structure, hierarchy and functions of Central Government (K2)
3. Explain the functions of Supreme Court and Judiciary Systems in the state (K2)
4. Discuss the structure, hierarchy and functions of State Government (K2)
5. Recall the Centre-State relationship, constitutional amendments and functionaries (K1)
6. Discuss the remedies and rights available to India Citizens (K2)

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	-	-	-	-	-
CO2	-	-	-	-	-	1	1	-	-	-	-	-
CO3	-	-	-	-	-	1	1	-	-	-	-	-
CO4	-	-	-	-	-	1	1	-	-	-	-	-
CO5	-	-	-	-	-	2	1	3	-	-	-	-
CO6	-	-	-	-	-	2	1	2	3	-	-	-

SEMESTER - IV

20EEPC401 SDG NO. 4,7,11	SYNCHRONOUS AND INDUCTION MACHINES	L	T	P	C
		2	1	0	3

OBJECTIVES:

To impart knowledge on the following Topics

- Construction, Working principle and performance of Synchronous Generators and Synchronous motors
- Construction, Principle of operation and Performance of Three phase and Single phase Induction machines
- Starting and speed control of three-phase induction motors

UNIT I SYNCHRONOUS GENERATORS **6+3**

Constructional details – Types of rotors – EMF equation – Armature reaction – Voltage regulation – EMF, MMF, ZPF and A.S.A methods – Two reaction theory – Slip test -Synchronizing and Parallel operation.

UNIT II SYNCHRONOUS MOTORS **6+3**

Principle of operation – V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed - Hunting – damper windings- Synchronous condenser.

UNIT III THREE PHASE INDUCTION MOTORS **6+3**

Constructional details – Types of rotors –- Principle of operation – Slip – Torque Equation - Condition for maximum torque - Torque-Slip characteristics – Equivalent circuit - Losses and efficiency – Load test - No load and blocked rotor tests - Separation of losses – Induction generators .

UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTORS **6+3**

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star- delta starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded connection-V/f control – Slip power recovery scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

UNIT V SINGLE PHASE INDUCTION MOTORS **6+3**

Constructional details of single phase induction motors – Double field revolving theory – Equivalent circuit – No load and blocked rotor test – Starting

methods of single-phase induction motors – Capacitor-start capacitor run Induction motor-Shaded pole Induction Motor.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. J.B.Gupta, "Theory and Performance of Electrical Machines", S.K.Kataria & Sons , 15th Edition 2015.
2. B.L.Theraja and A.K.Theraja, "A Textbook of Electrical Technology", S.Chand, 2012.

REFERENCES

1. 1. P.S.Bimbhra, "Electrical Machinery", Khanna Publishers, 7th Edition, Reprint, 2013.
2. B.R. Gupta, "Fundamental of Electric Machines", New age International Publishers, 3rd Edition,Reprint 2015.
3. S.K. Bhattacharya, "Electrical Machines", McGraw - Hill Education, New Delhi,3rd Edition, 2009.
4. Nagrath, I.J. and Kothari.D.P., "Electric Machines", McGraw-Hill Education, 4th Edition, 2011.
5. Er.R.K.Rajput, "Electrical Machines ", Laxmi Publications, 6th Edition,2016.

WEB RESOURCES:

1. https://www.electricaleasy.com
2. https://www.electrical4u.com

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105131/
2. https://nptel.ac.in/courses/108/106/108106072/
3. https://www.sciencedirect.com
4. https://www.btechguru.com/engineering

OUTCOMES:

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

1. Describe the construction, principle, EMF equation, regulation methods, two reaction theory and parallel operation of synchronous generators. (K2)
2. Explain the principle of operation, torque developed, characteristics, hunting and starting methods of synchronous motors and its applications as synchronous condenser.(K2)

3. Illustrate about the construction, principle of operation and compute the performance characteristics, Torque equations of three phase Induction machine.(K3)
4. Describe the starting, speed control and braking methods of three phase Induction motors.(K2)
5. Discuss about the construction, principle of operation, starting methods and performance characteristics of single phase Induction motors.(K2)

CO- PO, PSO MAPPING:

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

SEMESTER - IV

20EEPC402 SDG NO.4 & 12	TRANSMISSION AND DISTRIBUTION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the structure of electric power system, types of substations, methods of grounding, EHVAC, HVDC and FACTS.
- To develop expressions for the computation of transmission line parameters, obtain the equivalent circuit for the transmission lines and determine the voltage regulation and efficiency.
- To understand the mechanical design of transmission lines and to analyze the voltage distribution in insulator strings to improve the efficiency.
- To study the construction and types of cables, methods of grading of cables and distribution system components.

UNIT I TRANSMISSION LINE PARAMETERS 9

Structure of Power System - 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 and transposition - application of self and mutual GMD; skin and proximity effects -Typical configurations and conductor types.

UNIT II MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9

Performance of Transmission lines - short line, medium line and long line - equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance - transmission efficiency and voltage regulation, real and reactive power flow in lines - Formation of Corona – Critical Voltages – Effect on Line Performance.

UNIT III MECHANICAL DESIGN OF LINES 9

Mechanical design of OH lines – Line Supports –Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading. Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

UNIT IV UNDER GROUND CABLES 9

Underground cables - Types of cables – Construction of single core and 3 core cables – Insulation Resistance – Potential Gradient-Capacitance of Single – core and 3 core cables-Grading of cables - Power factor and heating of cables – DC cables.

UNIT V DISTRIBUTION SYSTEMS 9

Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions - Techniques of Voltage Control and Power factor improvement – Distribution Loss –Types of Substations -Methods of Grounding – Trends in Transmission and Distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. C.L.Wadhwa, 'Electrical Power Systems', New Age International Publishers, 6th edition, 2018
2. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.

REFERENCES:

1. B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, Fifth Edition, 2008.
2. V.K.Mehta, Rohit Mehta, 'Principles of power system', S. Chand & Company Ltd, New Delhi,2013
3. D.P.Kothari, I.J. Nagarath, 'Power System Engineering', McGraw-Hill Publishing Company limited, New Delhi, Second Edition, 2019.
4. Luces M. Fualken berry, Walter Coffer,'Electrical Power Distribution and Transmission', Pearson Education, 2007.

WEB REFERENCES:

1. https://www.electrical4u.com/transmission-line-in-power-system
2. https://www.electricaleasy.com/2017/03/underground-power-cables.html
3. https://www.eeeguide.com/insulating-materials-for-underground-cables

ONLINE RESOURCES:

1. https://www.coursera.org/lecture/electric-power-systems/transmission-subtransmission-imo4x
2. https://martechmedia.com/index.php/technical-elearning/course-catalog/electrical-distribution/

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Compute the line parameters in single and three phase power transmission system. (K3)
2. Model different types of transmission line to illustrate the power flow and effects on line performance.(K3)
3. Identify the sag and voltage distribution in the insulator strings.(K3)
4. Construct the cable and develop the expression for cable parameters.(K3)
5. Solve DC / AC distribution problems and identify recent trends in transmission and distribution systems.(K3)

CO- PO, PSO MAPPING:

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

SEMESTER - IV

20EEPC403 SDG NO. 4, 9&11	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic functional elements of instrumentation and fundamentals of electrical and electronic instruments
- To understand the comparison between various measurement techniques
- To impart knowledge on various storage, display devices and to understand the working of various transducers and the data acquisition systems

UNIT I INTRODUCTION **9**

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration- Principle and types of analog and digital voltmeters, ammeters.

UNIT II ELECTRICAL AND ELECTRONIC INSTRUMENTS **9**

Principle and types of multimeters – Single and three phase wattmeters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III COMPARATIVE METHODS OF MEASUREMENTS **9**

D.C potentiometers, D.C Bridges (Wheat stone, Kelvin and Kelvin Double bridge) & A.C bridges (Maxwell, Anderson and Schering bridges), transformer

ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic Interference –Grounding techniques.

UNIT IV STORAGE AND DISPLAY DEVICES 9

Digital plotters and printers, CRT display, digital CRO, digital storage oscilloscope, Mixed Storage Oscilloscope, PQ Analyser, LED, LCD display – Data Loggers.

UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart sensors-Thermal Imagers.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. A.K. Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", DhanpatRai and Co, 2018
2. Doebelin E.O. and Manik D.N., "Measurement Systems – Applications and Design", Special Indian Edition, McGraw Hill Education Pvt. Ltd., 2007.

REFERENCES :

1. H.S. Kalsi, "Electronic Instrumentation", McGraw Hill, III Edition 2010.
2. D.V.S. Murthy, "Transducers and Instrumentation", Prentice Hall of India Pvt Ltd, 2015.
3. J. B. Gupta, "A Course in Electronic and Electrical Measurements", S. K. Kataria& Sons, Delhi, 2013.

WEB RESOURCES:

1. https://electrical4u.in/electrical-measurements/
2. https://www.electrical4u.com/electrical-measuring-instruments-types-accuracy-precision-resolution-speed/
3. https://www.electricaleasy.com/2014/06/instrument-transformers-ct-and-pt.html

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108105153
2. https://swayam.gov.in/nd1_noc19_ee44/preview

OUTCOMES:

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

1. Apply the basic concepts in instrumentation like functional elements of an instrument, standards, characteristics, calibration and Errors in instruments.(K2)
2. Extend the basic concepts of instrumentation to illustrate the working of electrical, electronic instruments and magnetic Measurements.(K2)
3. Construct bridges to measure the electrical quantities like resistance, inductance and capacitance. (K3)
4. Summarize various grounding techniques, interferences and screening methods. (K2)
5. Describe various storage and display devices. (K2)
6. Explain the working and applications of various transducers including data acquisition system, thermal imagers. (K2)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	1	1	-	1	-	-	-	-	2	2	2	2
CO2	2	1	1	1	-	1	-	-	-	-	2	2	2	2
CO3	2	2	2	2	-	1	-	-	-	-	2	2	2	2
CO4	2	-	1	1	-	1	-	-	-	-	2	2	2	2
CO5	2	1	1	1	-	1	-	-	-	-	2	2	2	2
CO6	2	-	1	2	2	1	-	-	-	-	2	2	2	2

SEMESTER - IV

20EEPC404 SDG NO. 4	CONTROL ENGINEERING	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand the use of transfer function models for analysis physical systems and introduce the control system components
- To provide adequate knowledge in the time response of systems and steady state error analysis
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems

- To introduce stability analysis for Electrical, Mechanical systems
- To introduce design of Compensator
-

UNIT I MATHEMATICAL MODELING OF SYSTEMS 12

Open loop and Closed loop systems - Physical system - Linear and Non - linear systems - Transfer function - Mathematical modeling of electrical and mechanical systems - Analogous systems - Effect of feedback on system sensitivity - Block diagram representation - Signal flow graphs and their properties - Mason's gain formula. Control system components: Potentiometer and DC servomotors.

UNIT II TIME DOMAIN ANALYSIS 12

Standard test signals - Time response of first order and second order feedback control systems to step input - Time domain specifications - Steady state error - Static error constants - Dynamic error coefficients - System response with additional poles and zeros -Introduction to P, PI, PID modes of feedback control

UNIT III STABILITY ANALYSIS 12

Concept of Stability - Necessary conditions for stability - Routh Hurwitz criterion - Relative Stability Analysis. Root locus: Concepts of root locus - Construction of root locus - Determination of open loop gain for a specified damping of the dominant roots.

UNIT IV FREQUENCY DOMAIN ANALYSIS 12

Frequency domain specifications – Correlation between frequency domain and time domain specifications - Bode plot – Polar plot – Determination of closed loop response from open loop response- Nyquist stability criterion.

UNIT V DESIGN OF FEED BACK CONTROL SYSTEMS 12

Design specifications: Lead, Lag and Lag-Lead compensators using Root locus and Bode plot techniques.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017. (Unit I – V)
2. Benjamin C. Kuo, "Automatic Control Systems", Wiley,2014.(Unit I – V)

REFERENCES:

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson,2015.
2. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education, 2009.
3. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor & Francis Reprint, 2009.
4. RamesC.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House,2017.
5. M.Gopal, "Control System: Principle and design", McGraw Hill Education,2012.
6. Prof. S. D. Agashe, "Control Engineering", NPTEL Video Lecture Notes, IIT Bombay.

ONLINE RESOURCES:

1. https://freevideolectures.com/course/5301/dynamics-and-control
2. https://freevideolectures.com/course/2337/control-engineering

WEB RESOURCES:

1. https://swayam.gov.in/nd1_noc20_ee13/preview
2. https://nptel.ac.in/courses/107106081/
3. https://www.tutorialspoint.com/control_systems/index.htm

OUTCOMES:

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

1. Derive the mathematical model of electrical, mechanical systems and determine/reduce the transfer function for the system using block diagram reduction and signal flow graph methods.(K3)
2. Determine the time response and specifications of I and II order systems for standard test inputs.(K3)
3. Determine the stability of a system using root locus, Routh Hurwitz and Nyquist stability criterion.(K3)
4. Determine the frequency response specifications and construct bode plot, polar plot for determining stability and establish the correlation between time and frequency domains. (K3)
5. Apply bode plot and root locus for the design of controllers and compensators.(K3)

CO- PO, PSO MAPPING:

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

SEMESTER - IV

20BSMA403 SDG NO. 4	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To identify small, large samples and apply testing of hypothesis
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems
- To introduce the basic concepts of solving algebraic and transcendental equations
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines
- To introduce the knowledge of various techniques and methods of solving ordinary differential equations

UNIT I TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F-distributions for mean, variance and proportion - Contingency table (test for independence) - Goodness of fit.

UNIT II DESIGN OF EXPERIMENTS 12

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices .

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 12

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Single step methods : Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Multi step methods : Milne's and Adams - Bashforth predictor corrector methods for solving first order equations. Solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by Crank Nicholson method – One dimensional wave equation by explicit method.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Grewal. B.S. and Grewal. J.S., “Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., “Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES

1. Burden, R.L and Faires, J.D, "Numerical Analysis”, 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis” Pearson Education, Asia, New Delhi, 2006.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., “Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.

WEB RESOURCES:

1. https://www.classcentral.com/course/swayam-numerical-analysis-17709
2. https://online-learning.harvard.edu/course/statistics-and-r?delta=1

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3057/numerical-methods-and-computation
2. https://nptel.ac.in/courses/111107105/
3. https://www.maths.unsw.edu.au/courses/math2089-numerical-methods-and-statistics

OUTCOMES:

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

1. Apply statistical techniques for testing of hypothesis of small and large samples. (K3)
2. Perform Analysis of Variance (ANOVA) in the Design of Experiments. (K3)
3. Provide numerical solution for Algebraic equations, Transcendental equations and Eigen value problems. (K3)
4. Apply Numerical techniques to interpolate data and find Numerical Differentiation and Integration. (K3)
5. Solve Ordinary and Partial Differential equations using numerical techniques. (K3)

CO- PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	-	1
CO2	3	3	2	1	1	-	-	-	-	-	-	1
CO3	3	3	2	1	1	-	-	-	-	-	-	1
CO4	3	3	2	1	1	-	-	-	-	-	-	1
CO5	3	3	2	1	1	-	-	-	-	-	-	1

SEMESTER - IV

20EEPL401 SDG NO. 4,7,11	SYNCHRONOUS AND INDUCTION MACHINES LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To expose the students to the operation of synchronous machines and induction motors and give them experimental skill

LIST OF EXPERIMENTS:

1. Regulation of three phase alternator by EMF and MMF methods.
2. Regulation of three phase alternator by ZPF and ASA methods.
3. Regulation of three phase salient pole alternator by slip test.
4. Measurements of negative sequence and zero sequence impedance of alternators.
5. V and Inverted V curves of Three Phase Synchronous Motor.
6. Load test on three-phase induction motor.
7. No load and blocked rotor tests on three-phase induction motor (Determination of equivalent circuit parameters).
8. Separation of No-load losses of three-phase induction motor.
9. Load test on single-phase induction motor.
10. No load and blocked rotor test on single-phase induction motor.
11. Study of Induction motor Starters

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. DC Shunt Motor Coupled With Three phase Alternator – 4nos
2. DC Shunt Motor Coupled With Three phase Slip ring Induction motor – 1No.
3. Three Phase Induction Motor with Loading Arrangement – 2nos
4. Single Phase Induction Motor with Loading Arrangement – 2nos
5. Tachometer -Digital/Analog – 8nos
6. Single Phase Auto Transformer – 2nos
7. Three Phase Auto Transformer – 3nos
8. Single Phase Resistive Loading Bank – 2nos
9. Three Phase Resistive Loading Bank – 2nos

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Analyze EMF and MMF methods.(K4)
2. Analyze the characteristics of V and Inverted V curves.(K4)
3. Inspect the importance of synchronous machines.(K4)
4. Examine the importance of induction machines.(K4)
5. Evaluate separation of losses.(K5)
6. Classify the starting methods of AC machines.(K4)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	1	-	-	1	1	1	1	3	3	2
CO2	3	3	2	2	1	-	-	-	1	1	1	2	3	2
CO3	3	3	3	3	1	-	-	1	1	1	3	1	3	2
CO4	3	3	3	3	1	-	-	1	1	1	3	1	3	2
CO5	3	3	2	2	1	-	-	-	1	1	1	2	3	2
CO6	3	3	2	2	1	-	-	-	1	1	1	2	3	2

SEMESTER - IV

20EEPL402 SDG NO. 4 & 9	CONTROL ENGINEERING AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To provide knowledge on analysis of control system with controllers and compensators
- To provide knowledge on the design of control system with basics of instrumentation.
- To provide knowledge on instrumentation systems form various types of bridges and signal conditioning components

LIST OF EXPERIMENTS:

CONTROL SYSTEMS:

1. P, PI and PID controllers
2. Stability Analysis

3. Modeling of Systems – Machines, Sensors and Transducers
4. Design of Lag, Lead and Lag-Lead Compensators
5. Position Control Systems
6. Synchro -Transmitter- Receiver and Characteristics
7. Simulation of Control Systems by Mathematical development tools.

INSTRUMENTATION:

8. Bridge Networks –AC and DC Bridges
9. Dynamics of Sensors/Transducers
   a. Temperature b. Pressure c. Displacement d. Optical e. Strain f. Flow
10. Power and Energy Measurement
11. Signal Conditioning a. Instrumentation Amplifier b. Analog – Digital and Digital –Analog converters (ADC and DACs)
12. Process Simulation.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	PID controller simulation and learner kit	– 1 No.
2.	Digital storage Oscilloscope for	- 3 Nos
3.	DC motor –Generator test set-up	-1 No
4.	CRO 30MHz	– 5 Nos
5.	Function Generator 2 MHZ	–5 Nos
6.	Position Control Systems Kit – 1 No., Tacho Generator Couplingset	- 1 No
7.	AC Synchro transmitter& receiver	–1 No
8.	Stepper motor	– 1 No
	Digital multi meters	- 15 Nos
	Speed and torque sensors	-5 Nos
9.	Personal computers with control system simulation package	- 10 Nos

OUTCOMES:

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

1 Understand control theory and apply them to electrical engineering problems. (K3)
2. Analyze the various types of converters. (K4)
3. Design various compensators and analyse the stability. (K6)
4. Verify the concepts of bridge networks. (K5)
5. Analyse and design signal conditioning circuits. (K3)
6. Study the simulation packages. (K3)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	2	1	1	1	-	-	-	3	3
CO2	2	2	2	2	1	1	1	-	-	-	-	-	3	3
CO3	2	1	1	1	1	1	1	-	-	-	-	-	3	3
CO4	2	1	1	1	1	1	1	-	-	-	-	-	3	3
CO5	2	2	2	1	1	1	1	1	-	-	-	-	3	3
CO6	2	2	3	3	1	1	1		--	-	-	-	3	3

SEMESTER - IV

20EETE401 SDG NO.4,11,15	LIVE-IN-LAB - II	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To provide opportunities for the students, expose to Industrial environment and real time work
- To enable hands-on experience in the electronics hardware/Software domain
- To enable development of skill set for designing and realizing prototype electronic systems/simulation model

COURSE METHODOLOGY

- This initiative is designed to inculcate ethical principles of research and to get involve in life-long learning process for the students.
- The project work must involve engineering design with realistic constraints. It must also include appropriate elements of the following: Engineering standards, design analysis, modeling, simulation, experimentation, prototyping, fabrication, correlation of data, and software development.
- Project can be individual work or a group project, with maximum of 3 students. In case of group project, the individual project report of each student should specify the individual's contribution to the group project.
- On completion of the project, the student shall submit a detailed project report. The project should be reviewed and the report shall be evaluated and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

EVALUATION

- First evaluation (Immediately after first internal examination) : 20 marks
- Second evaluation (Immediately after second internal examination): 30marks
- Final evaluation Last week of the semester) : 50marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Conduct literature survey to identify the gap and an application oriented research problem in the specific domain(K4)
2. Design and validate the proposed system using simulation(K6)
3. Prototype the proposed system(K5)
4. Analyze the obtained results and prepare a technical report(K4)
5. Publish the work in journals and apply for the patents.(K3)
6. Prepare for industrial environment and real time work(K3)

CO- PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO4	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO5	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO6	2	2	2	2	3	2	2	2	2	2	3	3	3	3

SEMESTER - IV

20EETP401 SDG NO. 4	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

PROBLEM SOLVING SKILLS – PHASE 1

COURSE OBJECTIVE:

- Improve their quantitative ability.
- Improve their reasoning ability.
- Enhance their verbal ability through vocabulary building and grammar
- Equip with creative thinking and problem solving skills

UNIT I QUANTITATIVE ABILITY – III **6**

Compound Interest - Profit and Loss - Partnership - Percentage - Set Theory

UNIT II QUANTITATIVE ABILITY – IV **6**

True Discount - Ratio and Proportion - Simplification - Problems on H.C.F and L.C.M

UNIT III REASONING ABILITY – II **6**

Course of Action - Cause and Effect - Statement and Conclusion - Statement and Argument - Data Sufficiency (DS) - Statement and Assumption - Making Assumptions.

UNIT IV VERBAL ABILITY – II **6**

Change of Voice - Change of Speech - Letter and Symbol Series - Essential Part - Verbal Reasoning - Analyzing Arguments.

UNIT V CREATIVITY ABILITY – II **6**

Seating Arrangement - Direction Sense Test - Character Puzzles - Missing Letters Puzzles - Mirror &Water Images.

TOTAL : 30 PERIODS

REFERENCES:

1) R. S. Agarwal, "Quantitative Aptitude for Competitive Exams"
2) Sarvesh Verma, "Quantum CAT"
3) R. S. Agarwal, "A Modern Approach to Logical Reasoning"
4) Arun sharma, "Verbal Ability and Reading Comprehension"

ADVANCED C PROGRAMMING AND INTRODUCTION TO ETAP & PSCAD - PHASE 2

COURSE OBJECTIVE:

- The course is oriented to those who want to advance structured and procedural programming understating and to improve C programming skills. The major objective is to provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.

UNIT I INTRODUCTION TO RECURSION AND GROWTH FUNCTIONS **6**

Introduction to Recursion - Recurrence Relation - Deriving time complexity and space complexity using recurrence relation Polynomial Equations - Compare growth functions - Nth Fibonacci Number - Exponent Function - Taylor Series - Tower of Hanoi.

UNIT II STORAGE CLASSES, THE PREPROCESSOR AND DYNAMIC MEMORY ALLOCATION **6**

Storage Classes and Visibility - Automatic or local variables - Global variables - Macro Definition and Substitution - Conditional Compilation - Dynamic Memory Allocation - Allocating Memory with malloc and callo Allocating Memory with calloc - Freeing Memory - The Concept of linked list - Inserting a node by using Recursive Programs - Deleting the Specified Node in a Singly Linked List.

UNIT III FILE MANAGEMENT AND BIT MANIPULATION **6**

Defining and Opening a file - Closing Files - Input/output Operations on Files - Predefined Streams - Error Handling during I/O Operations - Random Access to Files - Command Line Arguments - The hexadecimal number system - C bitwise operators - How to generate all the possible subsets of a set - Tricks with Bits - Applications of bit operations.

UNIT IV Advanced Level Programming Using MATLAB **6**

Determination of current and voltage flow in an electrical circuit ,computation of line parameter in an electrical circuit, determination of transfer function of a mechanical system and electrical system, stability analysis of a system

UNIT V MATLAB AND SIMULINK TOOLBOX **6**

Introduction SIMULINK tool box - blocks - Systems and sub-systems - Solving a model - MATLAB SIMULINK for power systemmodelling- Simulating control system tool box

TOTAL : 30 PERIODS

REFERENCES:

1. R. G. Dromey, "How to Solve It By Computer", Pearson, 1982
2. A.R. Bradley, "Programming for Engineers", Springer, 2011
3. Kernighan and Ritchie, "The C Programming Language", (2nd ed.) Prentice Hall, 1988
4. Power systems analysis illustrated with MATLAB and ETAP,Madhusudan, Shertukde ,Hemchandra, 2019, ISBN 10:0429792425

ONLINE RESOURCES

1. https://www.youtube.com/watch?v=k94A5cbmDes
2. https://www.youtube.com/watch?v=qGiKv3-02vw

WEB RESOURCES

1. https://onlinecourses.nptel.ac.in/noc20_ge05/preview
2. https://www.mathworks.com/content/dam/mathworks/mathworks-dot-com/campaigns/portals/files/intel/may-12-2015-advanced-matlab.pdf

COURSE OUTCOMES :

Upon completion of this course, the students should be able to:

1. Analyze their quantitative ability. (K4)
2. Understand the ability of arithmetic reasoning along with creative thinking and problem solving skills. (K2)
3. Create their verbal ability through vocabulary building and grammar. (K6)
4. Evaluate code organization and functional hierarchical decomposition with complex data types. (K5)
5. Apply matlab programming to solve various Power System problems. (K3)
6. Develop the knowledge on Power System based design using MATLAB and SIMULINK Tool Box . (K6)

CO- PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO2	-	-	-	-	3	2	-	3	2	3	-	2	-	-
CO3	-	-	-	-	3	2	-	-	1	3	-	2	-	-
CO4	-	-	-	-	3	2	-	3	3	3	-	2	2	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2	2	2
CO6	-	-	-	-	3	2	-	-	2	3	-	2	2	2

SEMESTER - V

20EEPC501 SDG NO. 4, 7	POWER SYSTEM ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To model the power system under steady state operating condition
- To apply efficient numerical methods to solve the power flow problem
- To model and carry out short circuit studies on power system
- To model and analyze stability problems in power system

UNIT I INTRODUCTION **9**

Need for system planning and operational studies – Modeling of Power System Components – Single line diagram – per unit quantities – p.u. impedance diagram – p.u. reactance diagram – Primitive Network - Incident Matrices - Formation of bus admittance matrix (Y_{BUS}) - Direct Inspection method and Singular transformation methods - Formation of bus impedance matrix (Z_{BUS}) without mutual coupling.

UNIT II POWER FLOW ANALYSIS **9**

Importance of power flow analysis-Bus classification – Load flow equations – Load flow solutions – Gauss-Seidel method – Handling of Voltage controlled buses - Newton-Raphson method - Computation of slack bus power and transmission line losses.

UNIT III SYMMETRICAL FAULT ANALYSIS **9**

Assumptions in short circuit analysis- Types of faults – Short circuit current calculation using Thevenin's theorem and Bus Impedance matrix – Short circuit capacity – Selection of circuit breakers.

UNIT IV UNSYMMETRICAL FAULT ANALYSIS **9**

Symmetrical components – Sequence impedances – Sequence network of power system components: Synchronous machines, Transmission line, Transformer and Loads – Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG – Unsymmetrical fault analysis using bus impedance matrix.

UNIT V STABILITY ANALYSIS **9**

Classification of power system stability – Rotor angle stability – Swing equation – Swing curve – Power Angle equation – Equal area criterion – Critical

clearing angle and time – Classical step-by-step solution of the swing equation – modified Euler method.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John J. Grainger, William D. Stevenson, Jr, "Power System Analysis",Mc Graw Hill Education (India) Private Limited, New Delhi, 2017.
2. Nagarath I.J., Kothari D.P. "Modern Power System Analysis", Fourth Edition, Tata Mc Graw Hill Publishing Company, New Delhi, 2011.

REFERENCES:

1. Pai M.A. "Computer Techniques in Power System Analysis", Tata Mc Graw Hill Publishing Company, New Delhi, 2003.
2. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Education Pvt.Ltd., New Delhi, 21st reprint, 2010.
3. Abhijit Chakrabarti,Sunita Halder,"Power System Analysis Operation and Control",PHI Learning Private Limited, New Delhi, 2011.
4. J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, "Power System Analysis & Design", Fifth Edition, Cengage Learning India Private Limited , 2012.
5. Gupta B.R., "Power System Analysis and Design", Eighth Edition, S. Chand & Co.Publishing Ltd, New Delhi, 2011.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108105067/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/2353/power-systems-analysis

OUTCOMES:

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

1. Build the power system models based on admittance and impedance matrices for power networks. (K3)
2. Develop the input data required for load flow calculation and select the most appropriate algorithm. (K3)
3. Solve the power system network under Symmetrical Conditions and select the circuit breaker ratings. (K3)
4. Make use of symmetrical components for analyzing the unbalanced faults. (K3)
5. Apply different numerical integration methods for factors influencing the stability. (K3)

CO- PO, PSO MAPPING:

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

SEMESTER - V

20EEPC502 SDG NO. 4 & 7	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn different types of power semiconductor devices, operation, characteristics, performance parameters of controlled rectifiers.
- To know the operation, switching techniques and basic topologies of Chopper switching regulators, and different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study various AC- AC converters such as AC Voltage controller, Cyclo converter and Matrix converter.

UNIT I POWER SEMICONDUCTOR DEVICES **9**

Study of switching devices - SCR, TRIAC, GTO, IGBT and MOSFET - Static and Dynamic Characteristics – SCR, MOSFET and IGBT - Triggering, commutation and snubber circuits for SCR. Introduction to Driver Circuits.

UNIT II PHASE-CONTROLLED CONVERTERS **9**

2-pulse, 3-pulse and 6-pulse converters – Performance parameters - Effect of source inductance - Dual converters - Applications- Light dimmer system.

UNIT III DC TO DC CONVERTERS **9**

Step-down and step-up chopper-control strategy– Introduction to types of choppers-A, B, C, D and E -Switched mode regulators- Buck, Boost, Buck- Boost regulators, Applications-Battery operated vehicles.

UNIT IV INVERTERS **9**

Single phase and three phase voltage source inverters (both120 degree mode and 180 degree mode)– Voltage& harmonic control--PWM techniques: Multiple PWM, Sinusoidal PWM, Modified Sinusoidal PWM – Introduction to space vector modulation –Current source inverter, Applications-Induction heating, UPS.

UNIT V AC TO AC CONVERTERS **9**

Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistage sequence control -single phase and three phase cyclo converters – Introduction to Matrix converters, Applications –welding.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, New Delhi, 4th Edition, 2017.
2. P. S. Bimbhra, 'Power Electronics', Khanna Publishers, New Delhi, 6th Edition, 2018.

REFERENCES

1. Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint, 2003.
2. Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.
3. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.
4. Ned Mohan, Tore M. Undel, William P. Robbins, "Power Electronics: Converters, Applications, and Design", John Wiley and sons Publication, 3rd Edition, 2010.
5. M. D. Singh and K. B. Khachandani, "Power Electronics", McGraw-Hill Education, 2nd Edition, 2017.

WEB RESOURCES

1. https://nptel.ac.in/courses/108/105/108105066/#
2. https://www.sciencedirect.com/topics/materials-science/power-electronics
3. https://www.coursera.org/specializations/power-electronics

OUTCOMES:

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

1. Explain operation and Static Characteristics of SCR, TRIAC, GTO, IGBT and MOSFET, Dynamic characteristics of SCR, MOSFET and IGBT and the Triggering, commutation and snubber circuits for SCR (K2)
2. Describe the 2,3,6 pulse converters with performance parameters and effect of source inductance, Dual converter, Light dimmer system(K2)
3. Discuss the operation of Class A to E choppers and Switched mode Regulators such as Buck, Boost, and Buck-Boost Regulators, Battery operated vehicles.(K2)
4. Interpret the single and three phase voltage source inverter , current source inverters, voltage control, Voltage& harmonic control--PWM techniques: Multiple PWM, Sinusoidal PWM, Modified Sinusoidal PWM, SVM, Induction heating, UPS(K2)
5. Explain the single and three phase AC voltage controllers, Power Factor Control – Multistage sequence control, Cyclo converter and Matrix converter, welding(K2)

CO- PO, PSO MAPPING:

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

SEMESTER - V

20EEPC503 SDG NO. 4, 7	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		2	0	1	3

OBJECTIVES:

- To discuss architecture of 8085 microprocessor and its instruction sets &programming with peripheral / interfacing devices
- To outline the architecture of 8051 microcontroller and its instruction sets & programming with simple application development
- To introduce an advance processor for system development

UNIT I INTRODUCTION TO 8085 ARCHITECTURE 9

Functional block diagram ––Pin & Architecture Diagram - Memory interfacing – I/O ports and data transfer concepts – Timing Diagram – Interrupt structure

UNIT II 8085 INSTRUCTION SET AND PROGRAMMING 9

Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing - Look up table - Subroutine instructions, stack.

UNIT III INTERFACING BASICS AND ICs 9

Study of Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8279 Key board display controller and 8254 Timer/ Counter – Interfacing with 8085 - A/D and D/A converter interfacing.

UNIT IV INTRODUCTION TO 8051 MICROCONTROLLERS 9

Functional block diagram - Instruction format and addressing modes – Interrupt structure – Timer –I/O ports – Serial communication, Simple programming- key board and display interface – Temperature control system - stepper motor control.

UNIT V INTRODUCTION TO ADVANCED ARCHITECTURE 9

ARM Cortex-M0 – overview - Programmer's Model - Memory System Overview - System Control Block - Microcontroller Start sequence - Inputs and Outputs - Development Flow.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. 1. A.Nagoor kani , Microprocessor & Microcontroller ,McGraw Hill Education; 2nd edition (1 July 2017)

2. Joseph Yiu , 'The Definitive Guide to the ARM Cortex-M0' Newnes; Illustrated edition (4 April 2011

REFERENCES:

1. R.S. Gaonkar, "Microprocessor Architecture Programming and Application with 8085", Wiley Eastern Ltd., New Delhi, 2013.
2. Muhammad Ali Mazidi & Janice GilliMazidi, R.D.Kinely, "The 8051 Micro Controller and Embedded Systems", PHI Pearson Education, 5th Indian reprint, 2003.
3. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
4. Douglas V.Hall, "Microprocessor and Interfacing", Mc Graw Hill Edu,2016.
5. Muhammad Tahir and Kashif Javed, "ARM microprocessor Systems - Cortex-M Architecture, Programming, and Interfacing", CRC Press, 2011.

WEB RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105102/
2. https://8085-simulator.en.softonic.com/
3. https://mcu-8051-ide.soft112.com/

OUTCOMES:

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

1. Describe the architecture of the 8085 processor with its internal features and memory structure(K2)
2. Apply the instruction sets of 8085 for developing an assembly language program (K3)
3. Utilize the various interfacing peripherals for 8085 processor's application (K3)
4. Make use of the 8051 microcontroller for its application development (K3)
5. Outline the architecture of ARM processor and its features(K2)

CO- PO,PSO MAPPING:

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

SEMESTER - V

20EEPL501 SDG NO. 4, 7	POWER ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To familiarize the Operation and characteristics of various switching devices with experimental results
- To familiarize the Operation of various types of converters with simulation and experimental results
- To familiarize the Operation of Chopper, Inverter and AC Voltage controller with simulation and experimental results

LIST OF EXPERIMENTS :

1. Steady state characteristics of SCR and TRIAC
2. Steady state characteristics of MOSFET and IGBT.
3. Thermal design of heat sink.
4. AC to DC half and fully controlled converter
5. Step down and Step up MOSFET based choppers
6. Simulation of 1Φ converters with R and RL load.
7. Simulation of 3Φ converters with R and RL load.
8. Simulation of DC-DC converters.
9. Simulation of AC voltage controllers.
10. Simulation of 1Φ inverters.
11. Simulation of 3Φ inverters.

TOTAL : 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Device characteristics(for SCR, TRIAC, MOSFET and IGBT kit with built-in / discrete power supply and meters) - 2each
2. Single phase SCR based half controlled converter and fully controlled converter along with built-in/separate/firing circuit/module and meter – 2each
3. MOSFET based step up and step down choppers (Built in/ Discrete) – 1each
4. IGBT based single phase PWM inverter module/Discrete Component –2
5. IGBT based three phase PWM inverter module/Discrete Component –2

6. Switched mode power converter module/Discrete Component –2
7. SCR &TRIAC based 1 phase AC controller along with lamp or rheostat load -2
8. Dual regulated DC power supply with common ground
9. Cathode ray Oscilloscope–10
10. Isolation Transformer –3
11. Single phase Auto transformer–3
12. Components (Inductance, Capacitance) 3 set for each
13. Multimeter –5
14. Rheostats of various ranges – 2 sets of 10value
15. Work tables – 10
16. DC and AC meters of required ranges –20

Component data sheets to be provided

OUTCOMES:

Upon completion of this course, student should be able to

1. Describe the working and characteristics of power switching devices. (K2)
2. Recognize the thermal design of a heat sink. (K2)
3. Demonstrate the single phase and three phase controlled converters with customer requirements.(K3)
4. Examine the chopper and inverter for applications extended to automobile applications. (K4)
5. Interpret the operation of AC voltage controllers. (K3)

CO- PO, PSO MAPPING :

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

SEMESTER - V

20EEPL502 SDG NO. 4	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To Write ALP for arithmetic and logical operations in 8085 microprocessor and 8051microcontroller.
- To Interface different I/Os with 8085 microprocessor and 8051 microcontroller.
- To Introduce design and development of a simple application and 8051 microcontroller

LIST OF EXPERIMENTS :

1. Simple arithmetic operations: addition / subtraction / multiplication / division.
2. Programming with control instructions:
   (i) Ascending / Descending order, Maximum / Minimum of numbers.
   (ii) Programs using Rotate instructions.
   (iii) Hex / ASCII / BCD code conversions.
3. Interface Experiments: with 8085 (I) A/D Interfacing. & D/A Interfacing.
4. Traffic light controller.
5. I/O Port / Serial communication
6. Programming Practices with Simulators/Emulators/open source
7. Read a key ,interface display
8. Demonstration of basic instructions with 8051 Micro controller execution, including: (i) Conditional jumps & looping (ii) Calling subroutines.
9. Programming I/O Port and timer of 8051
   (i) study on interface with A/D & D/A (ii) Study on interface with DC & AC motors.
10. Application hardware development using embedded processors

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	8085 Microprocessor Trainer with Power Supply	15
2.	8051 Micro Controller Trainer Kit with power supply	15
3.	8255 Interface boards	5
4.	8251 Interface boards	5
5.	8259 Interface boards	5

6. 8279 Keyboard / Display Interface boards 5
7. 8254 timer/ counters 5
8. ADC and DAC cards 5
9. AC & DC motor with Controller s 5
10. Traffic Light Control Systems 5

OUTCOMES:

After completing this course, the students should be able to

1. Understand computing platform and software for engineering problems. (K2)
2. Write the programming logics for code conversion. (K2)
3. Acquire knowledge on A/D . D/A, DC and AC motor interfacing with microcontroller as well as microprocessor. (K3)
4. Understand basics of serial communication programming . (K2)
5. Develop the programming Basics of embedded processors using software simulators.(K2)

CO- PO, PSO MAPPING :

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

SEMESTER - V

20HSPL501 SDG NO. 4, 8	COMMUNICATION AND SOFT SKILLS LAB	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop effective communication and presentation skills
- To enhance the employability and career skills of the learners
- To enable the learners for preparing job application and e-portfolio
- To make the learners use soft skills efficiently
- To develop their confidence and help them in attending interviews successfully

UNIT I LISTENING AND SPEAKING SKILLS 6

Conversational skills participate in formal and informal talks – general, – group discussion – time management – group dynamics – GD strategies - making effective presentations - listening/watching interviews conversations, documentaries - listening to lectures, discussions from social media – improving articulation.

UNIT II ADVANCED READING AND WRITING SKILLS 6

Reading different genres of texts - writing job applications – cover letter – résumé – emails – memos - writing abstracts – summaries – interpreting visual texts - e-portfolio.

UNIT III SKILLS FOR COMPETITIVE EXAMS 6

Reading passages for competitive exams – language focus exercise – building vocabulary tasks - FAQs related to competitive exams – current affairs - improving global reading skills – elaborating ideas – summarizing – understanding arguments – identifying opinion/attitude and making inferences - critical reading.

UNIT IV SOFT SKILLS 6

Motivation – emotional intelligence – managing changes – stress management – leadership straits – team work – career planning – intercultural communication – creative and critical thinking

UNIT V INTERVIEW SKILLS 6

Different types of interview – personal interview – panel interview – telephone/online interview - interview etiquette - answering questions – offering information – mock interviews – FAQs related to job interviews

TOTAL: 30 PERIODS

REFERENCES:

1. Business English Certificate Materials, Cambridge University Press.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge, 2011.
3. International English Language Testing System Practice Tests, Cambridge University Press.
4. Personality Development (CD-ROM), Times Multimedia, Mumbai.

WEB REFERENCES:

1. https://nptel.ac.in/courses/109/107/109107121/
2. https://swayam.gov.in/nd1_noc19_hs33/preview
3. https://ict.iitk.ac.in/courses/enhancing-soft-skills-and-personality/

ONLINE RESOURCES:

1. https://www.britishcoucil.my/english/courses-adults/learning-tips/importance-of-soft-skills
2. https://www.skillsoft.com/content-solutions/business-skills-training/soft-skills-training/

OUTCOMES:

Upon completion of the course learners should be able to

1. Demonstrate a better understanding of the communication process by articulating effectively(K2)
2. Exhibit soft skills & technical skills and construct e-portfolio effectively(K3)
3. Apply critical thinking abilities and perform well in group discussions(K2)
4. Adapt the skills towards grooming as a professional continuously(K2)
5. Identify different types of personal interview skills through mock interviews and practices(K2)
6. Execute the employability and career skills in their chosen profession(K3)

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	2	3	1	1
CO2	-	-	-	-	-	-	-	2	3	3	2	1
CO3	-	-	-	-	-	-	-	2	3	2	-	1
CO4	-	-	-	-	-	-	-	1	1	3	2	2
CO5	-	-	-	-	-	2	-	1	2	3	-	1
CO6	-	-	-	-	-	-	-	1	1	3	2	2

SEMESTER - V

20EETE501 SDG NO. 4,11,15	LIVE-IN-LAB - III	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To provide opportunities for the students, exposure to the Industrial environment and real time work.
- To enable hands-on experience in the electronics hardware/Software domain

- To enable development of skill set for designing and realizing prototype electronic systems/simulation model

COURSE METHODOLOGY:

1. This initiative is designed to inculcate ethical principles of research and to get involved in a life-long learning process for the students.
2. The project work must involve engineering design with realistic constraints. It must also include appropriate elements of the following: Engineering standards, design analysis, modeling, simulation, experimentation, prototyping, fabrication, correlation of data, and software development.
3. Project can be individual work or a group project, with a maximum of 3 students. In case of group project, the individual project report of each student should specify the individual's contribution to the group project
4. On completion of the project, the student shall submit a detailed project report. The project should be reviewed and the report shall be evaluated and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

EVALUATION

1. First evaluation (Immediately after first internal examination) : 20 marks
2. Second evaluation (Immediately after second internal examination): 30 marks
3. Final evaluation (Last week of the semester) : 50 marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL: 30 PERIODS

OUTCOMES:

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

1. Perform literature survey to identify the gap and an application oriented research problem in the specific domain (K2)
2. Design and validate the proposed system using simulation (K3)
3. Implement the proposed system (K3)
4. Examine the obtained results and prepare a technical report (K4)
5. Publish the work in journals and apply for the patents.(K3)
6. Prepare for industrial environment and real time work (K3)

CO - PO, PSO MAPPING :

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

SEMESTER - V

20EETP501 SDG NO. 4,11,15	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

APTITUDE & COGNITIVE SKILLS – PART 3

OBJECTIVES:

- Enhance their quantitative ability.
- Enhance their reasoning ability
- Enhance their verbal ability.
- Equip with creative thinking and problem solving skills

UNIT I QUANTITATIVE ABILITY – V **10**

Square Root And Cube Root, Logarithm, Volume and Surface Area, Permutation and Combination

UNIT II QUANTITATIVE ABILITY – VI **10**

Probability, Averages, Area, Odd Man Out, Crypt Arithmetic, Flowcharts

UNIT III REASONING ABILITY – III **8**

Data Interpretation Table Charts, Data Interpretation Bar Charts, Blood Relationship, Puzzles

UNIT IV VERBAL ABILITY – III **10**

Spellings, Selecting Words, Spotting Errors, Ordering of Words, Logical Sequence of Words

UNIT V CREATIVITY ABILITY – III 7

Logical Puzzles, Playing Cards Puzzles, Clock Puzzles, Number Puzzles, Sudoku

TOTAL : 45 PERIODS

REFERENCES :

1. Quantitative Aptitude for Competitive Exams by R. S. Agarwal
2. Quantum CAT by Sarvesh Verma
3. A Modern Approach to Logical Reasoning by R. S. Agarwal
4. Verbal Ability and Reading Comprehension by Arun Sharma

PYTHON PROGRAMMING & CIRCUIT DESIGN – PART 1

OBJECTIVES:

- The course is designed to provide Strong knowledge of Python. Python programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the Python programming language.

UNIT I INTRODUCTION, DATATYPES AND STRINGS, LIST & TUPLES10

DataTypes - Integer , Float , Boolean , String , List , Tuple , Dictionary and Sets. String - Concatenation and Replication, isalnum functions, Slicing Operation sorted() , reversed() , min() , max() , index() and count() function, packing and unpacking of data in a tuple

UNIT II DICTIONARY AND SETS AND HANDLING 10

Dictionary - del Keyword,. Sets - Frozen sets, Internal working of sets, add() , union() , intersection() and difference() method, symmetric_difference, clear() method, Operators in sets, Higher Order Functions - map , filter , reduce and lambda function, Random Library

UNIT III EXCEPTIONAL HANDLING, REGULAR EXPRESSIONS AND OBJECT ORIENTED PROGRAMMING 10

Exception Handling - All Error Categories, try , except , finally blocks, Raising an exception, Regular Expression, Object Oriented Programming - Types of Inheritence, Data encapsulation and Abstraction, Polymorphism, Method OverRiding, Operator overloading, operator overRiding,

UNIT IV ELECTRICAL AND ELECTRONICS CIRCUIT DESIGN 8

LTSPICE- Design and analysis of electronic circuits -Frequency response of Amplifiers ; Electrical circuit-Analysis of transient current in RL,RC and RLC circuit, series resonance and parallel resonance , Power electronic circuit design

UNIT V DESIGN OF DIGITAL CIRCUITS 7

VHDL/Verilog/Quartus- Design and Analysis of Digital circuits- Logic gates, Adder ,Subtractor,FlipFlops,counter and Multiplier circuits

TOTAL : 45 PERIODS

REFERENCES:

1. Python-(Mark Lutz)
2. Python Training guide (BPB Publications)

OUTCOMES:

At the end of the course, the student should be able to:

1. Define the syntax and semantics of python programming language and Understand control flow statements, strings and functions. [K1]
2. Determine the methods to create and manipulate python programs by utilizing the data structures like lists, dictionaries, tuples and sets. [K3]
3. Annotate the concepts of functions, modules and packages in python. [K2]
4. Design the electrical and electronics circuits using LTSPICE software[K6]
5. Analyze the digital circuits using Verilog/VHDL software[k4]

CO- PO & PSO MAPPING:

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

SEMESTER - VI

20EEPC601 SDG NO. 4,9	SOLID STATE DRIVES AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the stable steady-state operation and transient dynamics of a motor-load system.
- To study and analyze the operation of the converter / chopper fed dc drive and to solve simple problems.
- To study and understand the operation of both classical and modern induction motor drives.
- To understand the differences between synchronous motor drive and induction motor drive and to learn the basics of permanent magnet synchronous motor drives.
- To analyze and design the current and speed controllers for a closed loop solid-state d.c motor drive.

UNIT I DRIVE CHARACTERISTICS 9

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

UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 9

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

UNIT III INDUCTION MOTOR DRIVE 9

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

UNIT IV SYNCHRONOUS MOTOR DRIVES 9

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

UNIT V DESIGN OF CONTROLLERS FOR DRIVES 9

Transfer function for dc motor, load and converter – Closed loop control with current and speed feedback - Armature voltage control and field weakening mode control - Design of controllers: Current controller and speed controller - Converter selection and characteristics.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, 2nd Edition, preprint edition 2002.
2. Bimal K. Bose. 'Modern Power Electronics and AC Drives', Pearson Education,2002.

REFERENCES:

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis, and Control", Pearson Education India, 1st Edition, 2015.
2. S.K. Pillai, 'A First Course on Electrical Drives', 3rd Edition New Age International Publishers, 2012.
3. Vedam Subrahmanyam, "Electric Drives Concepts and Applications", 2nd Edition, Tata McGraw-Hill Education Pvt Ltd, 2011
4. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics: Converters, Applications, and Design", John Wiley and sons Publication, 4th Edition, 2017.

ONLINE RESOURCES:

1. https://www.classcentral.com/course/swayam-fundamentals-of-electric-drives-14073
2. https://www.udemy.com/course/acdc-motors-and-drives/
3. https://nptel.ac.in/courses/108/104/108104140/
4. https://nptel.ac.in/courses/108/102/108102046/

OUTCOMES:

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

1. Explain the basic concepts of Electric drive characteristics and its selection, stability, motor load dynamics. (K2)
2. Choose appropriate converter / chopper for DC drives based on the mode of operation(K3)
3. Interpret the concept of scalar, vector and closed loop control of Induction motor drive through AC voltage controllers and inverters.(K2)
4. Explain the concept of self, margin angle, power factor control of Synchronous motor drive through VSI / CSI. (K2)

5. Derive the transfer function of the dc drive, select the appropriate converter to design the speed & current controllers for closed loop control. (K2)

CO- PO, PSO MAPPING:

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

SEMESTER - VI

20EEPC602 SDG NO. 4	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the significance of power system operation and control.
- To learn the real power-frequency interaction and design of power-frequency controller.
- To learn the reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
- To design the economic operation of power system.
- To learn SCADA and its application for real time operation and control of power systems

UNIT I INTRODUCTION 9

An overview of power system operation and control – system load variation – load characteristics – load curves and load duration curve – load factor – diversity factor – importance of load forecasting and quadratic and exponential curve fitting techniques of forecasting – plant level and system level controls.

UNIT II REAL POWER - FREQUENCY CONTROL 9

Basics of speed governing mechanism and modeling – speed-load characteristics – load sharing between two synchronous machines in parallel – control area concept – LFC control of a single-area system – static and dynamic analysis of uncontrolled and controlled cases – two-area system – modeling – static analysis of uncontrolled case – tie line with frequency bias control – state variable model.

UNIT III REACTIVE POWER – VOLTAGE CONTROL 9

Generation and absorption of reactive power – basics of reactive power control – Automatic Voltage Regulator (AVR)- block diagram representation of AVR loop– static and dynamic analysis – stability compensation – methods of voltage control: tap changing transformer, SVC (TCR + TSC) and STATCOM – secondary voltage control.

UNIT IV ECONOMIC OPERATION OF POWER SYSTEM 9

Statement of economic dispatch problem - input and output characteristics of thermal plant - incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - base point and participation factors method - statement of unit commitment (UC) problem - constraints on UC problem - solution of UC problem using priority list – special aspects of short term and long term hydrothermal problems.

UNIT V COMPUTER CONTROL OF POWER SYSTEM 9

Need of computer control of power systems-concept of energy control centers and functions – PMU - system monitoring, data acquisition and controls - System hardware configurations - SCADA and EMS functions - state estimation problem – measurements and errors -Introduction to GA to cost minimization - various operating states - state transition diagram.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Olle.I.Elgerd, "Electric Energy Systems theory - An introduction", McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollen berg, "Power Generation, Operation and Control", John Wiley & Sons, Inc., 2016.

REFERENCES:

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.

2. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
3. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
4. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108101040/
2. https://www.coursera.org/learn/electric-power-systems

OUTCOMES:

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

1. Explain the significance of power system operation and control and interpret the importance of load forecasting techniques. (K2)
2. Model LFC and AGC for single and two area power systems and perform steady state and dynamic analysis. (K3)
3. Model the reactive power voltage control and perform steady state and dynamic analysis. (K3)
4. Solve the problems related to the economic dispatch of power system, unit commitment and develop the strategies to minimize transmission line losses. (K3)
5. Identify the need for Computer control of the power system and make use of state estimation techniques. (K3)

CO- PO, PSO MAPPING:

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

SEMESTER - VI

20EEPW601 SDG NO. 4,9	EMBEDDED SYSTEMS AND IoT WITH LABORATORY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand the state of the art - Internet of Things architecture and various protocols
- To introduce the building blocks of embedded system with various processor scheduling algorithms in RTOS
- To apply the concept of Internet of Things and Embedded systems in the real world scenario

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS **9**

Introduction to Embedded Systems –Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

UNIT II EMBEDDED SYSTEM FOR IoT **9**

Overview of IOT- Sensing- Actuation- IoT Networking- Communication protocols-data handling - importance of cloud computing- features and importance of Industrial IoT.

UNIT III EMBEDDED NETWORKING **9**

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS422 – RS 485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C).

UNIT IV RTOS BASED SYSTEM DESIGN **9**

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-semaphores, Mailbox, pipes, priority inversion, priority inheritance.

UNIT V IoT AND EMBEDDED SYSTEM APPLICATION **9**

Embedded system for Smart Meter- smart Grid –Agriculture and Healthcare, Home automation.

LIST OF EXPERIMENTS : **15**

1. Embedded program to control the stepper motor.
2. Embedded program for timer control operation.
3. Embedded program for control the lighting system.
4. Embedded program for controlling the temperature .
5. Embedded program for display a message in LCD.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 1st Edition , 2017.
2. Rajkamal, "Embedded System-Architecture, Programming, Design", McGraw Hill, 2013.

REFERENCES:

1. ArshdeepBahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, Research papers, 2014.
2. Lyla B Das, "Embedded Systems-An Integrated Approach", Pearson, 2013.
3. Shibu. K.V, "Introduction to Embedded Systems", 2e, Mcgraw Hill, 2017.
4. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
5. Peckol, "Embedded system Design", John Wiley & Sons, 2010.

WEB RESOURCES:

1. https://swayam.gov.in/nd1_noc20_cs15/preview
2. https://nptel.ac.in/courses/108102045/

ONLINE RESOURCES:

1. https://www.tutorialspoint.com/embedded_systems/es_overview.htm
2. http://www.circuitstoday.com/embedded-systems-an-introduction
3. https://www.electronicsforu.com/resources/embedded-systems-overview

OUTCOMES:

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

1. Infer knowledge about embedded system and processors and their importance (K2)
2. Explain the concept of IOT and various protocols for IOT (K2)
3. Summarize the fundamentals and standards communication framework among the modules of embedded system (K2)

4. Understand the concepts of RTOS in embedded systems (K2)
5. Develop applications of IOT systems and embedded systems in real time. (K3)

CO- PO, PSO MAPPING:

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

SEMESTER - VI

20ITPC301 SDG NO. 4	DATA STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of ADT's
- To learn Linear Data Structures – Lists, Stacks, and Queues
- To understand Sorting, Searching and Hashing Algorithms
- To learn Dynamic Data Structures - Tree and Graph

UNIT I LINEAR DATA STRUCTURES – I **9**

Stacks and Queues : Abstract Data Types (ADTs) – Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to Postfix expression - Queue ADT – Operations - Circular Queue – Priority Queue –Dequeue – Applications of Queues.

UNIT II LINEAR DATA STRUCTURES – II **9**

Linked List: List ADT – Array-Based Implementation – Linked List Implementation –– Singly Linked Lists- Circularly Linked Lists- Doubly-Linked Lists – Applications of Lists –Polynomial Manipulation – All Operations (Insertion, Deletion, Merge, Traversal).

UNIT III NON LINEAR DATA STRUCTURES – I **9**

Trees : Tree ADT – Tree Traversals - Binary Tree ADT – Expression Trees –

Applications of Trees – Binary Search Tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree -Heap – Applications of Heap.

UNIT IV NON LINEAR DATA STRUCTURES – II 9

Graphs : Definition – Representation of Graph – Types of Graph – Breadth First Traversal –Depth First Traversal – Topological Sort – Bi-Connectivity – Cut Vertex – Euler Circuits – Applications of Graphs.

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching- Linear Search - Binary Search - Sorting - Bubble Sort - Selection Sort - Insertion Sort - Shell Sort – Radix Sort – Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education Asia, 2002.
2. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2011.

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
2. Stephen G. Kochan, "Programming in C", 3rd edition, Pearson Education.
3. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education, 1983.
4. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008.

WEB REFERENCES :

1. https://www.programiz.com/dsa
2. http://masterraghu.com/subjects/Datastructures/ebooks/remathareja.pdf

OUTCOMES:

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

1. Recognize the concepts of ADT for linear data structures.(K1)
2. Recognize ADT for non-linear data structure.(K1)
3. Understand linear and non-linear data structures to problem solutions.(K2)
4. Understand the various sorting and searching algorithms. (K2)

5. Apply appropriate ADT to problems involving Graph, Trees and Heap. (K3)
6. Apply appropriate data structures to solve real world problems efficiently.(K3)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	1	1	0	2	2	3	3	1	1
CO2	2	2	1	2	1	1	1	0	2	2	3	3	1	1
CO3	3	3	2	3	3	1	1	1	2	2	3	3	1	1
CO4	2	2	1	2	3	2	1	0	1	1	2	1	1	2
CO5	2	2	1	2	3	0	0	1	2	1	2	2	1	2
CO6	3	3	3	3	1	0	0	0	1	1	2	1	2	2

SEMESTER - VI

20EEPL601 SDG NO. 4	POWER SYSTEM SIMULATION LABORTARY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To present a problem oriented knowledge of power system analysis methods.
- To analyze the approaches behind power system network using software tools(C,C++, MATLAB, AU power lab)
- To identify & formulate solutions to problems relevant to power system using software tools.

LIST OF EXPERIMENTS:

1. Computation of Transmission Line Parameters
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks
3. Power Flow Analysis using Gauss-Seidel Method.
4. Power Flow Analysis using Newton Raphson Method
5. Symmetric and unsymmetrical fault analysis
6. Transient stability analysis of SMIB System

7. Economic Dispatch in Power Systems
8. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
9. State estimation: Weighted least square estimation
10. Electromagnetic Transients in Power Systems : Transmission Line Energization

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Personal computers (Pentium-IV, 80GB, 512 MBRAM) – 25 nos
2. Printer laser- 1 No.
3. Dot matrix- 1 No.
4. Server (Pentium IV, 80GB, 1GBRAM) (High Speed Processor) – 1 No.
5. Software: any power system simulation software – 5 licenses
6. Compliers: C, C++, VB, VC++ – 25 users

OUTCOMES:

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

1. Interpret the power system parameters for operational studies. (K2)
2. Develop the admittance and impedance matrices of interconnected power systems. (K3)
3. Experiment with the power flow using GS and NR method and solve the fault analysis. (k3)
4. Plan the economic dispatch Scheduling for thermal power plant. (k3)
5. Identify the load frequency dynamics of single and two area system (K3)

CO- PO, PSO MAPPING:

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

SEMESTER - VI

20ITPL301 SDG NO. 4	DATA STRUCTURES LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To implement Linear and Non-linear Data Structures
- To understand the different operations of Search Trees
- To implement Graph Traversal algorithms
- To get familiarized to Sorting and Searching algorithm

LIST OF EXPERIMENTS :

1. Array implementation of Stack and Queue ADTs
2. Array implementation of List ADT
3. Linked list implementation of List, Stack and Queue ADTs
4. Applications of List, Stack and Queue ADTs
5. Implementation of Binary Trees and operations of Binary Trees
6. Implementation of Binary Search Trees
7. Implementation of AVL Trees
8. Implementation of Heaps using Priority Queues
9. Graph representation and Traversal algorithms
10. Applications of Graphs- Implementation of searching and sorting algorithms
11. Implementation of any two Collision Techniques in Hashing

TOTAL: 45 PERIODS

LAB REQUIREMENTS :

Turbo C/Dev C++, Borland C

OUTCOMES:

On completion of this laboratory course, the student should be able to

1. Write functions to implement linear and non-linear data structure operations. [K1]
2. Suggest appropriate linear / non-linear data structure operations for solving a given problem. [K2]
3. Design and analyze the time and space efficiency of data structure.[K2]
4. Apply sorting and searching techniques. [K3]
5. Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval. [K3]

6. Choose and implement efficient data structures and apply them to solve problems. [K3]

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	2	1	1	-	-	-	-	2	2	2	2
CO2	2	3	2	2	2	1	-	-	-	-	2	3	2	2
CO3	3	3	2	2	1	1	-	-	-	-	2	2	2	2
CO4	3	3	2	2	1	1	-	-	-	-	2	3	2	2
CO5	1	2	2	1	2	1	-	-	-	-	1	1	2	2
CO6	1	2	2	1	1	-	-	-	-	-	1	1	2	2

SEMESTER - VI

20EEPJ601 SDG NO.4,11&15	INNOVATIVE DESIGN PROJECT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the engineering aspects of design with reference to simple products
- To foster innovation in design of products
- To develop design that add value to products and solve technical problems

COURSE PLAN

Study: Take minimum three simple products, processes or techniques in the area of specialization, study, analyze and present them. The analysis shall be focused on functionality, construction, quality, reliability, safety, maintenance, handling, sustainability, cost etc. whichever are applicable. Each student in the group has to present individually; choosing different products, processes or techniques.

Design: The project team shall identify an innovative product, process or technology and proceed with detailed design. At the end, the team has to document it properly and present and defend it. The design is expected to concentrate on functionality; design for strength is not expected.

Note: *The one hour/week allotted for tutorial shall be used for discussions and presentations. The project team (not exceeding four) can be students from different branches, if the design problem is multidisciplinary.*

TOTAL: 45 PERIODS

EVALUATION

1. First evaluation (Immediately after first internal examination) : 20 marks
2. Second evaluation (Immediately after second internal examination): 20 marks
3. Final evaluation (Last week of the semester) : 60 marks

Note: *All the three evaluations are mandatory for course completion and for awarding the final grade.*

OUTCOMES:

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

1. Perform literature survey to identify the gap and an application oriented research problem in the specific domain (K2)
2. Design and validate the proposed system using simulation (K3)
3. Implement the proposed system (K3)
4. Examine the obtained results and prepare a technical report (K4)
5. Publish the work in journals and apply for the patents.(K3)
6. Prepare for industrial environment and real time work (K3)

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO4	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO5	2	2	2	1	2	1	1	1	3	2	3	3	3	2
CO6	2	2	2	2	3	2	2	2	2	2	3	3	3	3

SEMESTER - VI

20EETP601 SDG NO. 4,11,15	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

APTITUDE & COGNITIVE SKILLS – PART 4

OBJECTIVES:

- Enhance their quantitative ability.
- Enhance their reasoning ability
- Enhance their verbal ability.

UNIT I Quantitative Ability – VII **10**

Races And Games, Boats and Streams, Surds and Indices, Pipes and Cistern, AlligationsAnd Mixtures

UNIT II Quantitative Ability – VIII **10**

Numbers, Problems on Numbers, Pick Wrong Number, Missing Number, Areas, Shapes, Perimeter

UNIT III Reasoning Ability – IV **8**

Data Interpretation Pie Charts, Data Interpretation Line Charts, Data Sufficiency (DS), Data Arrangements, LR – Arrangements, LR – Ranking

UNIT IV Verbal Ability – IV **10**

Sentence Correction, Sentence Improvement, Completing Statements, Sentence Formation, Paragraph Formation

UNIT V Creativity Ability – IV **7**

Dot Situation, Rule Detection, Embedded Images, Grouping Of Images, Image Analysis

TOTAL : 45 PERIODS

REFERENCES :

1. Quantitative Aptitude for Competitive Exams by R. S. Agarwal
2. Quantum CAT by Sarvesh Verma
3. A Modern Approach to Logical Reasoning by R. S. Agarwal
4. Verbal Ability and Reading Comprehension by Arun Sharma

PROBLEM SOLVING USING BASIC DATA STRUCTURES – EVOLUTIONARY COMPUTING TECHNIQUES & PLC - PART 1

UNIT I LINKED LIST & STACK, QUEUE & HEAP 10

Linked List - Doubly Linked List Traversal, Circular Linked List, Structure, Node creation, Traversal Stack, Stack –Time Complexities of the Operations, Infix to Postfix/Prefix Conversation, Histogram Problem, Implementation - Using Array, Using Linked List, Queue Implementation - Queue using Stack

UNIT II BINARY TREE AND HASHING 10

Binary Tree - Types of Binary Tree,Balanced Tree, Degenerate or pathological Tree, Binary Search Tree, Inorder , Preorder , PostOrder and LevelOrder Traversal, Hashing, Linear Probing for Collision Handling, Union and Intersection of two Linked Lists

UNIT III TREES AND GRAPH 10

AVL Tree -Right-Left Imbalance, Left and Right Rotation, - Red Black Tree, Rules of coloring Left and Right Rotation,Graph terminology –Representation of graphs –Path matrix –Graph Traversal –BFS (breadth first search) –DFS (depth first search) –Minimum spanning Tree –Kruskal's Algorithm & Prim's Algorithm –Warshall's algorithm (shortest path algorithm).

Unit IV EVOLUTIONARY COMPUTING 8

Fundamentals of genetic algorithms: Encoding, Fitness functions, Reproduction Genetic Modeling : Cross cover, Inversion and deletion, Mutation operator, Bit-wise operators, Bitwise operators used in GA. Convergence of Genetic algorithm.Applications of GA, Real life Problems. Particle Swarm Optimization(PSO)-Basic model-Global Best PSO-Local Best PSO-PSO Algorithm Parameters-Problem Formulation of PSO algorithm-Empirical Analysis of PSO Characteristics-Stopping Condition-Application-Advantages and Disadvantages of PSO

UNIT V PROGRAMMABLE LOGIC CONTROLLER 7

Introduction , advantages of PLC control panel , working principle of PLC , Different types of input/output circuits , programming with PLC, selection of PLC, applications.

TOTAL : 45 PERIODS

REFERENCES:

1. Weiss, Mark. A. (2012), Data structures and algorithm analysis in Java. 3rd edition. Harlow, Essex : Pearson (632 p).

2. Zobel, Justin (2014), Writing for Computer Science. 3. Springer Verlag London Ltd (270 p).
3. 3.Y.Yare,G.K.Venayagamoorthy,U.O.Aliyu,"Optimal maintenance scheduling of generators using multiple swarms—MDPSO framework",Engineering Applications of Artificial Intelligence,Vol.23,No.6,2010,pp.895–910.
4. Kennedy .J.Eberhart.R,"Particle swarm optimization", Proceedings of IEEE International Conference on Neural Networks, Perth, Australia,27 November–1 December 1995,(4),pp.1942–1948

WEB REFERENCES:

1. https://www.youtube.com/watch?v=MR-NaK7XMhM
2. https://www.youtube.com/watch?v=mFWuw5UG3pE
3. https://www.youtube.com/watch?v=PLYosK87D8E

OUTCOMES:

At the end of the course, the student should be able to:

1. Analyze the applications of linear data structure using Stack and Queue implementation. (K4)
2. Define the various hash functions and its implementation. (K2)
3. Apply the basic concepts of the Non Linear Data Structure - Trees and Graph. (K3)
4. Apply the basic concepts of evolutionary computing for optimization (K3)
5. 5: Illustrate the basics and implementation of Programmable logic controller (K2)

CO- PO & PSO MAPPING:

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

SEMESTER - VII

20EEPC701 SDG NO. 4,7	DISTRIBUTED GENERATION AND MICROGRID	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about renewable energy Sources and technologies
- To learn about the adequate inputs on a variety of issues in harnessing renewable energy
- To illustrate the concept of distributed generation & micro grid and its configuration.

UNIT I WIND ENERGY **9**

Introduction- Importance of renewable sources of energy- Present Indian and international energy scenario of conventional and RE sources-Power in the Wind – Types of Wind Power Plants (WPPs) - Components of WPPs-Working of WPPs- Sitting of WPPs-Grid integration issues of WPPs.

UNIT II SOLAR PV AND THERMAL SYSTEMS **9**

Solar Radiation-Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds- Thermal Energy storage system with PCM- Solar Photovoltaic systems : Basic Principle, Types of PV Systems- Types of Solar Cells-Photovoltaic cell concepts: Cell, module, array -PV Module I-V Characteristics-Efficiency & Quality of the Cell, series and parallel connections-maximum power point tracking-Applications.

UNIT III OTHER ENERGY SOURCES **9**

Fuel cell-Construction, working, types and applications- Energy Storage System- Hybrid Energy Systems-Wave Energy-Energy from waves, wave power devices- Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Basics of biomass energy, geothermal energy, tidal energy and hydro power system.

UNIT IV DISTRIBUTED GENERATIONS (DG) **9**

Concept of distributed generations, topologies, selection of sources-Standards for interconnecting Distributed resources to electric power systems: IEEE 1547-DG installation classes- Energy storage elements: Batteries, ultra-capacitors, flywheels-Captive power plants-Requirements for grid interconnection, limits on operational parameters, islanding issues-Impact of grid integration with NCE sources on existing power system.

UNIT V BASICS OF A MICRO GRID **9**

Concept and definition of micro grid-micro grid drivers and benefits-review of sources of micro grids- typical structure and configuration of a micro grid- AC and DC micro grids- Power Electronics interfaces in DC and AC micro grids

TOTAL: 45 PERIODS

TEXT BOOKS:

1. D.P.Kothari, K C Singal, RakeshRanjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt. Ltd, New Delhi, 2013.
2. AmirnaserYezdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modeling, Control and Applications", IEEE John Wiley Publications, 2010.

REFERENCES:

1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design",PHI Learning Private Limited, New Delhi, 2011
2. Scott Grinnell, "Renewable Energy & Sustainable Design", CENGAGE Learning USA, 2016
3. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
4. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
5. DorinNeacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor & Francis, 2006

WEB RESOURCES:

1. https://www.ases.org/?option=com_content&view=article&id=14&Itemid=22
2. https://www.energy.gov/eere/water/how-hydropower-works
3 https://www.wbdg.org/resources/distributed-energy-resources-der

ONLINE RESOURCES:

1. https://www.coursera.org/learn/wind-for-renewable-energies
2. http://www.nptelvideos.in/2012/11/energy-resources-and-technology.html
3. https://swayam.gov.in/nd1_noc20_ge06/preview
4. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee63/

OUTCOMES:

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

1 Explain the concepts of wind energy conversion system and grid integration.
2. Demonstrate the solar PV and thermal energy storage system with its characteristics.
3. Summarize the various renewable energy resources and its technology.
4. Outline the concept of distributed generation, energy storage elements and the requirements for grid interconnection.
5. Interpret the sources of micro grid, its typical structure and configuration.

CO, PO, PSO MAPPING:

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

SEMESTER - VII

20EEPC702 SDG NO. 4 & 9	ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of electric vehicles and its operations
- To understand the need for energy storage in hybrid vehicles
- To provide knowledge about various possible energy storage technologies that can be used in electric vehicles

UNIT I ELECTRIC AND HYBRID ELECTRIC VEHICLES 9

Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains

UNIT II ENERGY STORAGE FOR EV AND HEV 9

Energy storage requirements, Battery parameters, Types of Batteries, Modeling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modeling of PEMFC, Super Capacitors

UNIT III ELECTRIC PROPULSION 9

EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.

UNIT IV DESIGN OF ELECTRIC AND HYBRID ELECTRIC VEHICLES 9

Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of Parallel Hybrid Electric Drive Train: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity,

UNIT V POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING 9

Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z-converter for battery charging, High-frequency transformer based isolated charger topology, Transformer less topology.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. James Larminie, John lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Pvt Ltd., Second Edition 2012.
2. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, Second Edition 2011.

REFERENCE BOOKS :

1. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2005.
2. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013.
3. Chris Mi, M. Abul Masrur, David Wenzhong Gao, "Hybrid Electric Vehicles Principles And Applications With Practical Perspectives", Wiley Publication, 2011.
4. C.C. Chan and K.T. Chau, "Modern Electric Vehicle Technology", OXFORD University Press, 2001.

WEB REFERENCES:

1. https://www.energy.gov/eere/videos/energy-101electric-vehicles

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108/102/108102121/
2. https://nptel.ac.in/courses/108/103/108103009/
3. http://support.skillscommons.org/showcases/open-courseware/energy/e-vehicle-tech-cert/

OUTCOMES:

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

1. Explain the working of Electric Vehicles and recent trends.
2. Analyze different power converter topology used for electric vehicle application.
3. Develop the electric propulsion unit and its control for application of electric vehicles.
4. Compare electric vehicles with conventional vehicles.
5. Design and develop basic schemes of electric vehicles and hybrid electric vehicles.

CO – PO, PSO MAPPING:

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

SEMESTER - VII

20HSMG601 SDG NO. 4,8,9,10,12	PRINCIPLES OF ENGINEERING MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

At the end of the course, the student is expected to

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Management – Science or Art – Manager Vs Entrepreneur – types of managers – Engineers as Managers. 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 issues and future trends in Management; Industry 4.0 – Engineering management in modern business.

UNIT II PLANNING 9

Planning, Technology Planning - Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – MBO – process - Principles and functions of engineering 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 – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV DIRECTING AND CONTROLLING 9

Foundations of individual and group behaviour – Motivation – theories and techniques–Leadership – Level 5 leadership - theories – Leadership as a determinant of Engineering management - Communication – process and barriers – effective communication – Communication and IT - System and process of controlling – budgetary and non-budgetary control techniques.

UNIT V INNOVATION AND TECHNOLOGY MANAGEMENT 9

Innovation management of Product and Services, Role of R & D in Entrepreneurship, Breakthrough Innovation, Disruptive Innovation – Modern approaches in Engineering management – Green management, Lean management, Managing diversity. IPR – Principles of Ethics for Engineering Managers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Tripathy.P.C and Reddy.P.N, "Principles of Management", Tata McGraw Hill, 1999.

REFERENCES:

1. Stephen P. Robbins and Mary Coulter, "Management", Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert, "Management", Pearson Education, 6th Edition, 2004.
3. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management", Pearson Education, 7th Edition, 2011.
4. Robert Kreitner and Mamata Mohapatra, "Management", Biztantra, 2008.
5. Harold Koontz and Heinz Weihrich, "Essentials of Management", Tata McGraw Hill,1998.

WEB RESOURCES:

1. https://www.managementstudyguide.com/organization-management.htm
2. https://nptel.ac.in/courses/110/105/110105034/
3. https://courses.lumenlearning.com/boundless-management/chapter/principles-of-management/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/110/105/110105033/

OUTCOMES:

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

1. Get a clear idea on the practical implications of the management concepts in engineering with emphasis on the need for innovation in every sphere.
2. Manage functions like planning on international aspect of management.
3. Understand basic knowledge about organizing, staffing on international aspect of management.
4. Understand the concepts and principles of management viz., Directing, and Controlling in the changing business scenario.
5. Get through knowledge on the Efficient and Effective management of Men, Money and Technology towards developing the industrial system.

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	3	3	1	1	1
CO2	-	-	-	-	-	2	2	3	3	1	1	1
CO3	-	-	-	-	-	2	2	3	3	1	1	1
CO4	-	-	-	-	-	2	2	3	3	1	1	1
CO5	-	-	-	-	-	2	2	3	3	1	1	1

SEMESTER - VII

20EEPL701 SDG NO. 4,7	RENEWABLE ENERGY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To train the students in Renewability Energy Sources and technologies
- To provide adequate inputs on a variety of issues in harnessing Renewability Energy
- To recognize current and possible future role of renewability energy sources

LIST OF EXPERIMENTS:

1. Simulation study on Solar PV Energy System.
2. Experiment on "VI-Characteristics and Efficiency of 1kWp Solar PV System".
3. Experiment on "Shadowing effect & diode based solution in 1kWp Solar PV System".
4. Experiment on Performance assessment of Grid connected and Standalone 1kWp Solar Power System.
5. Simulation study on Wind Energy Generator.
6. Experiment on Performance assessment of micro Wind Energy Generator.
7. Simulation study on Hybrid (Solar-Wind) Power System.
8. Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System.
9. Simulation study on Hydel Power.
10. Experiment on Performance Assessment of 100W Fuel Cell.
11. Simulation study on Intelligent Controllers for Hybrid Systems.

LABORATORY REQUIREMENTS:

Personal computers (Intel i3, 80GB, 2GBRAM)	- 15 Nos
CRO 30MHz	- 9 Nos
Digital Multimeter	-10 Nos
PV panels (100W, 24V)	- 1 No
Battery storage system with charge and discharge control 40Ah	-1No
PV Emulator	-1No
Micro Wind Energy Generator module	- 1No
Potentiometer	- 5 Nos
Step-down transformer (230V/12-0-12V) -	5 Nos

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Perform an simulation of a renewable energy system. (K2)
2. Illustrate in detail a hybrid system(K2)
3. Analyze how changes in functionality in a component will affect the other components of the system. (K3)
4. Use laboratories and emulators of renewable energy systems to analyze relevant issues. (K2)

CO- PO,PSO MAPPING

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

SEMESTER - VII

20EEPJ701 SDG NO. 4, 6,7,8, 9, 11, 12, 13, 17	PROJECT PHASE - I	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same
- To train the students face reviews and viva voce examination

GUIDELINES TO BE FOLLOWED:

The students may be grouped into 3 to 4 and work under a project supervisor and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor (faculty member). The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. The Project Work Phase-I will have the following Sequence:

I. Problem Identification

1. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
2. List of possible solutions including alternatives and constraints
3. Cost benefit analysis
4. Time Line of activities

II. A report highlighting the design finalization [based on functional requirements and standards (if any)]

III. A presentation including the following:

1. Implementation Phase (Hardware / Software / both)
2. Testing and Validation of the developed system
3. Learning in the Project

IV. Consolidated report preparation

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Comprehend an industrial or real life problem and identify right/ real issue with solution. (K2)
2. Analyze the necessary studies and review the literature, design a setup of equipment, complete the analysis. (K3)
3. Compose a project report based on the findings. (K6)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Co1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2

SEMESTER - VII

20EETP701 SDG NO. 4,11,15	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

APTITUDE & TECHNICAL REFRESHER AND COMPANY SPECIFIC TRAINING - MACHINE DESIGN AND POWER SYSTEM MODELING – PART 4

OBJECTIVES:

- Enhance their quantitative ability.
- Enhance their reasoning ability
- Enhance their verbal ability.

UNIT I PRODUCT COMPANY SPECIFIC TRAINING – I 10

Product Specific Training for Amazon, Microsoft, IBM, ThoughtWorks, Juspay, Paypal, Mu Sigma, Zoho Corporation, VM Ware, Directi, Oracle, Wells Fargo, Goldman Sachs, Chargebee, Coda Global, Temenos, Freshworks, Adobe Systems., Ernst and Young, BA Continuum, Standard Chartered, AON Hewitt, Soliton Technologies, Payoda Technologies, Infoview Technologies,Athena Health Technology.

UNIT II PRODUCT COMPANY SPECIFIC TRAINING – II 10

Product Specific Training for TCS,Wipro,TechMahindra, InfoView, RobertBosch, , NTT Data, Verizon, Payoda Technologies. CTS, Accenture, MindTree, MPhasis, Odessa Technologies, Vuram Technologies, Hewlett Packard, HCL.

UNIT III: SERVICE COMPANY SPECIFIC TRAINING - I 10

Capgemini, Infosys, IBM, UGAM Solutions, Skava Systems, L&T Infotech, BahwanCybertech, Dhyan Infotech.

UNIT IV ELECTRICAL MACHINE DESIGN 8

Maxwell/Magnet- Design and analysis of DC, BLDC, Induction and Synchronous machines.

UNIT V POWER SYSTEM MODELING -ETAP & PSCAD 7

ETAP-Power System Modeling-Load Flow Study & Evaluation-Power transients analysis-Applications of PSCAD in Power Systems including Switching & Lightning Induced Transients for Insulation Coordination Transient Studies Configuring Transmission Lines with PSCAD-Distributed

Generation & Power Quality

TOTAL : 45 PERIODS

REFERENCES :

1. Quantitative Aptitude for Competitive Exams by R. S. Agarwal
2. Quantum CAT by Sarvesh Verma
3. A Modern Approach to Logical Reasoning by R. S. Agarwal
4. Verbal Ability and Reading Comprehension by Arun Sh
5. Modern distribution systems with PSCAD analysis, Yazdani, Atousa, CRC Press,2018,
6. Power systems analysis illustrated with MATLAB and ETAP,Madhusudan, Shertukde ,Hemchandra, 2019, ISBN 10:0429792425

WEB REFERENCES:

1. https://www.youtube.com/watch?v=BqG1ttpCI1U

OUTCOMES:

At the end of the course, the student should be able to:

1. Identify their quantitative ability. (K2)
2. Describe the ability of arithmetic reasoning along with creative thinking and problem solving skills. (K2)
3. Illustrate their verbal ability through vocabulary building and grammar. (K2)
4. Analyze the DC motor and BLDC motor using Maxwell/MAGNET software (K4)
5. Apply ETAP &PSCAD programming to solve various Power System problems (K3)

CO- PO & PSO MAPPING:

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

SEMESTER - VIII

20EEPJ801 SDG NO. 4,6,7, 8, 9,11,12,13,17	PROJECT PHASE-II	L	T	P	C
		0	0	8	4

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students face reviews and viva voce examination

GUIDELINES TO BE FOLLOWED:

The students may be grouped into 3 to 4 and work under a project supervisor and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor (faculty member). The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. The Project Work Phase-II will have the following Sequence:

I. Problem Identification

1. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
2. List of possible solutions including alternatives and constraints
3. Cost benefit analysis
4. Time Line of activities

II. A report highlighting the design finalization [based on functional requirements and standards (if any)]

III. A presentation including the following

1. Implementation Phase (Hardware / Software / both)
2. Testing and Validation of the developed system
3. Learning in the Project

IV. Consolidated report preparation

TOTAL: 120 PERIODS

OUTCOMES :

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

1. Comprehend an industrial or real life problem and identify right/ real issue with solution. (K2)
2. Analyze the necessary studies and review the literature, design a setup of equipment, complete the analysis. (K3)
3. Compose a project report based on the findings. (K6)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Co1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2

PROFESSIONAL ELECTIVES - I

20EEEL501 SDG NO. 4,7, 9, 11,12&13	ELECTRICAL ENERGY GENERATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Providing an overview of Power Plants
- Detailing the role of Engineers in their operation and maintenance
- Understanding the economics of various Power Plants

UNIT I COAL BASED THERMAL POWER PLANTS **9**

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment, Binary Cycles and Cogeneration systems.

UNIT II DIESEL AND GAS TURBINE POWER PLANTS **9**

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation- Components of Diesel and Gas Turbine power plants- Combined Cycle Power Plants- Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS **9**

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors- Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY **9**

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V TARIFF AND ECONOMIC ASPECTS OF ELECTRICAL ENERGY GENERATION SYSTEMS **9**

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of

different power plants.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Nag. P.K., "Power Plant Engineering", Fourth Edition, McGraw – Hill Publishing Company Ltd., 2014.
2. Hegde R.K., "Power Plant Engineering", First Edition, Pearson Education India. 2015.

REFERENCES:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill,1998.
4. S. C. Arora, S. Domkundwar, A. V. Domkundwar,"A Course In Power Plant Engineering", Sixth Edition, Dhanpat Rai & Company, 2011

WEB REFERENCES:

1. https://nptel.ac.in/courses/112107291/
2. https://nptel.ac.in/courses/121/106/121106014/

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=tYBg-zsli98&list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz
2. https://www.youtube.com/watch?v=JSgd-QhLHRI

OUTCOMES:

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

1. Explain the layout, construction and working of the components in a thermal power plant. .
2. Illustrate the layout, construction and working of the components in a Diesel, Gas and Combined cycle power plants.
3. Classify the various types of nuclear power plants, based on working principles.
4. Interpret the layout, construction and working of Renewable energy power plants.
5. Identify the applications, economics and environmental hazards of power plants.

CO- PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - I

20EEEL502 SDG NO. 4, 7, 9, 11, 12 & 13	POWER ENGINEERING & INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the generation of power from various resources
- To understand the Electrical Equipments in Power Station for the generation of electricity.
- To understand the Electrical Transmission and Distribution system
- To learn the workings of various Instruments
- To impart the Computer based system for power plant operation, maintenance and protection.

UNIT I POWER GENERATION **9**

Power Generation-Thermal, Nuclear, Diesel and Gas Turbine Power Plants - Power from renewable energy- hydro, wind and solar photo voltaic systems. Economics of power generation.

UNIT II ELECTRICAL EQUIPMENT IN POWER STATION **9**

Construction and working of Generator-Transformers-Switchyard-Typical layout of Switchyard of a Thermal Power Station, Bus system, Isolators, CTs, PTs, Earthing, Oil Circuit Breakers, Air Blast Circuit Breakers, SF6 Circuit Breakers, Vacuum Circuit Breakers.

UNIT III POWER TRANSMISSION AND DISTRIBUTION 9

Introduction to electrical Power System-Transmission Lines - line parameters -resistance- inductance and capacitance - Transmission and distribution system - Standard voltages for transmission-Substations and Feeders - Distributors & Service mains - Overhead transmission lines- Tower design- Sag calculation in conductors- Insulators- String efficiency and methods of increasing string efficiency- Underground Cables- Grading of cables, capacitance grading and inter sheath grading, testing of cables.

UNIT IV TRANSDUCERS, MECHANICAL MEASUREMENT AND INDUSTRIAL INSTRUMENTATION 9

Resistive, Capacitive, Inductive and piezoelectric transducers and their signal conditioning. Measurement of displacement, velocity and acceleration (translational and rotational), force, torque, vibration and shock. Measurement of pressure, flow, temperature and liquid level. Measurement of pH, conductivity, viscosity and humidity.

UNIT V INSTRUMENTATION SCHEMES FOR MONITORING AND CONTROL 9

Instrumentation schemes for monitoring and control of various parameters of power plants through control panels, Computer based data acquisition system for power plant operation, Maintenance and protection, Use of SCADA in power systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Nag. P.K, "Power Plant Engineering", Fourth Edition, Tata McGraw – Hill Publishing Company,2017
2. A.K.Sawhney , "Electrical & Electronic Measurement and Instrumentation", Dhanpat Rai & sons, New Delhi,2021

REFERENCES:

1. Nath, R., and Chandra,M, " Power System Protection and Switchgear", New Age International (P) Limited, Publishers,2003.
2. Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, Second Edition, New Delhi ,2011
3. Curtis D. Johnson, "Process Control Instrumentation Technology", Eighth Edition, Prentice Hall, New Delhi,2005.
4. Krishna Kant, " Computer-based Industrial Control, Prentice Hall India Learning Private Limited; , New Delhi,2010

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_me10/preview
2. https://nptel.ac.in/courses/108/102/108102146/
3. https://nptel.ac.in/courses/108/108/108108147/
4. https://www.coursera.org/learn/sensors-circuit-interface

OUTCOMES:

At the end of the course, the student should be able to:

1. Discuss the concepts of generation of power from solar, wind, biomass thermal, nuclear, hydro power plants (K2)
2. Illustrate about the Electrical equipments such as Generator, Transformers, Circuit breakers in Power Station. (K2)
3. Describe about the Electrical Power Transmission and Distribution systems (K2)
4. Explain the construction and working of active and passive Transducers (K2)
5. Discuss various non electrical quantity measurements like pressure, flow, temperature, conductivity, viscosity and humidity(K2)
6. Explain Computer based system for power plant operation, SCADA maintenance and protection (K2)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	3	2	1	2	-	2	1	1	2
CO2	3	2	2	1	2	3	2	1	2	-	2	1	2	2
CO3	3	2	2	1	2	3	2	1	2	-	2	1	1	3
CO4	3	2	2	1	2	3	2	1	2	-	2	1	1	3
CO5	3	2	2	1	2	3	2	1	2	-	2	1	1	3
CO6	3	2	2	1	2	3	2	1	2	-	2	1	1	3

PROFESSIONAL ELECTIVES - I

20EEEL503 SDG NO. 4, 9	SOLAR AND WIND ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the physics of wind power and energy
- To understand the principle of operation of wind generators
- To know the solar power resources
- To analyse the solar photo-voltaic cells
- To discuss the solar thermal power generation
- To identify the network integration issues

UNIT I FUNDAMENTALS OF ENERGY SCIENCE AND TECHNOLOGY 9

Introduction, Energy, Economy and Social Development, Classification of Energy Sources, Importance of Non -conventional Energy Sources, Salient features of Non-conventional Energy Sources, World Energy Status, Energy Status in India, important Aspects of Energy Conservation, Global Efforts, Achievements and Future Planning, Energy Conservation/Efficiency Scenario in India, Energy Conservation Opportunities

UNIT II SOLAR ENERGY-BASIC CONCEPTS 9

Introduction, Measurement of Solar Radiation, Solar Radiation Data, Solar Time, Solar Radiation Geometry, Solar Day Length, Extra-terrestrial Radiation on Horizontal Surface, Empirical Equations for Estimating Terrestrial Solar Radiation on Horizontal Surface, Solar Radiation on Inclined Plane Surface. Solar Collectors, Solar Water Heater, Solar Passive Space Heating and Cooling Systems, Solar Industrial Heating Systems, Solar Refrigeration and Air Conditioning Systems, Solar Cookers.

UNIT III SOLAR PHOTOVOLTAIC SYSTEMS 9

Introduction, Solar Cell Fundamentals, Solar Cell Characteristics, Solar Cell Classification, Solar Cell Technologies, Solar Cell, Module, and Array Construction, Maximizing the Solar PV Output and Load Matching. Maximum Power Point Tracker. Balance of System Components, Solar PV Systems, Solar PV Applications.

UNIT IV WIND ENERGY 9

Introduction, Basic Principles of Wind Energy Conversion, History of Wind Energy, Wind Energy Scenario – World and India. The Nature of the Wind, The

Power in the Wind, Forces on the Blades, Wind Energy Conversion, Wind Data and Energy Estimation, Site Selection Considerations

UNIT V BASIC COMPONENTS OF A WIND ENERGY CONVERSION(WEC) SYSTEM 9

Classification of WEC systems, Advantages and Disadvantages of WECS, Types of Wind Machines (Wind Energy Collectors), Analysis of Aerodynamic Forces Acting on the Blade, Performance of Wind- machines, Generating Systems, Energy Storage, Applications of Wind Energy, Environmental Aspects.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. B. H. Khan 'Non-Conventional Energy Resources' McGraw Hill, 2nd Edition, 2017
2. Rai, G. D 'Non-Conventional Sources of Energy' Khanna Publishers, 4th Edition, 2009

REFERENCE BOOKS:

1. ShobhNath Singh 'Non-Conventional Energy Resources' Pearson, 1st Edition, 2015
2. S.P. Sukhatme J.K.Nayak 'Solar Energy – Principles of Thermal Collections and Storage' McGraw Hill 3rd Edition, 2008
3. Ahmad Hemami, 'Wind Turbine Technology' Cengage Learning, 1st Edition, 2012
4. S.N.Bhadra, D.Kastha,S.Banerjee, Soumitro Banerjee 'Wind Electrical Sytems', OUP India,2005

ONLINE RESOURCES:

1. https://www.coursera.org/learn/renewable-energy-fundamentals
2. https://www.coursera.org/learn/solar-energy-basics
3. https://www.coursera.org/learn/wind-energy

OUTCOMES:

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

1. Summarize the importance of energy in human life, relationship among economy and environment with energy use and the increasing role of renewable energy (k2)
2. Apply the concept of energy storage and the principles of energy storage devices (k3)
3. Demonstrate the performance and operation of solar PV and wind machines with their environmental aspects (k2)

4. Utilize the radiation of solar energy and wind energy data to solve the real time problems. (k2)
5. Illustrate the design of solar PV and wind systems with their applications
6. Explain the process of harnessing solar energy and its applications in heating and cooling (k2)

CO, PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	3	-	-	-	-	-	-	-	2	2
CO2	1	1	2	2	2	-	-	-	-	-	2	-	2	2
CO3	1	2	1	1	2	-	-	-	-	-	1	-	2	2
CO4	1	2	1	2	2	-	-	-	-	-	1	1	3	1
CO5	2	-	3	1	1	-	-	-	-	-	1	-	3	3
CO6	1	2	-	1	1	-	-	-	-	-	1	1	1	2

PROFESSIONAL ELECTIVES - I

20EEEL504 SDG NO. 4,9	DESIGN OF ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss design factors, limitations in design and modern trends in design and manufacturing of electrical machines.
- To discuss the properties of electrical, magnetic and insulating materials used in the design of electrical machines.
- To derive the output equation of DC machine, single phase, three phase transformers, induction motor and synchronous machines.
- To discuss the selection of specific loadings, for various machines and separation of main dimensions for different electrical machines

UNIT I FUNDAMENTAL ASPECTS OF ELECTRICAL MACHINE DESIGN 9

Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques. Electrical Engineering Materials: Desirabilities of Conducting Materials, Comparison of Aluminium and Copper wires. Ferromagnetic Materials: Soft Magnetic materials – Solid Core Materials, Electrical Sheet and Strip, Cold Rolled Grain Oriented Steel.

Insulating Materials: Desirable Properties, Temperature Rise and Insulating Materials, Classification of Insulating materials based on Thermal Consideration.

UNIT II DESIGN OF DC MACHINES 9

Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings

UNIT III DESIGN OF TRANSFORMERS 9

Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, No Load Current. Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes

UNIT IV DESIGN OF THREE PHASE INDUCTION MOTORS 9

Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance

UNIT V DESIGN OF THREE PHASE SYNCHRONOUS MACHINES 9

Block Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding

TOTAL: 45 PERIODS

TEXT BOOKS:

1. A.K. Sawhney, "A course in Electrical Machine design", DhanpatRai Sixth Edition, 2013
2. A.Shanmugasundaram, G.Gangadharan, R.Palani "Electrical Machine Design Data Book", New Age International Pvt. Ltd, 1st Edition, 2005.

REFERENCES:

1. M.G. Say., "Performance and Design of Alternating Current Machines", CBS Publisher, 3rd Edition, 2002

2. Siskind,"Electrical Machine Design", Mcgraw Hill Book Co Publication, 1954.
3. M.V. Deshpande - A Course in Electrical Machine Design (Prentice Hall Of India).(Design And Testing Of Electrical Machines), 2010
4. R.K.Agarwal," Principles of Electrical Machine Design", Essakay Publications, Delhi, 2002

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=2zpkI0Uzab4
2. https://www.youtube.com/watch?v=AUV3ynKLeKA

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Outline the properties of conducting material , magnetic material and insulating material and their thermal considerations. (K2)
2. Design the main dimensions, output equations, poles, armature and commutators of DC machines. (K3)
3. Develop the main dimensions, output equations, cooling tubes and compute the performance characteristics of single-phase and three phase transformers. (K3)
4. Design the main dimensions, output equations, types of rotors and operating characteristics of three phase induction motor. (K3)
5. Design the main dimensions, output equations, rotors, operating characteristics of synchronous machines and illustrate the design concepts of turbo alternators. (K3)

CO, PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - I

20EEEL505 SDG NO. 4, 9	TRANSDUCER ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the methods of measurement, classification of transducers and to analyse error.
- To understand the behaviour of transducers under static and dynamic conditions and hence to model the transducer.
- To exposed different types of resistive, capacitive and inductive transducers and their application areas.
- To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

Units and standards – Static calibration – Classification of errors, Limiting error and probable error – Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers

UNIT II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics: - Accuracy, precision, resolution, sensitivity, linearity, span and range. Dynamic characteristics: Mathematical model of transducer, Zero, I and II order transducers, Response to impulse, step, ramp and sinusoidal inputs.

UNIT III VARIABLE RESISTANCE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

UNIT IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 9

Inductive transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details, characteristics of capacitive transducers – Different types & Signal Conditioning – Applications:- Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

UNIT V OTHER TRANSDUCERS **9**

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Fiber optic sensors – Seismic pickup transducers – Introduction to MEMS, Smart transducers and its interface standard (IEEE 1451).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Deobelin E.O. and Manik D.N., "Measurement Systems", Sixth edition Tata McGraw Hill Education Pvt Ltd,2017
2. Renganathan, S., "Transducer Engineering", Allied Publishes, 2003.

REFERENCES:

1. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2005
2. Albert D. Helfrick and Cooper, W. D., "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall., 2017.
3. Murthy D. V. S, "Transducers and Instrumentation", Second Edition, Prentice Hall, New Delhi,2011
4. Patranabis, D., "Sensors and Transducers", Second Edition, Prentice Hall of India,2003.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_ee41/preview
2. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html
3. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf

ONLINE RESOURCES:

1. https://instrumentationtools.com/tag/sensors-and-transducers-nptel-pdf/
2. https://electronics-tutorials.ws/io/io-

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Explain about different errors, error analysis and transducers (K2)
2. Infer the static and dynamic characteristics of various transducers (K2)
3. Explain the construction and working of variable Resistance Transducers (K3)
4. Describe about construction and working of Inductance Transducers (K3)

5. Illustrate the working of Capacitance Transducers (K2)
6. Explain about construction & working of Piezoelectric, Hall effect, Digital transducer, fibre optic and smart sensors.(K2)

CO, PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	3	-	-	-	-	2	1	1	2
CO2	3	2	2	1	2	3	-	-	-	-	2	1	2	2
CO3	3	2	2	1	2	3	-	-	-	-	2	1	1	3
CO4	3	2	2	1	2	3	-	-	-	-	2	1	1	3
CO5	3	2	2	1	2	3	-	-	-	-	2	1	1	3
CO6	3	2	2	1	2	3	-	-	-	-	2	1	1	3

PROFESSIONAL ELECTIVES - I

20EEEL506 SDG NO. 4, 9	ELECTRICAL ENGINEERING MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the knowledge of electrical and electronic materials.
- To impart the knowledge of conducting, dielectric, insulating and magnetic materials and their applications.
- To impart the knowledge of superconducting materials and their applications
- To impart the knowledge of plastics and materials for Opto - Electronic devices

UNIT I INTRODUCTION TO ELECTRICAL AND ELECTRONIC MATERIALS **9**

Introduction to Electrical and Electronic Materials: Importance of materials, Classification of electrical and electronic materials, Scope of electrical and electronic materials, Requirement of Engineering materials, Operational requirements of electrical and electronic materials, Classification of solids on the basis of energy gap, Products – working principle and materials, Types of engineering materials, Levels of material structure. Spintronics and Spintronic materials, Ferromagnetic semiconductors, Left handed materials. Conductors: Conductor materials, Factors affecting conductivity, Thermal

conductivity, Heating effect of current, Thermoelectric effect, Seebeck effect, Thomson effect, Wiedemann – Franz law and Lorentz relation, Problems .

UNIT II CONDUCTIVE MATERIALS AND APPLICATIONS 9

Mechanically processed forms of electrical materials, Types of conducting materials, Low resistivity materials, High resistivity materials, Contact materials, Fusible materials, Filament materials, Carbon as filamentary and brush material, Material for conductors, cables, wires, solder, sheathing and sealing. Dielectrics: Introduction to dielectric materials, classification of dielectric materials, Dielectric constant, Dielectric strength and Dielectric loss. Polarization, Mechanisms of polarization, Comparison of different polarization process, Factors affecting polarization, Spontaneous polarization, Behaviour of polarization under impulse and frequency switching, Decay and build-up of polarization under ac field, Complex dielectric constant.

UNIT III INSULATING MATERIALS AND MAGNETIC MATERIALS 9

Insulating materials and applications – Ceramic, Mica, Porcelain, Glass, Micanite and Glass bonded mica. Polymeric materials – Bakelite, Polyethylene. Natural and synthetic rubber. Paper. Choice of solid insulating material for different applications, Liquid insulating materials – Requirements, Transformer oil, Bubble theory, Aging of mineral insulating oils. Gaseous insulating Materials – Air, Nitrogen, Vacuum.-Origin of permanent magnetic dipole, Magnetic terminology, Relation between relative permeability and magnetic susceptibility. Classification of magnetic materials, Diamagnetic, Paramagnetism, Ferromagnetism, Antiferromagnetism and the corresponding materials. Ferrimagnetism and ferrites – properties and applications, Soft and hard ferrites. Curie temperature, Laws of magnetic materials. Magnetization curve, Initial and maximum permeability. Hysteresis loop and loss, Eddy current loss.

UNIT IV SUPERCONDUCTIVE MATERIALS 9

Concept of superconductors, Meaning of phenomenon of superconductivity, Properties of superconductors, Types of superconductors, Critical magnetic field- and critical temperature, Effects of Isotopic mass on critical temperature, Silsbee rule, Depth of penetration and coherence length. Ideal and Hard superconductors, Mechanism of super conduction, London's theory for Type I superconductors, GLAG theory for Type I superconductors, BCS theory, Applications and limitations. Applications of high temperature superconductors, Superconducting solenoids and magnets, MRI for medical diagnostics.

UNIT V PLASTICS AND MATERIALS FOR OPTO ELECTRONIC DEVICES 9

Introduction, Thermoplastics, Rubbers, Thermosets, DC and AC properties, Mechanical properties and processing of plastic- Introduction, Optical phenomena, Reflection, Refraction, Transmittivity, Scattering, Optical absorption, Optical properties of non-metals, Optical properties of metals, Optical properties of semiconductors, Optical properties of insulators. Luminescence, Opto – Electronic devices, Photoconductivity, Photoconductive cell.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. K.M. Gupta, Nishu Gupta "Advanced Electrical and Electronics Materials; Processes and Applications" Wiley, First Edition, 2015
2. P.L Kapur "Electrical & Electronics Engineering Materials", Khanna Publishers, Eight Edition, 2016.

REFERENCES:

1. R.K. Shukla Archana Singh "Electronic Engineering Materials" McGraw Hill, 8th Edition, 2012.
2. L Solymar et al "Electrical Properties of Materials" Oxford University Press New Delhi, 9th Edition, 2014.
3. A.J. Dekker "Electrical Engineering Materials" Pearson, 3rd edition, 2016.
4. S.O. Kasap "Principle of Electronic Materials and Devices" McGraw Hill 3rd Edition 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/113/106/113106032/
2. https://nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_14_m.pdf

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=3W-rOtTc3ek
2. https://nptel.ac.in/courses/113/102/113102080/
3. https://www.youtube.com/watch?v=XaId7WR0mGo

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the electrical and electronics materials, their importance, classification and operational requirement. (K2)
2. Understand the conducting materials used in engineering, their

properties and classification. (K2)

3. Explore the dielectric materials and insulating materials used in engineering, their properties and classification. (K2)
4. Outline the different magnetic materials used in engineering, their properties and classification. (K2)
5. Explain the phenomenon superconductivity, super conducting materials and their application in engineering. (K2)
6. Categorize the plastic, materials used for Opto electronic devices and its properties and applications. (K2)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	1	2	-	-	-	-	-	-	1	3
CO2	2	1	2	2	1	2	-	-	-	-	-	-	2	2
CO3	2	1	2	2	-	3	-	-	-	-	-	-	2	2
CO4	2	1	2	2	-	2	-	-	-	-	-	-	2	3
CO5	2	2	1	1	-	2	-	-	-	-	-	-	2	3
CO6														

PROFESSIONAL ELECTIVES - I

20EEEL507 SDG NO. 4, 9	DISCRETE-TIME SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make students impart knowledge about the signals and systems & their mathematical representation of discrete time systems.
- To make students aware of the Transformation techniques & their computation.
- To make the students understand Filters and their design for digital implementation.
- To make students familiarize with Programmability digital signal processor & quantization effects.

UNIT I INTRODUCTION **9**

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II DISCRETE TIME SYSTEM ANALYSIS **9**

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z- transform, application to discrete systems - Stability analysis, frequency response – Convolution – Discrete Time Fourier transform , magnitude and phase representation.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION **9**

Process Discrete Fourier Transform- properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT & DIF using radix 2 FFT – Butterfly structure.

UNIT IV DESIGN OF DIGITAL FILTERS **9**

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. Analog filter design – Butterworth and Chebyshev approximations; IIR Filters, digital design using impulse invariant and bilinear transformation Warping, pre warping.

UNIT V DIGITAL SIGNAL PROCESSORS **9**

Introduction – Architecture – Features – Addressing Formats – Functional modes - Introduction to Commercial DS Processors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John G. Proakis , Dimitris G Manolakis, ,'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 5th edition, 2022.
2. Sanjit. K. Mitra, 'Digital Signal Processing –A Computer Based Approach', McGraw Hill Edu, 4th edition. 2013.

REFERENCES:

1. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning, 3rd edition, 2016.

2. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 3rd Edition, 2017
3. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with Mat Lab', CRC Press, 2nd Edition 2012.
4. Sen M. kuo, woon- seng Gan,"Digital Signal Processors,Architecture, Implementations & Applications, Pearson, 2013

WEB REFERENCES:

1. https://nptel.ac.in/courses/117/102/117102060/
2. https://nptel.ac.in/courses/117/104/117104070/

ONLINE RESOURCES:

1. https://www.youtube.com/playlist?list=PL9567DFCA3A66F299

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the importance of signal and systems in time and frequency domain. (K2)
2. Summerize Signals and systems & their mathematical representation. (K2)
3. Analyze the Characteristics and properties of Linear Time Invariant (LTI) system in Time domain, Fourier domain and Z-domain. (K3)
4. Analyze the frequency transformation techniques & their computation.
5. Ability to understand the types of filters and their design for digital implementation.(K3)
6. Illustrate programmability digital signal processor & quantization effects. (K2)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	1	-	-	-	-	-	-	2	2	2	2
CO2	2	2	3	2	-	-	-	-	-	-	2	2	2	2
CO3	3	2	3	2	-	-	-	-	-	-	2	2	2	2
CO4	1	2	2	2	-	-	-	-	-	-	2	2	2	2
CO5	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO6	2	2	1	2	1	-	-	-	-	-	1	1	1	1

PROFESSIONAL ELECTIVES - I

20EEEL508 SDG NO. 4	ARDUINO AND RASPBERRY PI BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Layout and Libraries inside the Arduino and Raspberry Pi development Environment
- Measure various physical parameters using sensors by interfacing using Arduino and Raspberry Pi.
- Various communication protocol for wired and wireless communication.
- Interface with various Electro-mechanical devices like DC motor, Stepper motor, Servo motor.

UNIT I ARDUINO INTRODUCTION & CONCEPTS 9

Introduction to Arduino – Pin configuration and architecture- Device and platform features-Concept of digital and analog ports - Familiarizing with Arduino Interfacing Board- Introduction to Embedded C and Arduino platform.

UNIT II ARDUINO & EMBEDDED C 9

Arduino data types - Variables and constants- Operators- Control Statements- Functions –Pointers-structures ,

UNIT III ARDUINO WITH PERIPHERAL DEVICES 9

Sensors - Humidity Sensor, Temperature Sensor, Ultrasonic Sensor- Interfacing Servo motors-Controlling LEDs with keys - Arduino UART- GSM/GPRS Arduino Interfacing.

UNIT IV INTRODUCTION TO RASPBERRY Pi & PROGRAMMING CONCEPT 9

Basic functionality of Raspberry Pi board and its processor – differentiating Raspberry Pi board with Arduino – Raspberry Pi Interfaces - Serial , SPI , I2C , Programming Raspberry Pi with Python

UNIT V APPLICATION USING RASPBERRY Pi 9

LED Blinking using Python Raspberry Pi library - Temperature sensing using 1-wire temp sensor – detection of room light from a photocell sensor connected to the GPIO pins – DC motor, stepper motor, Camera interfacing using Raspberry Pi

TOTAL : 45 PERIODS

TEXT BOOKS

1. Alan G. Smith - Introduction to Arduino: A piece of cake, CreateSpace Independent Publishing Platform, 2011.
2. Ebenupton and GerathHalfacreee, Raspberry pi user guide, John Wiley & Sons, 2016

REFERENCE BOOKS

1. Massimo benzi, Michael Shiloh - Make: Getting Started with Arduino, 3ed./, Maker media, 2014.
2. Michael McRoberts - Beginning Arduino, Apress, 2010
3. Brians Evans – Beginning Arduino Programming, Apress,2011.
4. Tim Cox,Raspberry pi for Python Programmers Cook book Packt Publishing limited,2nd Revised Edition,2016.

WEB REFERENCES:

1. https://www.classcentral.com/course/raspberry-pi-platform-4334
2. https://nptel.ac.in/courses/106/105/106105166/

ONLINE RESOURCES:

1. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106105193/lec21.pdf
2. https://www.futurelearn.com/courses/physical-computing-raspberry-pi-python/0/steps/23043

OUTCOMES:

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

1. Understand the concepts of Arduino and embedded C (K2)
2. Apply the various libraries of Arduino and embedded C (K3)
3. Utilize the various peripheral devices for Arduino for its application (K3)
4. Make use of Arduino and Raspberry pi for wire and wireless commu nication (K3)
5. Develop the real time application with Arduino and Raspberry pi (K3)

CO, PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	1	-	-	-	-	-	-	1	2	3
CO2	2	3	3	2	2	-	-	-	-	-	-	1	2	2
CO3	2	1	3	2	1	1	1	-	-	-	-	2	2	2
CO4	2	3	2	2	2	-	-	-	-	-	1	2	2	2
CO5	3	3	3	2	2	1	1	-	1	-	1	2	3	3
CO6	3	3	3	2	2	1	1	-	1	-	1	2	3	3

PROFESSIONAL ELECTIVES - I

20EEEL509 SDG NO. 4,7&13	INTERNET OF THINGS FOR ELECTRICAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about basics of Internet of Things
- To understand about basics of data handling methods
- To understand the details of Sensors and Embedded Devices
- To know about IoT Security and Business Models
- To apply IOT for Electrical Engineers

UNIT I INTRODUCTION **9**

IoT framework-IoT architectural view-Sources of IoT-M2M Communication-IoT system layers-Communication technologies - Data consolidation - Device management-Web communication protocols-Message communication protocols- IP addressing in IoT-Application layer protocols

UNIT II DATA HANDLING **9**

Data acquiring and storage-Organizing the data-Data analytics-Knowledge acquiring-Knowledge management-Knowledge storage-Cloud computing paradigm-Cloud service models-IoT cloud-based services, Xively, Nimbits

UNIT III SENSORS & EMBEDDED DEVICES **9**

Sensor technology-Industrial IoT-Actuator-Sensor data communication protocols-Wireless sensor networks-Embedded computing basics-

Embedded platforms for prototyping-prototyping embedded device software

UNIT IV IoT SECURITY & BUSINESS MODELS **9**

Vulnerabilities-Security requirement-Threat analysis-IoT security tomography-IoT layered attacker model-Secure message communication-Security models for IoT-Privacy and ethical issues-Business model innovation-Value creation in the IoT- Business model scenarios for IoT-Challenges in IoT

UNIT V CASE STUDIES FOR ELECTRICAL ENGINEERS **9**

Traffic light control system- Healthcare-Artificial intelligence system in object system-Sentiment analysis of product reviews- Distributed healthcare information systems-Industrial IoT-IoT applications in the supply chain and customer monitoring-Connected car and its application and services-Smart homes-Smart cities- Smart agriculture- Intelligent amalgamation of blockchain technology

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Rajkamal," Internet of Things - Architecture and Design principles", McGrawHill India Pvt Ltd., e-Book.
2. Arun Kumar Rana, Ayodeji Olalekan Salau, Sharad SHarma, Shubam Thayal, Swati Gupta, " Internet of Things- Energy, Industry, and healthcare", CRC press, 2022.

REFERENCE BOOKS:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-On Approach", VPT Publisher, 2014.
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand and David Boyle, "From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence", Academic Press, 2014.
3. Olivier Hersent, David Boswarthick and Omar Elloumi, - The Internet of Things: Key Applications and Protocols, John Wiley and Sons Ltd., UK 2012.
4. Charalampos Doukas, "Building Internet of Things with the Arduino", Create space, April 2002.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc21_cs17/preview.
2. https://onlinecourses.nptel.ac.in/noc21_ee85/preview.

3. https://www.digimat.in/nptel/courses/video/106105166/L01.html.
4. https://www.digimat.in/nptel/courses/video/106105166/L02.html.

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the characteristics, functional blocks of IoT. (K3)
2. Understand data acquiring, storage and cloud management system. (K3)
3. Analyze sensors and embedded devices. (K3)
4. Ability to design IoT security and business models. (K4)
5. Apply IOT concepts for development of applications. (K4)
6. Apply IOT concepts for development of application in Electrical engineering. (K4)

CO, PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - I

20EEEL510 SDG NO. 4,9	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on safety Engineering Fundamentals and safety Management practices.
- To make students aware of the various available methods of chemical Hazards, Safety Regulations, Explosions, and Disaster Management
- To make the students aware of basic concepts of Environmental control, industrial noise, noise measuring Instruments.
- To make the students understand different types and techniques of System Safety Analysis.

UNIT I INTRODUCTION **9**

Evolution of modern safety concepts - Fire Prevention- Mechanical Hazards - Boilers, Pressure Vessels - Electrical Exposure.

UNIT II CHEMICAL HAZARDS **9**

Chemical Exposure - Toxic Materials - Ionizing Radiation and Non Ionizing Radiation - Industrial Hygiene - Industrial Toxicology.

UNIT III ENVIRONMENTAL CONTROL **9**

Industrial Health Hazards - Environmental control - Industrial noise - Noise measuring Instruments - Control of noise, Vibration, - Personal Protection.

UNIT IV HAZARD ANALYSIS **9**

System Safety Analysis - Techniques - Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP Analysis and Risk Assessment.

UNIT V SAFETY REGULATIONS

Explosions - Disaster Management - Catastrophe control, Hazard Control, Safety Education and training - Factories Act - Safety Regulations product Safety - Case Studies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John.V.Grimaldi, "Safety Management", AITB S Publishers, 2003.

REFERENCES:

1. Safety Manual, “EDEL Engineering Consultancy", 2000.
2. David L Goetsch, "Occupational Safety and Health for Technologists", 5th Edition Engineers and Managers, Pearson Education ltd., 2005.

WEB REFERENCES:

1. https://nptel.ac.in/courses/110105094/

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=v-eltsixu4I.
2. https://www.youtube.com/watch?v=QGkyYkx2NFY
3. https://www.youtube.com/watch?v=v-eltsixu4I

OUTCOMES:

Upon completion of the course, the student should have:

1. Explain the basic concepts of mechanical, fire, chemical, Environmental Hazards and industrial hygiene and safety. (K2)
2. Apply proper techniques for Fire Prevention, Electrical Exposure, Ionizing and Non Ionizing Radiation, toxicology. (K3)
3. Outline the Industrial Health Hazards, Industrial noise, control of noise, vibration and personal protection. (K2)
4. Outline the System Safety Analysis- Techniques- Fault Tree Analysis (FTA), Failure Modes and Effect Analysis(FMEA), HAZOP Analysis and Risk Assessment. (K2)
5. Explain the modern safety concepts, catastrophe control, hazard control, Safety education and training - Factories Act, Safety Regulations, Product safety for Industrial safety and disaster management. (K2)
6. Compare various case studies for Safety Regulations and disaster management for various types of industries. (K2)

CO, PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	1	-	3	-	-	-	-	-	-	-	-	2	1	-
CO3	1	3	-	-	3	-	-	-	-	-	-	-	1	3
CO4	-	-	3	-	-	-	-	-	-	-	-	2	-	-
CO5	-	-	3	-	-	-	-	-	-	-	-	2	-	-
CO6	-	3	-	-	-	-	-	-	-	-	-	-	-	3

PROFESSIONAL ELECTIVES - II

20EEEL601 SDG NO. 4 & 7	POWER SYSTEM TRANSIENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Generation of switching transients and their control using circuit – theoretical concept
- Mechanism of lighting strokes and the production of lighting surges
- Propagation, reflection and refraction of travelling waves
- Voltage transients caused by faults, circuit breaker action, load rejection on integrated power system

UNIT I INTRODUCTION AND SURVEY 9

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT II SWITCHING TRANSIENTS 9

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple re-striking transients – ferro-resonance.

UNIT III LIGHTNING TRANSIENTS 9

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS 9

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step

response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM 9

The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines – over voltage induced by faults -switching surges on integrated system Qualitative application of EMTP for transient computation.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Allan Greenwood, "Electrical Transients in Power Systems", Wiley Inter Science, New York, 2ndEdition,1991.
2. PritindraChowdhari, "Electromagnetic transients in Power System", John Wiley and SonsInc., Second Edition,2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, "Power System Transients – A statistical approach", PHI Learning Private Limited, Second Edition, 2010.

REFERENCES

1. M.S.Naidu and V.Kamaraju, "High Voltage Engineering", McGraw Hill, Fifth Edition, 2013.
2. R.D. Begamudre, "Extra High Voltage AC Transmission Engineering", Wiley Eastern Limited, 1986.
3. Y.Hase, "Handbook of Power System Engineering", Wiley India,2012.
4. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley,2012.
5. Akihiro ametani, "Power System Transient Theory and Applications", CRC press, 2013.

WEB REFERENCES

1. https://nptel.ac.in/courses/108105104/
2. https://www.epfl.ch/labs/deslpwrs/research/power-systems-transients/

COURSE OUTCOMES:

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

1. Understand and analyze switching and lightning transients.(K2)
2. Acquire knowledge on generation of switching transients and their control.(K2)
3. Analyze the mechanism of lighting strokes.(K3)

4. Understand the importance of propagation, reflection and refraction of travelling waves.(K2)
5. Infer the voltage transients caused by faults and concept of circuit breaker action, load rejection on integrated power system. (K2)

CO, PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - II

20EEEL602 SDG NO. 4,11&12	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on over voltage phenomenon and breakdown mechanisms of different dielectrics
- To learn about high voltage and high current generation and measurement techniques.
- To learn how to conduct dielectric tests on various electrical equipment.

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEM 9

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages, Corona and its effects – Reflection and Refraction of Travelling waves- Protection against over voltages.

UNIT II DIELECTRIC BREAKDOWN 9

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of High DC, AC, impulse voltages and currents – Triggering and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers – Peak Voltmeter, Generating Voltmeters – Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps – High current shunts- Digital techniques in high voltage measurement.

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION 9

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", 6th Edition Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2020.
2. E.Kuffel and W.S. Zaengl, J.Kuffel, High voltage Engineering fundamentals, Newnes Second Edition ,Elsevier , New Delhi 2005.

REFERENCES:

1. C.L.Wadhwa, High voltage Engineering, New Age International Publishers, Third Edition, 2010.
2. Subir Ray, An Introduction to High Voltage Engineering, PHI Learning Private Limited, New Delhi, Second Edition, 2011.
3. Dieter Kind, Kurt Feser, High Voltage Test Techniques, Reed Educational and Professional publishing Ltd. (Indian edition), New Delhi, 2001.
4. L.L.Alston, High Voltage Technology, Oxford University Press, First Indian Edition 2011.

WEB RESOURCES:

1. https://nptel.ac.in/courses/108104048/
2. https://www.gegridsolutions.com/services/
3. https://swayam.gov.in/nd1_noc20_ee43/preview

ONLINE RESOURCES:

1. https://digital-library.theiet.org/content/journals/hve
2. https://www.mdpi.com/journal/energies/special_issues/HV_Engineering

OUTCOMES:

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

1 Explain the various types of over voltages in power system and its control techniques.(K2)
2. Illustrate the nature of breakdown mechanisms in solid, liquid and gaseous dielectrics.
3. Interpret the generation of various types of high voltages and currents in laboratories.(K2)
4. Identify the various techniques to measure high voltages and currents.(K3)
5. Explain the testing procedure of high voltage power apparatus and insulation coordination. (K2)

CO, PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - II

20EEEL603 SDG NO. 4,7&12	ELECTRIC ENERGY UTILIZATION AND CONSERVATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the conservation of electrical power and energy efficient equipments.
- To understand the principle, design of illumination systems and energy efficient lamps.
- To study the methods of industrial heating and welding.
- To understand the electric traction systems and their performance.

UNIT I ILLUMINATION **9**

Importance of lighting – properties of good lighting scheme – laws of illumination – types of lamps – lighting calculations – basic design of illumination schemes for residential, commercial, street lighting, factory lighting and flood lighting – LED lighting and energy efficient lamps.

UNIT II REFRIGERATION AND AIR CONDITIONING **9**

Refrigeration - Domestic refrigerator and water coolers - Air-Conditioning - Various types of air-conditioning system and their applications, smart air conditioning units - Energy Efficient motors: Standard motor efficiency, need for efficient motors, Motor life cycle, Direct Savings and payback analysis, efficiency evaluation factor.

UNIT III HEATING, WELDING AND ELECTROLYSIS **9**

Methods of electric heating - Resistance heating - Arc Furnaces - Induction heating - Dielectric heating. Electric Welding Types- Resistance welding - Arc welding - Electric oven heating. Faraday's laws of Electrolysis - Application of electrolytic Process - Electroplating - electroforming - Anodizing - Current and Energy Efficiency - Power Supplies - Types of Rectifiers.

UNIT IV ELECTRIC TRACTION **9**

Choice of an Electric Motor - Traction Motors - Characteristic - Systems of railway electrification - Power and Energy output from driving axles - Specific Energy output and consumption - Electric Braking - System of railway electrification

UNIT V CONSERVATION OF ELECTRICAL ENERGY **9**

Energy Conservation: Introduction-Motivation for Energy Conservation-Principles of Energy Conservation- Energy Conservation Planning-Energy Conservation in Electrical Generation, Transmission and Distribution-Energy Conservation in Household and Commercial Sectors- Energy Conservation legislation

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dr. Uppal S.L. and Prof. S. Rao, 'Electrical Power Systems', Khanna Publishers, New Delhi, 15th Edition, 2014.
2. Wadhwa, C.L. “Generation, Distribution and Utilization of Electrical Energy”, New Age International Pvt. Ltd, Revised Third edition, 2015.

REFERENCES:

1. Gupta.J.B, "Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons, 2019.
2. Partab.H, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co, New Delhi, 2017.
3. Openshaw Taylor.E, "Utilization of Electrical Energy in SI Units", Orient Longman Pvt. Ltd, 2003.
4. Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council.

WEB REFERENCES:

1. https://www.youtube.com/watch?v=p3PkcLjNUhI
2. https://www.youtube.com/watch?v=FjdQoBO22vk
3. http://nptel.iitm.ac.in/courses.php?disciplineId=108
4. https://en.wikipedia.org/wiki/Energy_conservation

ONLINE RESOURCES:

1. https://www.omega.co.uk/prodinfo/Heaters.html
2. http://www.railway-technical.com/trains/rolling-stock-index-l/train-equipment/electric-traction-control-d.html
3. https://www.scribd.com/doc/51540789/electric-heating-and-welding

OUTCOMES:

Upon completion of the course, the student should:

1. Explain the main aspects of utilization and conservation of electric energy.(K2)
2. Infer an appropriate method of heating for any particular industrial application.(K2)
3. Make use of domestic wiring connections and debug any faults that occurred.(K3)
4. Construct an electric connection for any domestic appliance like refrigerator as well as to design a battery charging circuit for a specific household application.(K3)
5. Develop the appropriate type of electric supply system as well as to evaluate the performance of a traction unit.(K3)
6. Identify energy efficient applications for domestic,industrial and commercial purposes. (K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	1	2	-	-	-	-	-	-	1	3
CO2	2	1	2	2	1	2	-	-	-	-	-	-	2	2
CO3	2	1	2	2	-	3	-	-	-	-	-	-	2	2
CO4	2	1	2	2	-	2	-	-	-	-	-	-	2	3
CO5	2	2	1	1	-	2	-	-	-	-	-	-	2	3
CO6	1	1	1	1	-	-	-	-	-	-	-	-	1	1

PROFESSIONAL ELECTIVES - II

20EEEL604 SDG NO. 4	MODELING AND ANALYSIS OF ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various fundamentals, machine design, machine modelling of various types of electrical machines. This will help you to gain knowledge and to do research in the area of electrical machine modeling

UNIT I BASIC CONCEPTS OF MODELING 9

Basic Two pole Machine – voltage and current relationship-Torque Equations-Mathematical model of separately excited D.C motor –Steady State analysis - Transfer function of Separately excited D.C Motor - Mathematical model of D.C Series motor, Shunt motor - Linearization Techniques for small perturbations

UNIT II REFERENCE FRAME THEORY 9

Real time model of a two-phase induction machine-Transformation to obtain constant matrices - three phase to two phase transformation - Power equivalence -Generalized model in arbitrary reference frame - Electromagnetic torque - Derivation of commonly used Induction machine models - Stator reference frame model - Rotor reference frame model Synchronously rotating reference frame model -Equations in flux linkages

UNIT III MODELING OF INDUCTION MACHINES 9

Three phase induction machine, Equivalent circuit analysis of steady state

operation-Free acceleration characteristics-Voltage and Torque equations in machine variables and arbitrary reference frame variables-analysis of dynamic performance for load torque variations- digital computer simulation.

UNIT IV MODELING OF SYNCHRONOUS MACHINE 9

Three phase synchronous machine and analysis of steady state operation-Voltage and Torque equations in machine variables and rotor reference frame variables(Parka's Equations).

UNIT V DYNAMIC ANALYSIS OF SYNCHRONOUS MACHINE 9

Analysis of dynamic performance for load torque variations-Generalized theory of rotating Electrical machine and Krons primitive machine.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis& control", Pearson Publications, 1st edition, 2015.
2. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive systems", IEEE Press, 3rd Edition,2013.

REFERENCES:

1. P.S.Bimbra, "Generalized Theory of Electrical Machines" Khanna publications, 7th edition , 2021.
2. Chee Mun Ong "Dynamic simulation of Electric machinery using MATLAB / Simulink", Prentice Hall of India Publications, 1998.

WEB RESOURSES:

1. https://en.wikipedia.org › wiki › Small-signal_model
2. https://uknowledge.uky.edu/cgi/viewcontent.cgi?article=1120&context=ece_etds
3. https://www.sciencedirect.com/science/article/pii/B978012369536950005X
4. https://ieeexplore.ieee.org/document/7381445
5. https://onlinelibrary.wiley.com/doi/10.1002/9781118524336.ch3

ONLINE RESOURCES:

1. http://nptel.ac.in/courses/108106023/

OUTCOMES:

At the end of the course, the student should be able to:

1. Explain about the basic concepts of machine modeling. (K2)

2. Illustrate the dynamic modeling and phase transformation. (K2)
3. Outline the electrical machine Equivalent circuit parameters. (K2)
4. Construct the modeling of induction machine(K3)
5. Explain the performance and dynamic modeling of synchronous machines. (K2)
6. Outline the steady state & transient analysis of electrical machines.(K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	-	-	-	-	-	1	2	2
CO2	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO3	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO4	3	3	3	2	-	-	-	-	-	-	-	1	2	2
CO5	3	2	2	2	-	-	-	-	-	-	-	-	2	2
CO6	3	2	2	2	1	-	-	-	-	-	-	1	2	2

PROFESSIONAL ELECTIVES - II

20EEEL605 SDG NO. 4,7	ADVANCED CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge on design state feedback control and state observer.
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

UNIT I STATE VARIABLE ANALYSIS 9

Introduction- concepts of state variables and state model-State model for linear continuous time systems, Diagonalisation- solution of state equations-Concepts of controllability and observability.

UNIT II STATE VARIABLE DESIGN **9**

Introduction to state model: Effect of state feedback - Pole placement design: Necessary and sufficient condition for arbitrary pole placement, State regulator design Design of state observers- Separation principle- Design of servo systems: State feedback with integral control.

UNIT III SAMPLED DATA ANALYSIS **9**

Introduction spectrum analysis of sampling process signal reconstruction difference equations The Z transform function, the inverse Z transform function, response of Linear discrete system, the Z transform analysis of sampled data control systems, response between sampling instants, the Z and S domain relationship. Stability analysis and compensation techniques.

UNIT IV NON LINEAR SYSTEMS **9**

Introduction, common physical nonlinearites, The phase plane method: concepts, singular points, stability of non linear systems, construction of phase trajectories system analysis by phase plane method. The describing function method, stability analysis by describing function method, Jump resonance.

UNIT V OPTIMAL CONTROL **9**

Introduction: Classical control and optimization, formulation of optimal control problem, Typical optimal control performance measures - Optimal state regulator design: Lyapunov equation, Matrix Riccati equation - LQR steady state optimal control – Application examples.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M.Gopal, "Digital Control and State Variable Methods", 4th edition, Mc Graw Hill India, 2012
2. K. Ogata, 'Modern Control Engineering', 5th Edition, Pearson, 2012.
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.

REFERENCES:

1. M.Gopal, Modern Control System Theory, 3rd edition, New Age International Publishers, 2014.
2. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011.

3. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.
4. T. Glad and L. Ljung,, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002.
5. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.

OUTCOMES:

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

1. Illustrate concepts of State model, State feedback & State observers for solving problems related to Controllability and Observability. (K2)
2. Construct pole placement controller and state variable observer for Linear Time Invariant (LTI) and Linear Time Variant (LTV) systems.(K3)
3. Outline the concept of Z-Transforms for solving problems related to stability analysis and compensation techniques.(K2)
4. To make use of describing function techniques for solving problems related to non linear systems using isoclines, delta and analytical methods.(K3)
5. Extend the basic concepts of optimization for understanding the solving techniques related to optimal control. (K2)
6. Apply Matrix Ricatti and LQR algorithms for solving optimization related problems in control systems. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	-	-	-	-	-	1	2	2
CO2	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO3	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO4	3	3	3	2	-	-	-	-	-	-	-	1	2	2
CO5	3	2	2	2	-	-	-	-	-	-	-	-	2	2
CO6	3	2	2	2	1	-	-	-	-	-	-	1	2	2

PROFESSIONAL ELECTIVES - II

20EEEL606 SDG NO. 4,9	DIGITAL CONTROL ENGINEERING ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the components of digital control system to provide the knowledge on pulse transfer functions and their analysis
- To analyse the stability, controllability and observability of a given discrete transfer function.
- To design a controller in discrete domain.
- To represent the linear time invariant System in discrete State Space and compute the state transition Matrix.

UNIT I INTRODUCTION TO DIGITAL CONTROL SYSTEMS 9

Introduction to digital control – Sampling Process – Sample and Hold Circuit – Zero and First Order hold – Z-Transform – Inverse Z- Transform – Region of convergence – Initial and Final Value Theorem - discrete transfer function

UNIT II PULSE TRANSFER FUNCTION AND TIME RESPONSE 9

Block diagram reduction methods – Reduction Rules- Multi-loop – MIMO Systems – Signal Flow Graph- steady state error – error transfer functions-Error Constants-Time-Domain Analysis of Second Order Systems-Time Response specifications.

UNIT III STABILITY ANALYSIS 9

Introduction-Jury Stability Test- Schur-Cohn stability Test- Bilinear transformation- Stability by Pole Location – Root locus method- Bode Plot.

UNIT IV DIGITAL CONTROLLER DESIGN 9

Digital Lag Lead Compensator by Bode method- Design of P,PI and PID Controller- Ziegler's- Nichols Method, Cohen-Coon Method – Dead-beat controller and Dahlin's controller.

UNIT V DISCRETE STATE VARIABLE TECHNIQUE 9

State equation of discrete data system with sample and hold – State transition equation – Methods of computing the state transition matrix - Decomposition of discrete data transfer functions – State diagrams of discrete data systems - Controllability and Observability.

TOTAL:45 PERIODS

TEXT BOOKS:

1. V.I.George and C.P.Kurien, Digital Control System, Cengage Learning, 2012.
2. B.C.Kuo, Digital Control System, 2nd Edition, Oxford University Press, 2010.

REFERENCES:

1. M.Gopal, 'Digital Control and State Variable Methods', Tata McGraw Hill, 3rd Edition, 2009.
2. C.M. Houpis, G.B.Lamount, ' Digital Control Systems- Theory, Hardware, Software', International Student Edition, McGraw Hill Book Co., 1985
3. M.Sami Fadali, Antonio Visioli, Digital Control Engineering Analysis and Design, Academic Press, 2013.
4. C.L.Philips and J.M.Pan, "Feedback Control System, Pearson, 2013.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108103008/
2. https://ocw.mit.edu/courses/mechanical-engineering/2-171-analysis-and-design-of-digital-control-systems-fall-2006/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3488/advanced-control-systems
2. http://mocha-java.uccs.edu/ECE4540/

OUTCOMES:

Upon completion of the course, the student should have:

1. Recall the concepts of digital control, sampling process, z transform, inverse z transform, state diagrams of discrete time systems, decomposition methods and pulse transfer function. (K2)
2. Summarize the concepts of Block Diagram Reduction Methods, Reduction Rules, Multi-loop MIMO Systems, Signal Flow Graph.(K2)
3. Apply the concepts of Controllability and Observability, Initial and Final Value Theorem. (K3)
4. Analyze the system in state variable form. Analyze the error and constants and time domain specification of pulse transfer function.(K3)
5. Test the stability of the given transfer function through various methods. (K3)
6. Design a digital controller for the given process . (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	2	-	-	-	-	-	1	2	2	2
CO2	2	1	1	1	1	-	-	-	-	-	1	2	2	2
CO3	1	2	2	2	2	-	-	-	-	-	1	2	2	2
CO4	2	2	2	2	2	-	-	-	-	-	1	2	2	2
CO5	1	2	2	2	2	-	-	-	-	-	1	2	2	2
CO6	2	1	1	1	1	-	-	-	-	-	1	2	2	2

PROFESSIONAL ELECTIVES - II

20ESEC307 SDG NO. 4	COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the various analog and digital modulation techniques
- To study the principles behind information theory and coding
- To study the various digital communication techniques

UNIT I ANALOG MODULATION **9**

Amplitude Modulation – AM, DSBSC, SSBSC, VSB-Modulators and Demodulators – Angle modulation – PM and FM -Modulators and Demodulators – Super heterodyne receivers

UNIT II PULSE MODULATION **9**

Low pass sampling theorem – Quantization – PAM, PTM – Line coding – PCM, DPCM, DM & ADM - Time Division Multiplexing, Frequency Division Multiplexing.

UNIT III DIGITAL MODULATION AND TRANSMISSION 9

Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase shift keying – BPSK, QPSK, 8 PSK.QAM-8 QAM, 16 QAM – Comparison of various digital communication system, Inter Symbol Interference– Eye pattern.

UNIT IV INFORMATION THEORY AND CODING 9

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding , Mutual Information, Channel capacity – Error control codes-Linear block codes, Cyclic codes, Syndrome calculation – Convolution Coding.

UNIT V WIRELESS COMMUNICATION 9

Spread Spectrum and Multiple Access Techniques – Global system for Mobile Communication (GSM)-Cellular Concept and Frequency Reuse-Satellite Communication-Bluetooth

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Wayne Tomasi, "Advanced Electronic Communication Systems", Pearson Education, 2007.
2. Simon Haykin, Michael Moher "Communication Systems", 5th Edition, John Wiley & Sons. 2001.
3. H Taub, D L Schilling, G Saha, "Principles of Communication Systems", TMH 2007.

REFERENCES:

1. Simon Haykin "Digital Communications", John Wiley, 2006.
2. B.Sklar, "Digital Communications Fundamentals and Applications", Pearson Education, 2007
3. B.P.Lathi, Zhi Ding "Modern Digital and Analog Communication Systems", 3rd edition, Oxford University Press, 2011
4. H P Hsu, Schaum Outline Series – "Analog and Digital Communications" TMH2006.

ONLINE RESOURCES:

1. https://freevideolectures.com/search/communication-engineering/
2. https://www.tutorialspoint.com/principles_of_communication/index.htm

WEB RESOURCES:

1. https://swayam.gov.in/nd1_noc20_ee16/preview
2. https://www.scientechworld.com/education-software-training-and-skill- development/sku-online-learning/analog-and-digital-communication

OUTCOMES:

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

1. Comprehend and appreciate the significance and role of this course in the present contemporary world.(K2)
2. Apply analog communication techniques.(K2)
3. Compare different digital communication techniques.(K2)
4. Use data and pulse communication techniques.(K2)
5. Analyze Source and Error control coding.(K2)
6. Understand Wireless Communication.(K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	-	2	-	-	-	-	1	2	3	3
CO2	3	2	3	2	-	2	-	-	-	-	1	2	3	3
CO3	3	2	3	2	-	2	-	-	-	-	1	2	3	3
CO4	3	1	3	2	3	2	-	-	-	-	1	2	3	3
CO5	3	1	3	2	3	2	-	-	2	-	1	2	3	3
CO6	3	1	3	2	3	2	-	-	2	-	1	2	3	3

PROFESSIONAL ELECTIVES - II

20EEEL607 SDG NO. 4,9	ELECTRONIC PRODUCT DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enhance the knowledge and skills based on the product design.
- To understand the ergonomics and reliability of the Product and its packaging with the necessary fundamental knowledge and skills.
- To gain knowledge about Control panel design of Electronic Equipments.

- To include the concept of Printed Circuit Board design.

UNIT I INTRODUCTION TO ELECTRONIC PRODUCT DESIGN 9

Man Machine dialog and Industrial design,user centred design-five element of successful design-cognition-ergonomics-Packaging and factors-design for manufacture-assembly and disassembly-wiring,temperature-vibration and shock-safety-noise-energycoupling-grounding-filtering and shielding.

UNIT II HARDWARE DESIGN AND TESTING METHODS 9

Design Process-Identifying the requirements-formulating specifications-design specifications-specifications verses requirements-system partitioning—Functional design, Architectural design-Functional model verses architectural model-Prototyping-Performance and Efficiency measures-Formulating a test plan-writing specifications-Test procedure and test cases-Egoless design-design reviews-Module debug and test: black box test, white box test, grey box test.

UNIT III SOFTWARE DESIGN AND TESTING METHODS 9

Types of software models -software development Life cycle- waterfall model - Metrics and software limitations-Risk abatement and Failure Preventions-Software bugs and Testing-Good Programming Practice-User Interface-Embedded-Real Time Software.

UNIT IV PCB DESIGN 9

Fundamental Definitions-Standards-Routing Topology configurations-Layer stack up assignment-Grounding Methodologies-Aspect Ratio-Image planes-Functional partitioning-Critical Frequencies-Bypassing and Decoupling-Design Techniques for ESD Protection-Guard Band Implementation.

UNIT V PRODUCT DEBUGGING AND TESTING 9

Steps of Debugging-Techniques for Troubleshooting-Characterization-Electromechanical Components-passive components-active components-active devices-operational amplifier-Analog Digital Conversion-Digital components-Inspection and test of components-simulation-Prototyping and Testing-Integration-Validation and verification-EMI &EMC Issues.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ralph Remsburg, "Advanced Thermal Design of Electronic Equipment", Springer ,1998.
2. V.S.Bagad, "Electronic Product design",Technical Publications,2019.

REFERENCE BOOKS:

1. Dave S. Steinberg, "Cooling techniques for Electronic Equipment", Wiley - Interscience, 2nd Edition, 1991
2. E. Paul DeGarmo, J. T. Black, Ronald A.Kohser "Materials and Processes in Manufacturing", 12th Edition, Wiley, 2019.
3. Military Handbook, Electronic Reliability Design Handbook, Department of Defence, USA,1998.
4. Patrick O'Connor & Andre Kleyne "Practical Reliability Engineering", 5th edition, Wiley Publication, 2012.

WEB REFERENCES:

1. https://predictabledesigns.com/how-to-develop-and-prototype-a-new-product/
2. https://www.researchgate.net/publication/309611173_The_Future_o_f_Product_Design_Utilising_Printed_Electronics

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/117/108/117108140/
2. https://www.ionocom.com/services/ionocom.pdf
3. https://www.scribd.com/document/357966527/A-Step-by-Step-Guide-to-Electronic-Product-Design-and-Development-pdf.
4. https://www.powershow.com/view/272bb9-Y2FmY/Electrical_and_Electronic_Product_Design_for_Environment_powerpoint_ppt_presentation

OUTCOMES:

At the end of the course, the student should be able to:

1. Understand the concepts of Electronic Product Design.(K2)
2. Develop the Hardware Layout and Testing methods.(K3)
3. Implementation of software design and Testing methods.(K3)
4. Understand about PCB Design and Implementation of Electronic Equipments.(K2)
5. Apply Product Debugging and Testing. (K3)
6. Understand the application and design procedure of Electronics products.(K2)

CO, PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	1	-	-	-	-	-	-	1	3	3
CO2	3	2	3	2	2	-	-	-	-	-	-	1	2	2
CO3	2	2	3	2	2	-	-	-	-	-	1	2	2	2
CO4	2	2	2	2	2	-	-	-	-	-	-	3	2	2
CO5	3	3	3	2	2	-	1	-	1	-	-	2	2	3
CO6	3	3	2	2	2	-	1	-	1	-	1	2	3	3

PROFESSIONAL ELECTIVES - II

20EEEL608 SDG NO. 4,9	INDUSTRIAL DATA COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an overview of Industrial data communications systems and fundamental understanding of principles, standards and protocols.
- To impart knowledge on industrial networks and Field buses
- To impart the fundamental understanding on SCADA systems.
- To provide insight into some of the new principles those are evolving for future networks.

UNIT I DATA COMMUNICATION CONCEPTS AND MODELS 9

Concepts: Serial and Parallel Transmission - Data Signals - Data Organization: Signals, Communication codes, Error coding, Protocol concepts – Communication Models: ISO OSI Model, The Internet Model, IEEE 802 Model, Application Models, One, Two, Three, and N-Tier Models, Data Exchange Architectures.

UNIT II SERIAL COMMUNICATION STANDARDS AND LOCAL AREA NETWORKS 9

Serial Communication standards: TIA/EIA Standards - Interface Signal Functions - PC Serial Communications, Local Area Networks: IEEE 802 LAN Model - LAN Infrastructure - IEEE 802 Media Access Control - Logical Link Control.

UNIT III NETWORK SOFTWARE, INDUSTRIAL NETWORKS AND FIELD BUSES 9

Commercial Systems - Network Operating Systems - Protocols Used - Industrial Networks and Field buses: Industrial Network Requirements - Process Automation Controllers - Programmable Logic Controllers – HART - PROFIBUS/PROFINET - Foundation Field bus.

UNIT IV SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEMS 9

Wide-Area Communications - Modbus RTU Protocol - Communications Security – SCADA Applications: Power Generating Stations - Power Distribution System - Remote Industrial Plant, Wireless SCADA.

UNIT V WIRELESS COMMUNICATION 9

Wireless sensor networks: Hardware components – energy consumption of sensor nodes – Network architecture – sensor network scenario. Wireless HART – Existing Wireless Options: IEEE 802.15.4 - ISA 100 – Zigbee – Bluetooth – their relevance to industrial applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Lawrence Larry M. Thompson and Tim Shaw, "Industrial Data Communications", 5th Edition, ISA Press, 2007
2. Steve Mackay, Edwin Wright, John Park and Reynders,D "Practical Industrial Data Networks: Design, Installation and Troubleshooting", Newnes Publication, 2004.

REFERENCES:

1. Bowden,R., "HART Application Guide", HART Communication Foundation, 1999.
2. Bela G.Liptak, "Instrument Engineers' Handbook, Volume 3: Process Software and Digital Networks", 4th Edition, CRC Press, 2011.
3. Berge,J., "Field Buses for Process Control: Engineering, Operation, and Maintenance", ISA Press, 2004.
4. Buchanan,W., "Computer Busses: Design and Application", CRC Press, 1st Edition, 2000.

OUTCOMES:

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

1. Understand the concepts of various industrial data communication networks, protocols and their selection.(K2)

2. Select and use most appropriate networking technologies and standards for a given application.(K2)
3. Design and ensure that the best practice is followed in installing and commissioning the data communications links.(K6)
4. Understand the concepts of SCADA Systems and its applications(K2)
5. Understand requirements of industrial application and provide wired solution.(K2)
6. Understand requirements of industrial application and provide wireless solution.(K2)

CO, PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	-	-	-	-	2
CO2	2	2	2	2	-	-	-	-	-	-	-	-	-	2
CO3	2	2	2	2	-	-	-	-	-	-	-	-	2	2
CO4	2	2	2	2	-	-	-	-	-	-	-	-	-	2
CO5	2	2	2	2	-	-	-	-	-	-	-	2	2	2
CO6	2	2	2	2	2	-	-	-	-	-	-	2	-	2

PROFESSIONAL ELECTIVES - II

20EEEL609 SDG NO. 4 & 8	DIGITAL CONSUMER TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To aware of the consumer products, demand, and marketing review
- To acquire knowledge of the various available digital audio, video and display devices
- To learn about the input and output devices that can be connected to mobile and personal computer for networking.
- To understand the emerging techniques based devices for consumers.

UNIT I DIGITAL GENERATION AND CONSUMER DEVICES 9

Generation - Digitization of consumer products - Home networking - Era of digital consumer devices - Market Forecast - Market drivers - Success factors and challenges - Digital home. Perspective on global marketing - Process of consumer behavior - Connecting consumer research and consumer behavior.

UNIT II DIGITAL AUDIO AND VIDEO SYSTEMS 9

Microphones and Loud speakers - Construction, working principles and applications; Principles of digital audio systems - Internet audio formats and players - Components of MP3 - Components of digital TV - SDTV and HDTV technologies - Digital home theater systems.

UNIT III DIGITAL DISPLAY DEVICES AND IMAGING 9

LED Video - LCDs - Plasma Display Panels - Field Emission Displays - Digital light Processor - Comparison of different digital displays - Digital camcorders - Digital display interface standards.

UNIT IV INTERNET AND PC DEVICES 9

Printers - Scanners - Smart Card readers - Benefits of using ebooks and challenges - Mobile phones and smart phone - DVD types and working, applications and challenges.

UNIT V EMERGING CONSUMER DEVICES 9

Net TV - Pen Computing and Digital notepad - Lighting control - Home control and security - Energy management systems - Home theatre and Entertainment - Vehicle Security - Home networking - PLC and Xilinx solutions. Geo- Spatial maps - Smart transportations.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Bali S.P, "Consumer Electronics", Pearson Education, India,2010.
2. Gupta R.G, "Audio Video systems", Second edition, Tata Mc Graw Hill Education, 2017.

REFERENCES:

1. Amit Dhir, "The Digital Consumer Technology - Hand book", Elsevier Publications, 2004.
2. R.R Gulati, "Color Television - Principles & Practice" , Wiley Eastern Limited, New Delhi, 2003.
3. Thomas M. Coughlin, "Digital Storage in Consumer Electronics", Elsevier Publications, 2008.

WEB REFERENCES:

1. https://www.sciencedirect.com/book/9780750678155/the-digital-consumer-technology-handbook
2. https://www.elsevier.com/books/the-digital-consumer-technology-handbook/dhir/978-0-7506-7815-5

ONLINE RESOURCES:

1. https://youtu.be/Nv1hyTloIfs
2. https://youtu.be/VRFotmHcMwo

OUTCOMES:

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

1. Explain the digitization of consumer products and global marketing (K2)
2. Describe the concepts of various audio, video and digital display devices (K2)
3. Describe the digital technology of display devices (K2)
4. Summarize the peripheral devices for internet and PC applications (K2)
5. Explain the applications of the digital devices (K2)
6. Classify the emerging consumer devices. (K2)

CO, PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	3	2	2	2	-	2	1	1	2
CO2	3	2	2	1	2	3	2	2	2	-	2	1	2	2
CO3	3	2	2	1	2	3	2	2	2	-	2	1	1	3
CO4	3	2	2	1	2	3	2	2	2	-	2	1	1	3
CO5	3	2	2	1	2	3	2	2	2	-	2	1	1	3
CO6	3	2	2	1	2	3	2	2	2	-	2	1	1	2

PROFESSIONAL ELECTIVES - III

20EEEL701 SDG NO. 4 & 7	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge about the stand alone and grid connected renewable energy systems
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems

UNIT I INTRODUCTION **9**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) -Qualitative study of different renewable energy resources ocean, Biomass, Hydrogen energy systems : operating principles and characteristics of: Solar PV, Fuel cells, wind electrical systems-control strategy, operating area.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION **9**

Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III POWER ELECTRONICS FOR SOLAR **9**

Block diagram of solar photo voltaic system - line commutated converters (inversion-mode) - Boost and buck-boost converters-selection of inverter, battery sizing, array sizing- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV POWER ELECTRONICS FOR WIND **9**

Three phase AC voltage controllers-AC-DC-AC converters - uncontrolled rectifiers, PWM Inverters, matrix converters- Stand alone operation of fixed and variable speed wind energy conversion systems- Grid connection Issues - Grid integrated PMSG and SCIG Based WECS.

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS **9**

Need for Hybrid Systems -Range and type of Hybrid systems-Case studies of Wind-PV- Maximum Power Point Tracking (MPPT).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.N.Bhadra, D. Kastha, & S. Banerjee, "Wind Electrical Systems", Oxford University Press,2013.
2. Rashid .M. H "Power electronics Hand book", Academic press, 2001.

REFERENCES:

1. B.H.Khan, "Non-conventional Energy Sources", Tata McGraw Hill Publishing Company.
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 2011.
3. Fang Lin Luo and Hong Ye, "Renewable Energy Systems", Taylor & FrancisGroup,2013.
4. R.Seyezhai and R.Ramaprabha, "Power Electronics for Renewable Energy Systems", Scitech Publications,2015.
5. Gray, L. Johnson, "Wind Energy System", Prentice Hall linc,1995.

WEB REFERENCES:

1. https:// https://www.energy.gov/eere/solar/solar-power-electronic-devices
2. https://www.irena.org/geothermal

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ph44
2. https://www.youtube.com/watch?v=1vPjW7PqvwU
3. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/tidal-power-station

OUTCOMES:

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

1. Outline the engineering aspects of electrical energy generation & utilization and impacts of renewable energy generation on environ ment.(K2)
2. Explain the use of electrical machines for renewable energy conversion.(K2)
3. Apply different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.(K3)
4. Analyse the stand alone and grid connected renewable energy systems.(K4)
5. Develop maximum power point tracking algorithms and Provide knowledge about hybrid renewable energy systems. (K3)

CO, PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - III

20EEEL702 SDG NO. 4 & 8	POWER QUALITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I INTRODUCTION TO POWER QUALITY 9

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

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 9

Sources of sags and interruptions - estimating voltage sag performance. Thevenin's equivalent source- analysis and calculation of various faulted condition. Voltage sag due to induction motor starting. Estimation of the sag severity - mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches.

UNIT III OVER VOLTAGES **9**

Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding – line arresters - protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD and EMTP.

UNIT IV HARMONICS **9**

Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion - voltage and current distortion - harmonic indices - inter harmonics – resonance. Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters. IEEE and IEC standards.

UNIT V POWER QUALITY MONITORING **9**

Monitoring considerations - monitoring and diagnostic techniques for various power quality problems - modeling of power quality (harmonics and voltage sag) problems by mathematical simulation tools - power line disturbance analyzer – quality measurement equipment - harmonic / spectrum analyzer - flicker meters - disturbance analyzer. Applications of expert systems for power quality monitoring.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Electrical Power Systems Quality, Dugan R C, Mc Granaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw–Hill, 2012, 3rd edition.
2. J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", (New York : Wiley), 2011.

REFERENCES:

1. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad," Power Quality Problems & AMP ; Mitigation Techniques" Wiley, 2015.
2. G.T. Heydt, "Electric Power Quality", 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications,1994.
3. M.H.J.Bollen,"Understanding Power Quality Problems: Voltage Sags and Interruptions", (New York: IEEE Press),2000.
4. R.S.Vedam, M.S.Sarma, "Power Quality – VAR Compensation in Power Systems," CRC Press 2013.

WEB RESOURCES:

1. https://nptel.ac.in/courses/108106025/

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=X6k9fOfxlyg

OUTCOMES:

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

1. Classify the different types of power quality problems. (k2)
2. Illustrate the sources of Sag, Estimation and mitigation techniques of Sag(k2)
3. Outline the sources of over voltage, protection of transformers and cables and illustrate the mitigation techniques. (k2)
4. Explain the sources of Harmonics and its effect on equipment. (K2)
5. Infer various power quality monitoring and measuring equipment (k2)

CO, PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - III

20EEEL703 SDG NO. 4 & 8	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impact concepts behind economic analysis and Load management.
- Energy management on various electrical equipments and metering.
- Concept of lighting systems and co generation.

UNIT I INTRODUCTION **9**

Basics of Energy – Need for energy management – Energy accounting - Energy monitoring, targeting and reporting - Energy audit process.

UNIT II ENERGY MANAGEMENT FOR MOTORS AND COGENERATION 9

Energy management for electric motors – Transformer and reactors - Capacitors and synchronous machines, energy management by cogeneration – Forms of cogeneration – Feasibility of cogeneration – Electrical interconnection.

UNIT III LIGHTING SYSTEMS **9**

Energy management in lighting systems – Task and the working space - Light sources – Ballasts – Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards.

UNIT IV METERING FOR ENERGY MANAGEMENT **9**

Metering for energy management – Units of measure - Utility meters – Demand meters – Paralleling of current transformers – Instrument transformer burdens – Multi tasking solid state meters, metering location vs requirements, metering techniques and practical examples.

UNIT V ECONOMIC ANALYSIS AND MODELS **9**

Economic analysis – Economic models - Time value of money - Utility rate structures – Cost of electricity – Loss evaluation, load management – Demand control techniques – Utility monitoring and control system – HVAC and energy management – Economic justification.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", 8th Edition, The Fairmont Press, 2016
2. Eastop T.D & Croft D.R, "Energy Efficiency for Engineers and Technologists", Longman Scientific & Technical, ISBN-10-0582031842, 1990.

REFERENCES:

1. Reay D.A, "Industrial Energy Conservation: A Hand Book for Engineers and Managers", 2nd Revision edition, Pergamon Press, 1979.
2. "IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities", IEEE, 196.
3. Amit K. Tyagi, "Handbook on Energy Audits and Management", TERI, 2003.
4. "International Copper Association India, Electricity in buildings Good practice Guide", McGraw-Hill Education, 2017.

OUTCOMES:

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

1. Summarize the basic concepts of Energy, Energy management, Energy accounting and Energy audit process.(K2)
2. Extend the basic concepts of energy management to electric motors, transformers, capacitors and synchronous machines. (K2)
3. Outline the energy management by cogeneration – various forms of cogeneration and feasibility of cogeneration. (K2)
4. Illustrate the Energy management in lighting systems, various sources of lighting, types of ballasts and lighting controls.(K2)
5. Explain the working and applications of various metering equipments for energy management with practical examples. (K2)
6. Describe the economic models for time value of money, cost of Electricity, loss evaluation, load management and economic justification. (K2)

CO, PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	2	1	1	-	-	-	-	-	2	2
CO2	3	1	-	-	1	-	1	-	1	-	-	-	2	1
CO3	2	2	-	-	1	-	1	-	-	-	-	-	1	1
CO4	2	2	-	-	-	-	-	-	-	-	1	-	1	2
CO5	3	1	-	-	-	-	1	-	-	-	-	-	1	1
CO6	2	1	-	-	2	-	-	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVES - III

20EEEL704 SDG NO. 4 & 8	COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand basics of Computer aided design procedure and Finite Element method
- Deduce the Finite Element Method for the design of DC machines
- Deduce the Finite Element Method for the design of AC machines

UNIT I INTRODUCTION **9**

Design problem-Mathematical programming methods, computer aided design- Mathematical formulation of the problem. Programming techniques (LP & NLP only)-Methods of solution- Unconstrained optimization problems-constrained optimization problems.

UNIT II OPTIMAL DESIGN OF DC MACHINE **9**

Design of armature- Windings and field systems- Selection of variables for optimal design- Formulation of design equations-Objective function-Constraint functions- Algorithms for optimal design.

UNIT III OPTIMAL DESIGN OF POWER TRANSFORMER **9**

Design of magnetic circuit-Design of windings- Selection of variables for optimal design-Formulation of design equations- Objective function-Constraint functions- Algorithms for optimal design.

UNIT IV OPTIMAL DESIGN FOR 3-PHASE ALTERNATOR 9

Design of stator- windings- Design of Field systems for salient pole and non-salient pole machines, Selection of variables for optimal design-Formulation of design equations- Objective function- Constraint functions-Algorithms for optimal design.

UNIT V OPTIMAL DESIGN OF 3-PHASE INDUCTION MOTOR 9

Design of stator-Windings- Design of squirrel cage rotor- Design of slip ring rotor- Selection of variables for optimal design- Formulation of design equations-Objective functions Constraint functions- Algorithms for optimal design.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dr. M. Ramamoorthy, "Computer- Aided Design of Electrical Equipment" Affiliated East-West press Pvt. Ltd. New Delhi, 2008
2. S.K. Sen, "Principles of Electrical Machine Design with Computer Programs", Oxford & IBH Publishing Co, 2006

REFERENCE BOOKS:

1. K M Vishnu Murthy, "Computer aided design of Electrical Machines", B S Publications.2015
2. Nicola Bianchi, "Electrical Machine Analysis using Finite Elements", CRC Taylor & Francis, 2008.

ONLINE RESOURCES:

1. https://www.sciencedirect.com/science/article/abs/pii/030488539190753W
2. https://www.coursehero.com/file/14048720/COMPUTER-AIDED-ELECTRICAL-MACHINE-DESIGN/
3. https://www.coursera.org/search?query=cad+for+electrical+machines&index=prod_all_products_term_optimization

OUTCOMES:

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

1. Explain the concepts related to computer aided design of electrical equipment's.[K2]
2. Recognize and implement the optimum design for DC machines.[K3]
3. Interpret the design equations to optimize power transformers. [K3]
4. Implement the design equations of AC induction machines for optimal design.[K3]

5. Use the design equations and formulate the optimum design of three phase alternators.[K3]

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Co1	3	1	3	2	3	-	-	-	-	-	2	2	3	2
CO2	3	1	3	2	3	-	-	-	-	-	2	2	3	2
CO3	3	1	3	2	3	-	1	-	-	-	2	2	3	2
CO4	3	1	3	2	3	-	1	-	-	-	2	2	3	2
CO5	3	1	3	2	3	-	1	-	-	-	2	2	3	2

PROFESSIONAL ELECTIVES - III

20EEEL705 SDG NO. 3,4,9,15	MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about the different bio potential, its propagation and its measurements
- To learn the different measurement techniques for non-physiological parameters
- To familiarize the different Imaging techniques and therapeutic equipments

UNIT I BIO POTENTIAL GENERATION AND ELECTRODES TYPES 9

Cell and its structure – Resting and Action Potential -Origin of bio potential and its propagation. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits-Recording problems - measurement with two electrodes.

UNIT II BIOSIGNAL CHARACTERISTICS AND ELECTRICAL SAFETY 9

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode-Electrical safety in medical environment: shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments

UNIT III NON-ELECTRICAL PARAMETER MEASUREMENTS 9

Measurement of blood pressure – Cardiac output – Heart rate – Heart sound–Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers : pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter – Temperature Measurement

UNIT IV MEDICAL IMAGING 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring – Introduction to Biometric systems

UNIT V ASSISTING AND THERAPEUTIC EQUIPMENTS 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy

TOTAL : 45 PERIODS

TEXT BOOKS:

1. R.S.Khandpur, "Hand Book of Bio-Medical instrumentation", Tata McGraw Hill Publishing Co Ltd., 3rd edition, 2014.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, "Bio-Medical Instrum entation and Measurements", 2nd edition, Pearson Education /PHI, 2002

REFERENCES:

1. M.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 2003.
2. L.A. Geddes and L.E.Baker, "Principles of Applied Bio-Medical Instrumentation", John Wiley & Sons, 1975.
3. J.Webster, "Medical Instrumentation", John Wiley & Sons, 3rd edition, 1995.
4. C.Rajarao and S.K. Guha, "Principles of Medical Electronics and Bio-medical Instrumentation", Universities press (India) Ltd, Orient Longman Ltd, 2000.

WEB RESOURCES:

1. https://www.mayoclinic.org/diseases-conditions/heart-disease/multimedia/circulatory-system/vid-20084745

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/102/101/102101068/

2. https://nptel.ac.in/courses/108/105/108105101/
3. https://nptel.ac.in/courses/108/105/108105091/

OUTCOMES:

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

1. Understand various biopotential concepts and electrodes used to capture the biosignals. (K2)
2. Analyse important biosignals like EEG,ECG and EMG and lead configurations to capture those signals. (K3)
3. Plan over doing Electrical safety in using biomedical instruments.(K3)
4. Explain non electrical parameter measurement in biomedical field.(K2)
5. Understand working of various recording, assisting and therapeutic instruments.(K2)

CO, PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	2	-	-	-	-	2	2	2	2
CO2	2	2	2	1	3	2	-	-	-	-	2	2	2	2
CO3	2	-	2	1	2	3	-	-	1	-	2	2	2	2
CO4	2	2	-	1	1	-	-	-	-	-	2	2	2	2
CO5	2	2	1	1	3	-	-	-	-	-	2	2	2	2
CO6														

PROFESSIONAL ELECTIVES - V

20EEEL706 SDG NO. 4 & 9	MICROELECTROMECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices and educate the rudiments of micro fabrication techniques.
- To introduce various sensors, actuators and different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering

UNIT I INTRODUCTION **9**

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I **9**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.

UNIT III SENSORS AND ACTUATORS-II **9**

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia, Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING **9**

Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Ant striction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS **9**

Polymers in MEMS– Polyimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Perylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Stephen D Senturia, "Microsystem Design", Springer Publication, 2004.
2. Tai Ran Hsu, "MEMS and Microsystems Design Manufacture", Tata McGraw Hill, New Delhi, 2002.

3. Julian W. Gardner and Vijay K. Varadan, Microsensors, MEMS, and Smart Devices, John Wiley & Sons Ltd, 1st Edition, reprinted 2007.

REFERENCES:

1. Nadim Maluf, "An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press, 2005.
3. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD, 2002.
4. James J. Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2005.
5. Thomas M. Adams and Richard A. Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/117105082/
2. https://www.sciencedirect.com/topics/engineering/micro-electro-mechanical-system

ONLINE RESOURCES:

1. https://youtu.be/j9y0gfN9WMg
2. https://youtu.be/2XnnwoIDq6I
3. https://youtu.be/lAHkOVEHNKA

OUTCOMES:

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

1. Describe the operation of micro devices, micro systems and their applications.(K2)
2. Illustrate the micro devices, micro systems using the MEMS fabrication process.(K2)
3. Explain semiconductors and solid mechanics to fabricate MEMS devices and the rudiments of Micro fabrication techniques.(K2)
4. Select various sensors, actuators and different materials used for MEMS.(K3)
5. Identify on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.(K3)

CO, PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - III

20EEEL707 SDG NO. 4 & 9	ELECTROMAGNETIC COMPATIBILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To tutor the basics of EMI,EMC
- To instill knowledge on the EMI coupling mechanism and its mitigation techniques
- To impart comprehensive insight about the current EMC standards and about various measurement techniques

UNIT I BASIC CONCEPTS **9**

Definition of EMI and EMC; Intra and Inter system EMI; Sources and victims of EMI, Conducted and Radiated EMI emission and susceptibility; Transient & ESD; Case Histories; Radiation Hazards to humans.

UNIT II COUPLING MECHANISM **9**

Common made coupling; Differential mode coupling; Common impedance coupling; Ground loop coupling; Field to cable coupling; Cable to cable coupling; Power mains and Power supply coupling.

UNIT III EMI MITIGATION TECHNIQUES **9**

Shielding – principle, choice of materials for H, E and free space fields, and thickness; EMI gaskets; Bonding; Grounding – circuits, system and cable grounding; Filtering; Transient EMI control devices and applications; PCB Zoning, Component selection, mounting, trace routing.

UNIT IV STANDARDS AND REGULATION **9**

Units of EMI; National and International EMI Standardizing Organizations – IEC, ANSI, FCC, CISPR, BIS, CENELEC; FCC standards; EN Emission and Susceptibility standards and specifications; MIL461E Standards.

UNIT V TEST METHODS AND INSTRUMENTATION **9**

EMI test sites - Open area site; TEM cell; Shielded chamber; Shielded Anechoic chamber; EMI test receivers; Spectrum Analyzer; Transient EMI Test wave Simulators; EMI coupling Networks - Line impedance Stabilization Networks; Feed through capacitors; Antennas and factors; Current probes and calibration factor; MIL-STD test methods; Civilian STD Test methods, Government policies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. V.P. Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press,New york, 2nd Edition, 2010.
2. Henry W.Ott., "Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 2011.

REFERENCES:

1. Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC", Vol I-V, 1988.
2. Bemhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, Norwood, 3rd Edition, 1987 .
3. C.R. Paul, "Introduction to Electromagnetic Compatibility", John wiley& sons Inc. 2006.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/106/108106138/

ONLINE RESOURCES:

1. https://www.classcentral.com/course/swayam-electromagnetic-compatibility-emc-12959
2. https://epd.wisc.edu/courses/emc-and-best-practices/

OUTCOMES:

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

1. Analyze EMI free system.(K3)
2. Outline the methods to Reduce system level crosstalk. (K2)

3. Design high speed Printed Circuit board with minimum interference.(K6)
4. Develope world free from unwanted electromagnetic environment.(K3)
5. Impart comprehensive insight about the current EMC standards and about various measurement techniques. (K2)

CO, PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - III

20EEEL708 SDG NO. 4 & 9	NANO TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept and knowledge of Nano science and Nanotechnology.
- To create awareness of clean room environment & societal implications of Nanotechnology
- To know about preparation methods and nanofabrication techniques.
- To know about the different characterization techniques used for Nano systems and its applications.

UNIT I INTRODUCTION **9**

Discussion of the International Technology Roadmap characteristics: Need for new concepts in electronics from microelectronics towards biomolecule electronics. Engineering and society - nano structured materials- Properties-Nanotoxicology-Clean room standards.

UNIT II PREPARARTION ROUTES **9**

Preparation of nanoscale materials: precipitation, mechanical milling, colloidal routes, Plasma Arcing, Chemical Vapor Deposition, Sol-Gels, Electrode Position, molecular beam epitaxy, atomic layer epitaxy.

UNIT III LITHOGRAPHY FOR NANOSCALE DEVICES 9

Lithography process, optical/UV, electron beam, Ion Beam and x-ray lithography, Nano imprint technique- Scanning probe lithography.

UNIT IV CHARECTERIZATION TECHNIQUES 9

X-ray and Neutron diffraction technique, Scanning Electron Microscopy plus environmental techniques, Transmission Electron Microscopy including high-resolution imaging, analytical electron microscopy, EDX and EELS, Surface Analysis techniques, XPS, SIMS, Auger. Electron Microscope – Scanning Electron Microscope – Atomic Force Microscope –Scanning Tunneling Microscope.

UNIT V EVOLVING INTERFACES OF NANO 9

Applications of nanotechnology: NEMS – Nanosensor – nanomedicines –Nano applications in electrical engineering –Nanoelectronics: quantum transport devices, molecular electronics devices, quantum computing, CNT, random access memory and mass storage devices. Nano motor, Nano robot, energy efficient battery technology, Nano dielectrics, lighting system, solar cell.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. T. Pradeep, Nano the essentials, McGraw Hill Education, 1st edition, 2017
2. Chattopadhyay K.K and A.N Banerjee, Introduction to Nanoscience and nanotechnology, Prentice Hall India Learning Private Limited, 2009

REFERENCES:

1. B S Murthy, P Shankar, Baldev Raj, BB Rath & James Murday. 'Text book of Nanoscience and Nano Technology', Universities Press, 2011.
2. Charles P.Poole & Frank, J.Owens, Introduction to nanotechnology, Wiley India, 2007.
3. Jan Korwink and Andreas Greiner, Semiconductors for Micro and Nanotechnology: An Introduction for Engineers, Weinheim Cambridge: wiley-VCH, 2001.
4. N. John Dinardo, Nanoscale Characterization of Surfaces and Interfaces, Second edition, Weinheim Cambridge: wiley-VCH,2000

WEB REFERENCES:

1. https://nptel.ac.in/courses/118/104/118104008/
2. https://nptel.ac.in/courses/118/102/118102003/

ONLINE RESOURCES:

1. https://ieeenano.org/
2. https://www.edx.org/course/fundamentals-nanoelectronics-part-b-purduex-nano521x
3. https://www.understandingnano.com/

OUTCOMES:

Upon completion of the course, the student should able to:

1. Understand the significance and implication of nanotechnology. (K2)
2. Apply the concept of nanotechnology for Electrical and Electronics Engineering Applications. (K3)
3. Familiar with Rules and guidelines of clean room standards. (K2)
4. Understand the Fabrication methods and characterization techniques. (K2)
5. Summarize the recent trends of nanotechnology. (K2)
6. Understand the significant applications of nanotechnology.(K2)

CO, PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	2	-	-	-	-	-	-	1	3
CO2	2	2	2	-	1	2	-	-	-	-	-	-	1	1
CO3	2	1	-	2	-	1	2	2	-	-	-	-	1	1
CO4	2	-	2	1	2	-	-	-	-	-	-	-	2	1
CO5	2	1	-	1	-	2	-	-	2	-	-	-	2	3
CO6	2	1	-	1	-	1	-	-	2	-	-	-	1	2

PROFESSIONAL ELECTIVES - III

20CSPC601 SDG NO. 4 & 9	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents and about the various applications of AI

UNIT I INTRODUCTION **9**

Introduction - Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents – Typical Intelligent Agents – Problem Solving Approach to Typical AI Problems – Search Strategies - Uninformed - Heuristics - Informed.

UNIT II PROBLEM SOLVING METHODS **9**

Local Search Algorithms and Optimization Problems - Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Alpha-Beta Pruning - Stochastic Games.

UNIT III REPRESENTATION OF KNOWLEDGE **9**

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining - Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering - Categories and Objects - Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information.

UNIT IV PLANNING AND LEARNING **9**

Planning – Planning with State Space Search- Partial Order Planning Algorithm – Planning Graphs - Logical Formulation of Learning - Knowledge in Learning - Explanation-based Learning - Learning using Relevance Information.

UNIT V NATURAL LANGUAGE PROCESSING **9**

Language models - Phrase Structure Grammars - Syntactic Analysis – Augmented Grammars and Semantic Interpretation - Application with NLP: Developing a Simple Chatbot - Types of Chatbot.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Stuart J Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.

2 Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence", Tata McGraw-Hill Education, Third Edition, 2008.

REFERENCES:

1. M. Tim Jones, "Artificial Intelligence: A Systems Approach(Computer Science)", Jones and Bartlett Publishers, Inc.; First Edition, 2008.
2. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
3. William F. Clocksin and Christopher S. Mellish, "Programming in Prolog: Using the ISO Standard", Springer, Fifth Edition, 2003.
4. George F Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Pearson Education, New Delhi, Fifth Edition, 2017.
5. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", O'Reilly, 2009, https://www.nltk.org/book/.
6. I. Bratko, "Prolog: Programming for Artificial Intelligence", Addison-Wesley Educational Publishers Inc., Fourth Edition, 2011.

WEB REFERENCES:

1. https://books.google.co.in/books?id=uSvYmki2yg0C&printsec=frontcover&dq=Supervised+Learning&hl=en&sa=X&ved=0ahUKE wigkNa1xN3oAhWawjgGHe8hAzoQ6AEIKDAA#v=onepage&q=Sup ervised%20Learning&f=false

OUTCOMES:

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

1. Infer the agent characteristics and its problem solving approaches.(K2)
2. Select appropriate search algorithms for any AI problem.(K1)
3. Apply the principles of AI in game playing.(K3)
4. Construct and solve a problem using first order and predicate logic.(K3)
5. Identify the methods of solving problems using planning and learning.(K3)
6. Implement applications for Natural Language Processing that use Artificial Intelligence.(K3)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	2	1	1	-	1	-	-	1	2	3
CO2	2	3	2	3	2	1	1	-	1	-	-	1	3	3
CO3	2	3	2	3	2	1	1	-	1	-	-	1	3	2
CO4	2	3	2	3	2	1	1	-	1	-	-	1	3	3
CO5	2	3	2	3	3	1	1	-	2	-	-	1	2	2
CO6	2	3	2	3	3	1	1	-	2	-	-	1	2	3

PROFESSIONAL ELECTIVES - III

20EEEL709 SDG NO. 9,12	INDUSTRIAL CONTROL AND AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students understand process control, PLC architecture and interfacing.
- To make the students design Automation systems for industrial applications.
- To make the students know about the importance of automation techniques manufacturing and process industries.
- To make students develop automation system for manufacturing and process industries.

UNIT I INTRODUCTION TO CONTROL AND AUTOMATION 9

Introduction to Process Control - Process control principles - Analog and Digital control – Introduction to Automatic control - Types of Automation; Architecture of Industrial Automation Systems, Advantages and limitations of Automation, Industrial revolutions – Special control structures.

UNIT II INTRODUCTION TO PLC 9

Functions of PLC - Architecture, Selection of PLC, Input Output modules - PLC interfacing with plant, memory structure of PLC - Advantages & disadvantages of PLC with respect to relay logic, Ladder diagram examples – PLC Data move instructions, table and register moves, PLC FIFO & LIFO functions - PLC arithmetic and logical functions - PLC compare and convert functions - PLC program control and interrupts: jumps, subroutine, sequence control relay.

UNIT III SCADA AND DISTRIBUTED CONTROL SYSTEMS 9

Introduction to computer based industrial automation- Direct Digital Control (DDC), Distributed Control System (DCS) and Supervisory Control And Data Acquisition (SCADA) based architectures - Features of SCADA, MTU, RTU Functions - Applications of SCADA, Communications in SCADA - Specifications of DCS - configuration and programming - Functions including database management, reporting, alarm management, communication, third party interface, control, display etc. Performance criteria for DCS and other automation tools.

UNIT IV AUTOMATION IN MANUFACTURING INDUSTRIES 9

Introduction- Automation in production system, Principles and strategies of automation - Basic elements of an automated system, advanced automation functions, levels of automations - Induction Motor Drives: Introduction, Characteristics, and Adjustable Speed Drives - Networking of Sensors, Actuators and Controllers - Application of international standards in process safety control.

UNIT V INDUSTRIAL COMMUNICATION AND HMI 9

Introduction to Production Control Systems - Device network: CAN, PROFIBUS-PA, Control network: Control Net, PROFIBUS-DP, Ethernet, Interfaces: RFID, Barcode, HMI: Block Diagram, Types, Advantages and industrial applications. Instrumentation Subsystem, Control Subsystem – HMI in Automation, Human Interface Subsystem, Advance Human Interface System.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Madhuchhanda Mitra and Samarjit Sen Gupta, "Programmable Logic Controllers And Industrial Automation: An Introduction", 2nd Edition, ISBN 978-81-87972-63-1, 2017
2. M.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 5th Edition, Pearson Education, 2009.

REFERENCES:

1. Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson New International, 2013.
2. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2016.
3. Stuart A.Boyer, "SCADA: 'Supervisory control and Data Acquisition', 4th Edition, ISA, 2010.

4. G. K. McMillan, Douglas Considine, "Process/Industrial Instruments Hand book", 5th edition, McGraw Hill, New York, 2009.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/105/108105088/
2. https://nptel.ac.in/courses/108/105/108105062/
3. https://nptel.ac.in/courses/108/105/108105063/

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=eiLD2S2wZIk&list=PL8K8EFqIL0TAHv7rugAX-JIb9teBhy0ie

OUTCOMES:

Upon completion of the course, the student able to:

1. Explain various control and automation methods in process industries. (K2)
2. Develop PLC code for automation applications requiring special functions. (k2)
3. Outline hardware and software component required to constitute a SCADA system. (K2)
4. Illustrate DCS to handle local and distributed automation tasks.(K2)
5. Describe various automation technologies in manufacturing and process industries. (K2)
6. Discuss various communication technologies in manufacturing and process industries. (K2)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	3	1	1	-	2	1	2	2	2	1
CO2	2	2	2	2	3	1	-	-	-	1	1	2	2	1
CO3	2	2	2	2	2	1	-	-	1	1	1	2	2	1
CO4	2	1	2	1	3	1	1	-	1	1	1	2	2	1
CO5	2	2	2	2	2	1	1	-	2	1	2	2	2	1
CO6	2	1	2	2	3	1	1	1	2	1	2	2	2	1

PROFESSIONAL ELECTIVES - IV

20EEEL710 SDG NO. 4, 7	POWER SYSTEM PROTECTION AND SWITCHGEAR	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system
- To impart knowledge on characteristics and operations of different types of relays
- To learn the different apparatus protection, static and numerical relays
- To impact knowledge on operation of circuit breaker and different types of circuit breaker

UNIT I PROTECTION SCHEMES **9**

Principles and need for protective schemes – nature and causes of faults – types of faults – Methods of Grounding - Zones of protection and essential qualities of protection – Protection scheme.

UNIT II ELECTROMAGNETIC RELAYS **9**

Operating principles of relays - the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays.

UNIT III APPARATUS PROTECTION **9**

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION **9**

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, and distance protection of transmission lines.

UNIT V CIRCUIT BREAKERS **9**

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers –

Rating and selection of Circuit breakers.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Sunil S.Rao, "Switchgear and Protection", Khanna Publishers, New Delhi,2008.
2. B.Ravindranath and N.Chander, "Power System Protection and Switchgear", New Age International (P) Ltd., First Edition2011.

REFERENCES:

1. BadriRam, B.H. Vishwakarma, "Power System Protection and Switchgear", New Age InternationalPvt Ltd Publishers, Second Edition 2011.
2. Y.G.Paithankar and S.R.Bhide, "Fundamentals of power system protection", Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. C.L.Wadhwa, "Electrical Power Systems", 6th Edition, New Age International (P) Ltd., 2010.
4. Ravindra P.Singh, "Switchgear and Power System Protection", PHI Learning Private Ltd., NewDelhi, 2009.
5. VK Metha, "Principles of Power Systems", S. Chand,2005.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108101039/#
2. https://www.coursera.org/lecture/electric-power-systems/systemdesign- switching-circuit-breakers-0MMaF

OUTCOMES:

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

1. Explain nature and causes of faults, the need for power system protection and essential qualities of protection. (K2)
2. Outline the construction, operating principle, characteristics and applications of different types of protective relays. (K2)
3. Illustrate the protection scheme for various power system apparatus-transformer, generator, motor, bus bars and transmission line. (K2)
4. Construct various relays using static comparators and make use of numerical relay for Over current protection, transformer differential protection, distant protection of transmission lines. (K3)
5. Explain the arcing phenomenon and arc interruption in a circuit breaker

and outline the construction and operating principle of different types of circuit breaker. (K2)

CO, PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - IV

20EEEL711 SDG NO. 4, 9, 11	RESTRUCTURED POWER SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the restructuring of power market and impart knowledge on fundamental concepts of congestion management
- To familiarize with the concepts of locational marginal pricing and financial transmission rights
- To gain insight on the ancillary service management and pricing of transmission network and illustrate the electricity act and various power reforms in India

UNIT I FUNDAMENTALS OF POWER MARKETS 9

Fundamentals and structure of Restructured Power Market– Wheeling– Market Power- Power exchange and pool markets-Independent System Operator (ISO)– components- role of ISO Operating Experiences of Restructured Electricity Markets in various Countries (UK ,Australia, Europe, US, Asia).

UNIT II TRANSMISSION CHALLENGES 9

Transmission expansion in the New Environment–Introduction –Role of transmission planning– Transmission Capacity–Total Transfer Capability (TTC) – Computational procedure - Margins– Available transfer capability (ATC)–Principles–Constraints-Methods to compute ATC.

UNIT III CONGESTION MANAGEMENT AND ANCILLARY SERVICES 9

Concept of Congestion Management–Method store lieve the congestion-Inter and Intra zonal Congestion Management–Generation Rescheduling – Locational Marginal Pricing–Financial Transmission Right-Ancillary Services.

UNIT IV TRANSMISSION PRICING 9

Transmission pricing methods -Postage stamp-Contract path-MW-mile–MVAmile– Distribution Factor method–Tracing method- Short run marginal cost (SRMC)–Generator Ramping and Opportunity Costs.

UNIT V INDIAN POWER MARKET 9

Current Scenario– Regions–Salient features of Indian Electricity Act2003–Regulatory and Policy development in Indian power Sector–Availability based tariff–Necessity–Working Mechanism– Unscheduled Interchange Rate–Operation of Indian Power Exchange.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured Electrical power systems: operation, trading and volatility", Pub., 2001
2. Kankar Bhattacharya, JaapE.Daadler, MathH.J.Boolen, "Operation of Restructured Power Systems", Kluwer Academic Pub., 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.
3. LoiLeiLai, "Power system Restructuring and Regulation", John Wiley sons, 2001.
4. M.Shahidehpour, H.YaminandZ.Li, "Market Operations in Electric Power Systems ", John Wiley & Sons Inc., 2002.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108101005/
2. https://www.coursebuffet.com/sub/electrical-engineering/493/restructured-power-systems

ONLINE RESOURCES:

https://onlinelibrary.wiley.com/doi/pdf/10.1002/9780470608555.fmatter

OUTCOMES:

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

1. Demonstrate the restructured power market and the role of ISO in various countries. (K2)
2. Explain the transmission planning and methods to compute the available transfer capability (K2)
3. Classify the transmission congestion and illustrate the concepts involved in locational margin prices and financial transmission rights. (K2)
4. Outline the methods of transmission pricing and show the significance of ancillary services and pricing of transmission network. (K2)
5. Infer the current scenario of Indian power market and operation of Indian power exchange. (K2)

CO, PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - IV

20EEEL712 SDG NO. 4,7&13	ENERGY STORAGE TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To recollect the historical perspective and technical methods of energy storage
- To determine the performance factors of energy storage systems
- To discuss the hybrid energy storage and hydrogen fuel cell and identify the applications for renewable systems

UNIT I STORAGE: INTRODUCTION AND CHANGES 9

Storage Needs - Variations in Energy Demand - Variations in Energy Supply - Interruptions in Energy Supply - Transmission Congestion - Demand for

Portable Energy - Demand and scale requirements - Environmental and sustainability issues.

UNIT II TECHNICAL METHODS OF STORAGE 9

Introduction: Energy and Energy Transformations, Potential energy (pumped hydro, compressed air, springs) - Kinetic energy (mechanical flywheels) - Thermal energy without phase change passive (adobe) and active (water) - Thermal energy with phase change (ice, molten salts, steam) - Chemical energy (hydrogen, methane, gasoline, coal, oil) - Electrochemical energy (batteries, fuel cells) - Electrostatic energy (capacitors), Electromagnetic energy (superconducting magnets) - Different Types of Energy Storage Systems.

UNIT III PERFORMANCE FACTORS OF ENERGY STORAGE SYSTEMS 9

Energy capture rate and efficiency - Discharge rate and efficiency - Dispatch ability and load flowing characteristics, scale flexibility, durability – Cycle lifetime, mass and safety – Risks of fire, explosion, toxicity - Ease of materials, recycling and recovery - Environmental consideration and recycling, Merits and demerits of different types of Storage.

UNIT IV HYDROGEN FUEL CELLS AND FLOW BATTERIES 9

Hydrogen Economy and Generation Techniques, Storage of Hydrogen, Energy generation - Super capacitors: properties, power calculations - Operation and Design methods - Hybrid Energy Storage: Managing peak and Continuous power needs, options - Level 1: (Hybrid Power generation) Bacitor "Battery + Capacitor" Combinations: need, operation and Merits; Level 2: (Hybrid Power Generation) capacitor + Fuel Cell or Flow Battery operation-Applications: Storage for Hybrid Electric Vehicles, Regenerative Power, capturing methods.

UNIT V APPLICATION OF ENERGY STORAGES 9

Battery Storage System: Introduction with focus on Lead Acid and Lithium - Chemistry of Battery Operation, Power storage calculations, Reversible reactions, Charging patterns, Battery Management systems, System Performance, Areas of Application of Energy Storage: Waste heat recovery, Solar energy storage, Green house heating, Power plant applications, Drying and heating for process industries, energy storage in automotive applications in hybrid and electric vehicles.

TOTAL : 45 PERIODS

TEXT BOOKS:

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

2. Doughty Liaw, Narayan and Srinivasan, "Batteries for Renewable Energy Storage", The Electrochemical Society, NewJersy,2010.

REFERENCES :

1. Detlef Stolten, "Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications", Wiley, 2010.
2. Francois Beguin and Elzbieta Frackowiak ,"Super capacitors", Wiley,2013.
3. Michael Sterner ,Ingo Stadler "Handbook of Energy Storage- Demand, Technologies, Integration" by Springer-Verlag Berlin Heidelberg 2019(eBook ISBN978-3-662-55504-0)

WEB RESOURCES :

1. www.energystorage.org/technologies
2. https://www.eesi.org/papers/view/energy-storage-2019
3. https://www.geni.org/globalenergy/research/energy-storage-technologies/Energy-Storage-Technologies.pdf
4. https://www.renewableenergyworld.com/
5. https://www.forbes.com/

OUTCOMES:

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

1. Explore the historical changes and provide solution for environmental and sustainability issues.(K2)
2. Understand the different types of energy and various method of energy storage.(K1)
3. Outline the different performance factors devices according to environmental constraints.(K3)
4. Able to design the hybrid fuel cell and flow batteries according to application.(K6)
5. Able to categorize the energy storage devices to different application.(K5)

CO, PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - IV

20EEEL713 SDG NO. 4, 9	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Construction, principle of operation, control and performance of stepper motor and switched reluctance motors
- Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors and permanent magnet synchronous motors
- Construction, principle of operation and performance of other special machines

UNIT I STEPPER MOTORS **9**

Constructional features –Principle of operation –Types – Torque predictions – Linear Analysis – Characteristics – Drive circuits – Closed loop control – Concept of lead angle - Applications.

UNIT II SWITCHED RELUCTANCE MOTORS(SRM) **9**

Constructional features –Principle of operation- Torque prediction– Characteristics Steady state performance – Analytical Method – Power controllers – Control of SRM drive- Sensor less operation of SRM – Applications.

UNIT III PERMANENT MAGNET BRUSHLESS D.C. MOTORS **9**

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations- Power Converter Circuits and their controllers - Characteristics and control- Applications.

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) 9

Constructional features -Principle of operation – EMF and Torque equations - Sine wave motor with practical windings - Phasor diagram - Power controllers – performance characteristics -Digital controllers – Applications.

UNIT V SYNCHRONOUS RELUCTANCE MOTOR AND SPECIAL MACHINES 9

Constructional features – Principle of operation and Characteristics of Synchronous Reluctance Motor – Torque equation - Hysteresis motor-–Linear Induction Motor-Repulsion motor- Applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. T. Kenjo, "Stepping Motors and Their Microprocessor Controls", Clarendon Press London,1995
2. T.J.E.Miller, "Brushless Permanent-Magnet and Reluctance Motor Drives", Oxford University Press, 1989.

REFERENCE BOOKS:

1. R.Krishnan, "Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application", CRC Press, 2017.
2. T. Kenjo and S. Nagamori, "Permanent Magnet and Brushless DC Motors", Clarendon Press, London,1988.
3. E.G. Janardanan, "Special Electrical Machines", PHI learning Private Limited, Delhi, 2014.
4. K.Venkataratnam, "Special Electrical Machines", Universities Press (India) Private Limited,2008.

WEB REFERENCES:

1. https://www.designworldonline.com/stepper-motor-basics/
2. https://www.electronicshub.org/brushless-dc-motor-bldc-motor/

ONLINE RESOURCES:

1. https://www.electrical4u.com/brushless-dc-motors/
2. https://freevideolectures.com/course/3114/advanced-electric-drives/

OUTCOMES:

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

1. Describe the construction and operation different types of stepper motors. (K2)

2. Acquire knowledge in construction and operation of switched reluctance motor. (K2)
3. Acquire knowledge in construction and operation of permanent magnet DC motors. (K2)
4. Knowledge in construction and operation of permanent magnet brushless A.C. motors and permanent magnet synchronous motors. (K2)
5. Select a special machine for particular applications. (K3)

CO, PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - IV

20EEEL714 SDG NO. 4 & 9	EMBEDDED CONTROL OF ELECTRICAL DRIVES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the switching characteristics of transistors and SCRs. Series and parallel functions of SCRs, Programmable triggering methods of SCR.
- To learn controlled rectification AC supplies.
- To study of converters and inverters.
- To learn about motor control, charges, SMPS and UPS.

UNIT I INTRODUCTION **9**

Electric drive systems - solid state devices - solid state switching circuits – characteristics of elective motors - speed torque characteristics of electric motors – PWM techniques - rating and heating of motors.

UNIT II AC AND DC ELECTRIC DRIVES **9**

Introduction – classification of electric drives – dynamic conditions of a drive system – stability considerations of electrical drives – dc choppers, inverters, cycloconverter, ac voltage controllers, stepper motor.

UNIT III POWER CONVERTERS 9

Induction motor drives – synchronous motor drives – dc drives – block diagram representation of drive systems, signal flow graph representation of the systems, transient response, frequency response, stability of controlled drives.

UNIT IV CLOSEDLOOP CONTROL OF ELECTRICALDRIVES 9

Drive considerations – control system components – mathematical preliminaries – Nyquist stability criterion – Assessment of relative stability using Nyquist criterion – closed loop frequency response – sensitivity analysis in frequency domain – PID controllers – feed back compensation, robust control system design.

UNIT V MICROCONTROLLERS AND DSP APPLICATIONS 9

Introduction – dedicated hardware system versus microcontroller control – application areas and functions of microcontroller and dsp in drive technology – control of electric drives using microcontroller and dsp – control system design of microcontroller based variable speed drives – applications in textile mills, steel rolling mills, cranes and hoist drives, cement mills, sugar mills, machine tools, coal mills, paper mills, centrifugal pumps, turbo compressors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Vedam Subrahmanyam, "Electric drives – concepts and applications", Tata McGraw Hill publishing company limited, New Delhi, 2003.
2. John. B. Peatman, "Design with PIC Microcontrollers ", Pearson Education, Asia 2004.

REFERENCES:

1. Mohammed. A. El-sharkawi, " Fundamentals of Electrical drives", Books/cole, Thomson learning, A division of Thomson learning lin., 2001 edition.
2. Gopal. M, "Control System Principles and Design", Tata McGraw Hill publishing company limited, New Delhi, 2nd edition, 2009.
3. Nagrath. I. J, Gopal. M, "Control Systems Engineering", New age international publishers, 5th edition.

WEB REFERENCES:

1. https://youtube.com/playlist?list=PLFW6lRTa1g83sIfVY1p1xGqPGYUmXyahx
2. https://youtu.be/EaENkSSUK-k

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Explain about the basics characteristics of types of motors. (K2)
2. Understand different types of AC and DC electric drives. (K2)
3. Convert physical representation of drives to control system based representation. (K2)
4. Understand closed loop control of electrical drives. (K2)
5. Understand microcontroller and DSP based control of electrical drives. (K2)
6. Analyze various devices based on applications. (K3)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	3	-	-	-	-	-	-	-	2	-	1	3
CO2	-	-	2	-	-	-	-	2	-	-	1	-	2	2
CO3	2		2	-	-	-	-	-	-	-	2	-	2	2
CO4	-	-	3	-	-	-	-	2	-	-	2	-	2	3
CO5	1	-	-	-	-	-	-	2	-	-	-	-	1	2
CO6	2	-	2	-	-	-	-	2	-	-	2	-	2	3

PROFESSIONAL ELECTIVES - IV

20EEEL715 SDG NO. 4 & 9	ROBOTICS AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the various Generations of robots and Laws of robotics.
- To study about sensors and sources of robot.
- To introduce the various types of manipulators and End effectors.
- To study the various kinematics and inverse kinematics of robots and path planning for robot.
- To study the dynamics and Control of Manipulators of robot and its applications.

UNIT I BASIC CONCEPTS **9**

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Robot classifications and specifications- Asimov's laws of robotics – dynamic stabilization of robots.

UNIT II POWER SOURCES, SENSORS AND ACTUATORS 9

Hydraulic, pneumatic and electric drives: Design and control issues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT III MANIPULATORS AND GRIPPERS DIFFERENTIAL MOTION 9

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

UNIT IV KINEMATICS AND PATH PLANNING 9

Linear and angular velocities-Manipulator Jacobin-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance Solution kinematics problem – robot programming languages.

UNIT V DYNAMICS AND CONTROL WITH APPLICATIONS 9

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator. Multiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mikell P. Weiss G.M., Nagel R.N., Godrej N.G., "Industrial Robotics", McGraw-Hill Singapore, 2015.
2. Saeed B Niku, "Introduction to Robotics, Analysis, Systems, Applications" Prentice Hall, 3rd edition 2014.
3. Deb.S.R., "Robotics technology and flexible Automation", John Wiley, USA1997.

REFERENCES:

1. Asfahl C.R.,"Robots and manufacturing Automation", John Wiley, USA1992.
2. Klafter R.D., Chmielewski T.O., Begin A., "Robotic Engineering- An integrated approach", Prentice Hall of India, New Delhi, 1994.
3. R.K.Mittal and I.J.Nagrath, "Robotics and Control", Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
4. JohnJ.Craig, "Introduction to Robotics Mechanics and Control", Third edition, Pearson Education,2009.
5. Issac Asimov I Robot, "Ballantine Books", New York, 1987.

WEB REFERENCES:

1 https://nptel.ac.in/courses/112101099/
2 https://www.udemy.com/course/robotic-process-automation-fundamentals-and-build-a-robot
3 https://swayam.gov.in/nd1_noc20_me39/preview

ONLINE RESOURCES:

1 https://futureskillsnasscom.edcast.com/insights/2018-isaac-asimov
2 https://www.edureka.co/robotic-process-automation-training

OUTCOMES:

Upon completion of the course, the student able to

1. Explain the evolution of robot technology and mathematically representation of different types of robots.(K2)
2. Analyze the various components required to built a robot.(K3)
3. Explain the various end effectors and micro grippers available to design and built a robot.(K2)
4. Derive the kinematics, trajectory planning and dynamics of robots.(K2)
5. Develop various control schemes of Robotics control for the case studies with robot machine interface.(K2)

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	2	1	2	-	-	-	-	-	3
CO2	2	3	2	3	2	2	-	-	-	-	-	2
CO3	3	2	3	3	1	2	-	-	-	-	-	3
CO4	2	3	2	2	2	2	-	-	-	-	-	3
CO5	3	3	2	1	2	1	-	-	-	-	-	2

PROFESSIONAL ELECTIVES - IV

20EEEL716 SDG NO. 4 & 9	REAL TIME EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn the architecture and programming of ARM processor.
- Be familiar with the embedded computing platform design and analysis.
- Be exposed to the basic concepts of real time Operating system.
- Learn the system design techniques and networks for embedded systems

UNIT I INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS 9

Complex systems and microprocessors– Embedded system design process –Design example: Model train controller- Instruction sets preliminaries – ARM Processor – CPU: programming input and output- supervisor mode, exceptions and traps – Co-processors- CPU performance- CPU power consumption.

UNIT II EMBEDDED COMPUTING PLATFORM DESIGN 9

The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture-Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization –Program validation and testing.

UNIT III PROCESSES AND OPERATING SYSTEMS 9

Introduction – Multiple tasks and multiple processes – Multirate systems- Pre-emptive real-time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance-power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE.

UNIT IV SYSTEM DESIGN TECHNIQUES AND NETWORKS 9

Design methodologies- Design flows – Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques-Distributed embedded systems – MPSoCs and shared memory multiprocessors.

UNIT V CASE STUDY **9**

Data compressor – Alarm Clock – Audio player – Software modem-Digital still camera – Telephone answering machine-Engine control unit – Video accelerator.

TOTAL:45 PERIODS

TEXT BOOK:

1. Marilyn Wolf, "Computers as Components – Principles of Embedded Computing System Design", Third Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Wiley India Pvt.Ltd, 2015.

REFERENCES:

1. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.
2. David. E. Simon, "An Embedded Software Primer", 1st Edition, Fifth Impression, Addison-Wesley Professional, 2007.
3. Raymond J.A. Buhr, Donald L.Bailey, "An Introduction to Real-Time Systems- From Design to Networking with C/C++", Prentice Hall,1999.
4. C.M. Krishna, Kang G. Shin, "Real-Time Systems", International Editions, Mc Graw Hill 1997.
5. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc Graw Hill, 2004.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108105057
2. onlinecourses.nptel.ac.in/noc22_cs46/preview

ONLINE RESOURCES:

1. https://www.coursera.org/specializations/real-time-embedded-systems
2. http://vlabs.iitkgp.ernet.in/rtes/index.html#

OUTCOMES

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

1. Outline the concepts of embedded systems and ARM processor (K2)
2. Describe the embedded computing platform for various analysis (K2)
3. Explain the basic concepts of real time Operating system(K2)
4. Make Use the system design techniques to develop software for embedded systems (K3)

5. Apply embedded-system concepts to develop various application devices (K3)

CO- PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - IV

20EEEL717 SDG NO.4,9	FPGA BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to do the advanced design and analysis of digital circuits with HDL.
- To provide in depth understanding of logic and system design.
- To make the students to apply their knowledge for the design of advanced digital hardware systems with help of FPGA tools.
- To make students familiarize with design of combinational and sequential circuits for the required specifications

UNIT I INTRODUCTION **9**

Digital Design and FPGA - Role of FPGA - FPGA Types - FPGA Vs Custom VLSI - Goals and Techniques - Design Challenges - Design abstraction - Methodologies.

UNIT II FPGA FABRICS **9**

FPGA Architectures - SRAM Based FPGA - Logic Elements - Interconnection Networks - Antifuses - Logic Blocks - Chip I/O - Logic Elements - Interconnect - Circuit Design - Architecture of FPGA Fabrics - Logic Element Parameters - Interconnect Architecture - Pin out. DATA PATH C

UNIT III DATA PATH CONTROLLER **9**

Behavioral Design - Data path controller Architecture - Scheduling and allocation - Power - Pipelining - Design methodologies - Processes - Standards - Verification Design Example: Digital Signal Processor

UNIT IV VERILOG HDL **9**

Hardware Description Languages - Verilog Description - Modules - Assignment - Always block - Delays - Data Types and Operators - Behavioral and Structural Verilog - Constants - Arrays - Loops - Testing Verilog Program .

UNIT V HARDWARE MODELING USING VERILOG **9**

Combinational logic design: Decoders - Encoders - Multiplexers - Demultiplexers - Adders / Subtractors - Comparators - Sequential logic design: Flip - Flops - Synchronous and Asynchronous counters - ALU/CPU.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Wayne Wolf , "FPGA Based System Design" , Prentice Hall Pearson Education, Inc. 2005.
2. Charles Roth, Lizy K. John, ByeongKil Lee , "Digital Systems Design Using Verilog", Global Engineering, 1st Edition, 2014

REFERENCES:

1. Stephen D Brown, "Fundamentals of Digital Logic", TMH Publication, 2007
2. John. F. Wakerly , " Digital Design", Pearson Education, India, 2012
3. S. Trimberger, "Field Programmable Gate Array Technology", Kluwer Academic Publications,1994
4. Bob Zeidman, "Designing with FPGAs and CPLDs", Elsevier publications, 2002.

WEB REFERENCES:

1. https://nptel.ac.in/courses/117/108/117108040.
2. https://nptel.ac.in/courses/117/106/117106092

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=bwoyQ_RnaiA
2. https://www.youtube.com/watch?v=jbOjWp4C3V4

OUTCOMES:

Upon completion of the course, the student should have:

1. Distinguish different types of FPGA, recognize the challenges and understand the methodologies for FPGA design (K2)
2. Interconnect logic elements of FPGA to synthesize digital circuits for the given requirement. (K3)
3. Design and test a FPGA based digital signal processor for the given specifications. (K3)
4. Use Verilog programming techniques to develop programs based on structural, behavioral and dataflow models for digital circuits. (K3)
5. Design combinational and sequential circuits for the required specifications . (K3)
6. Develop Verilog programs to test the functionality of the designed circuit. (K3)

CO, PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - IV

20ITPC303 SDG NO.3,4,9	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the basic structure and operations of a computer.
- To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
- To learn the basics of pipelined execution.
- To understand parallelism and multi-core processors.
- To understand the memory hierarchies, cache memories and virtual memories. To learn the different ways of communication with I/O devices.

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM 9

Functional Units – Basic Operational Concepts – Performance Instructions: Language of the computer – Operations, Operands – Instruction representation – Logical Operations – decision making – MIPS addressing.

UNIT II ARITHMETIC FOR COMPUTERS 9

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operation – Sub word Parallelism

UNIT III PROCESSOR AND CONTROL UNIT 9

A Basic MIPS implementation Building a Datapath Control Implementation Scheme Pipelining Pipelined data path and control Handling Data Hazards & Control Hazards Exceptions.

UNIT IV PARALLELISIM 9

Parallel Processing Challenges – Flynn's classification – SISD, MIMD, SIMD, SPMD and vector Architectures – Hardware Multithreading – Multi-core processors and other Shared memory multiprocessors – Introduction to Graphics Processing Units, Clusters, Warehouse scale computers and other message – passing multiprocessor

UNIT V MEMORY & I/O SYSTEMS 9

Memory Hierarchy – memory technologies – cache memory - measuring and improving cache performance – virtual memory, TLB's – Accessing I/O devices – Interrupts – Direct memory access bus – structure bus – operation arbitration Interface – circuits - USB

TOTAL : 45 PERIODS

TEXT BOOKS:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010.
2. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.

3. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach||, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.

OUTCOMES:

On Completion of the course, the students should be able to:

1. Understand the physical and logical aspects of Computer System (K2)
2. Apply the various parameters of the processor to improve system performance. (K3)
3. solve fixed and floating point arithmetic operations. (K3)
4. Demonstrate data path and control unit of computer system (K3)
5. Understand parallel processing architectures with pipelining and avoidance of hazards (K2)
6. Define the various components of computer system hardware. (K1)

CO, PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	3
CO2	3	3	2	-	-	-	-	-	-	-	-	2	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	3
CO4	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO5	3	1	1	-	-	-	-	-	-	-	-	3	3	3
CO6	3	1	1	-	-	-	-	-	-	-	-	3	2	3

PROFESSIONAL ELECTIVES - IV

20EEEL718 SDG NO.9	INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about management principles, techniques, functions, managerial activities.
- To study about characteristics of management, various strategies of corporate, environmental threats and Industry analysis.
- To gain knowledge in quality and quality control, various quality management assessment tools, quality management standards and kaizen

- To learn the functions of money market, capital market, Cost benefit analysis and CVP graph.
- To study about human resource management, staff development and career development, training strategies and methods.

Unit I Basics of Management **9**

Introduction, Definition of management, characteristics of management, functions of management - Planning, Organising, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision Making, Principles of management – F.W.Taylor, Henry Fayol, Elton Mayo, Administration and management, Nature of management, levels of management, managerial skills, managerial roles, Forms of Organization- Line , Line –staff etc. Forms of ownerships – Partnership, Proprietorship, Joint stock, Co-operative society, Govt. Sector etc, concept of Globalisation

Unit II Strategic Management **9**

Military origins of strategy – Evolution - Concept and Characteristics of strategic management –Defining strategy – Mintzberg's 5P's of strategy – Corporate, Business and Functional Levels of strategy - Strategic Management Process. Preparing an Environmental Threat and Opportunity Profile (ETOP) – Industry Analysis - Porter's Five Forces Model of competition.BCG Matrix – GE 9 Cell Model -Balanced Scorecard, Generic Competitive Strategies: Low cost, Differentiation, Focus.

Unit III Quality Management **9**

Definition of quality, goalpost view of quality, continuous improvement definition of quality, types of quality – quality of design, conformance and performance, phases of quality management, Juran's and Demings view of quality, Quality Management Assistance Tools: Ishikawa diagram – Pareto Analysis – Pokka Yoke (Mistake Proofing).quality circles, TQM, Kaizen, Five S (5S), Six sigma Quality Management Standards (Introductory aspects only)- The ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004 Environmental Management System Standard- ISO 27001:2005 Information Security Management System (8 hrs)

Unit IV Financial & Project Management **9**

Capital Structure, Fixed & working capital, Role of Securities and Exchange Board of India (SEBI), function of money market and capital Market, sources of finance. Introduction to capital budgeting, Techniques of capital budgeting. Break even analysis - assumptions, importance, Cost-Benefit analysis, CVP graph, Project Management, Project network analysis, CPM, PERT and Project crashing and resource Leveling.

Unit V Human Resource Development **9**

Strategic importance HRM; objectives of HRM; challenges to HR professionals; role, Responsibilities and competencies of HR professionals; HR department operations; Human Resource Planning - objectives and process; human resource information system.. Talent acquisition; recruitment and selection strategies, career planning and management, training and development, investment in training programme; executive development.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. O.P. Khanna, "Industrial Engineering and Management", Dhanpat rai publications Ltd, New Delhi,2018
2. L.C.Jhamb, Savitri Jhamb, "Industrial Management – I" , Thirteenth Edition, Everest Publishing House,2013.
3. Dinesh Seth and Subhash C. Rastogi, "Global Management Solutions", Second Edition, Cengage Learning, USA,2009.

REFERENCE BOOKS:

1. B. Davis and Margrethe H. Olson, "Management Information Systems", Second Edition, McGraw Hill Higher Education,1985
2. Azar Kazmi, "Strategic Management & Business Policy", Third Edition, McGraw Hill Inc., US,2008.
3. Paneer Selvam "Production and Operation Management", Third Edition, PHI Learning Private Limited,2012
4. NVS Raju "Industrial Engineering Management", First Edition, Cenage India Private Limited, 2013
5. Ravishankar, "Industrial Engineering Management", Galgotia Publications Pvt Ltd,2000

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/107/112107292/

OUTCOMES:

At the end of the course, the student should be able to:

1. Describe about management principles and activities(K2)
2. Discuss the various characteristics of management and industrial analysis (K2)
3. Summarize the concepts of quality management and control, various standards in quality(K2)
4. Describe the financial concepts and cost benefit analysis for practical situation(K2)

5. Apply human resource management concepts in industry(K3)

CO, PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - V

20EEEL801 SDG NO.4	FACTS AND CUSTOM POWER DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- An introduction to the various types of FACTS controllers;
- Explanation of the principle of shunt compensation and series compensation;
- Description of the various power devices and converter topologies used in FACTS controllers;
- The concept of combined series and shunt FACTS controllers.

UNIT I INTRODUCTION **9**

Real and reactive power control in electrical power transmission lines–loads & system compensation-Uncompensated transmission line–shunt and series compensation.

UNIT II VARIABLE IMPEDANCE OR THYRISTOR BASED FACTS CONTROLLER **9**

Operation of the TCSC – Different modes of operation – Modeling of TCSC, Variable reactance model–Voltage control by SVC– Advantages of slope in dynamic characteristics–Influence of SVC on system voltage–Design of SVC voltage regulator– TCR – FC -TCR. Modeling for Power Flow and stability studies. Applications: Improvement of the system stability limit –Enhancement of system damping.

UNIT III VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS **9**

Static Synchronous Compensator (STATCOM) – Principle of operation – VI Characteristics. Applications: Steady state power transfer- enhancement of transient stability- prevention of voltage instability. SSSC-operation of SSSC and the control of power flow– modeling of SSSC in load flow and transient stability studies-Unified Power flow controller(UPFC)- Interline power flow controller(IPFC)

UNIT IV CUSTOM POWER DEVICES **9**

Dynamic Voltage Restorer (DVR) - Distributed Static Synchronous Compe nsator (DSTATCOM)-Unified Power Quality Conditioner (UPQC)– Interline Unified Power Quality Conditioner (IUPQC)

UNIT V DESIGN OF CONTROLLERS **9**

Model and analysis of the swing mode-Implications of Different Transfer Functions, Design of Damping Controller, deadbeat controller, adaptive controller.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.Mohan Mathur, Rajiv K.Varma,"Thyristor based Facts controllers for Electrical Transmission Systems", IEEE press and wiley & Sons, Inc, 2002.
2. Narain G.Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Delhi-110006, 2011.
3. T.J.E.Miller, Static Reactive power compensation, John Wiley and sons, Newyork, 1982.

REFERENCES:

1. K.R.Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International(P) Limited, Publishers, NewDelhi, 2008
2. Hirofumi Akagi, Edson Hirokazu Watanabe and Mauricio Aredes, "Instantaneous power theory and applications to power conditioning", John Wiley & Sons, 2007.
3. Arindam Ghosh and Gerard Ledwich, "Power quality enhancement using custom power devices", Springer Science & Business Media, 2012.
4. Dylan Dah-Chuan Lu, "An update on Power Quality", Intech, 2013.
5. Anrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Pérez and César Angeles-Camacho, "FACTS: Modeling and Simulation in Power Networks", John Wiley & Sons, West Sussex, 2004.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108106025
2. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee44/

ONLINE RESOURCES:

1. https://ece.ncsu.edu/seminar/facts-flexible-ac-transmission-systems-machine-for-smart-grid/
2. https://www.youtube.com/watch?v=dFC1aF5GUoA
3. https://www.youtube.com/watch?v=EWebbcUTJy4
4. https://www.youtube.com/watch?v=aYNQu7ClIh4

OUTCOMES:

Upon completion of the course, the students should able to

1. Understand about the fundamental principles of Passive and Active

Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems. (K2)

2. Illustrate various Static VAr Compensation Schemes like Thyristor / GTO Controlled Reactive Power Systems, PWM Inverter based Reactive Power Systems and their controls. (K2)
3. Develop analytical modeling skills needed for modeling and analysis of such Static VAr systems with a view towards Control Design. (K3)
4. Define fundamental principles of Unified Power Flow Conditioner and Interline Power Flow Conditioner in Power Systems. (K2)
5. Summarize various UPFC Systems, Converters used in them and their control.(K2)
6. Develop the analytical modeling skills for modeling and analysis of UPFC systems with a view towards Control Design. (K3)

CO, PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	2	1	2	-	-	-	-	-	-	1	3
CO2	1	1	1	2	1	2	-	-	-	-	-	-	2	2
CO3	2	1	1	2	-	3	-	-	-	-	-	-	2	2
CO4	1	2	2	2	-	2	-	-	-	-	-	-	2	3
CO5	1	1	1	1	-	2	-	-	-	-	-	-	2	3
CO6	1	1	2	1	1	1	-	-	-	-	-	-	1	1

PROFESSIONAL ELECTIVES - V

20EEEL802 SDG NO. 4,8, 9&12	SMART GRID TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Study about Smart Grid technologies in Smart Grid
- To Study about different smart meters and advanced metering infrastructure
- To familiarize the high performance computing for Smart Grid applications

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid.

UNIT II SMART GRID TECHNOLOGIES (Transmission) 9

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control.

UNIT III SMART GRID TECHNOLOGIES (Distribution) 9

DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

UNIT IV SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU), Intelligent Electronic Devices(IED) & their application for monitoring &protection.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Stuart Borlase, "SmartGrid: Infrastructure, Technology and Solutions", CRC Press 2017.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley, 2012

REFERENCES

1. Vehbi C. Güngör, DilanSahin, TaskinKocak, SalihErgüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, "Smart Grid Technologies: Communication Technologies and Standards IEEE Transactions On Industrial Informatics", Vol.7,No.4, November, 2011.

2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang, "Smart Grid – The New and Improved Power Grid: A Survey", IEEE Communications Surveys & Tutorials.2011

WEB REFERENCES:

1. https://www.edx.org/course/smart-grids-the-basics
2. https://nptel.ac.in/courses/108107113/
3. https://en.wikipedia.org/wiki/Smart_meter

ONLINE RESOURCES:

1. https://www.smartgrid.gov/the_smart_grid/smart_grid.html
2. https://www.elprocus.com/overview-smart-grid-technology-operation-application-existing-power-system/
3. http://iitk.ac.in/smartcity/qip/download/ppt/Day-1/01_Smart%20GridGeneral%20 Introduction%20and%20its%20Status%20in%20India_S%20C%20Srivastava.pdf

COURSE OUTCOMES:

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

1. Develop more understanding on the concepts of Smart Grid and its present developments. (K3)
2. Classify different Smart Grid technologies in transmission. (K2)
3. Identify different Smart Grid technologies in Distribution. (K3)
4. Summarize smart meters and advanced metering infrastructure. (K2)
5. Understand LAN, WAN and Cloud Computing for Smart Grid applications. (K2)

CO, PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - V

20EEEL803 SDG NO. 4,9,11	EHVAC & EHVDC POWER TRANSMISSION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on structure of power system, standard voltage levels and compute transmission line parameters
- To know about HVDC system and locate various FACTS devices on power system
- To study the effect of fields on living and non-living organisms

UNIT I TRANSMISSION LINE TRENDS **9**

Standard transmission voltages, average values of line parameters – Power handling capacity and line losses - number of lines, Advantages and disadvantages of HVAC and HVDC system.

UNIT II LINE AND GROUND PARAMETERS **9**

Resistance, Temperature rise and current carrying capacity of conductors. Properties of Bundle conductors – Calculation of L and C parameters – Modes of propagation – Effect of ground return.

UNIT III HVDC SYSTEM **9**

HVDC Power transmission–Description, principles of operation and Planning for HVDC transmission– –DC breakers–Operating problems– HVDC transmission based on VSC –Types and applications of MTDC systems.

UNIT IV FACTS **9**

Basic concepts – Reactive power control, uncompensated transmission line, series compensation, SVC, thyristor control, series capacitor, static synchronous compensator, unified power flow controller and applications.

UNIT V ELECTROSTATIC AND MAGNETIC FIELDS OF EHV LINES **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.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. K.R. Padiyar, " HVDC Power Transmission System", New Age International Publishers, 3rd Edition, Reprint 2017.

2. Rakosh Das Begamudre " Extra high voltage AC transmission Engineering", New Age International Publishers, Fourth Edition, 2011.

REFERENCES:

1. C.L. Wadhwa" Electrical Power Systems", New Age International Publishers, Sixth Edition,2018.
2. M.L. Soni, P.V. Gupta, U.S. Bhatnagar, A.Chakrabarti, " A Text Book on Power System Engineering", DhanpatRai& Co., 2018.
3. P. Kundur "Power System stability and control", Tata McgrawHilll Publishers, Second Edition, 2020.

WEB RESOURCES:

1. https://nptel.ac.in/courses/108104048/
2. https://swayam.gov.in/nd1_noc20_ee43/preview

ONLINE RESOURCES:

1. http://www.ehvpower.com/
2. https://www.electricalindia.in/future-of-transmission-line-2/

OUTCOMES:

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

1 Classify transmission (HVAC & HVDC) and distribution voltage levels. (K2)
2. Infer transmission line parameters. (K2)
3. Interpret HVDC transmission in Power System. (K2)
4. Outline the uses of placing FACTS devices. (K2)
5. Summarize electrostatic and magnetic fields of EHV lines. (K2)

CO, PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - V

20EEEL804 SDG NO.3,4,9	SOFT COMPUTING TECHNIQUES FOR ELECTRICAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the concepts of feed forward neural networks
- To teach about the concept of fuzziness involved in various systems
- To expose the ideas about genetic algorithm and to provide adequate knowledge about of FLC and NN toolbox

UNIT I INTRODUCTION AND ARTIFICIAL NEURAL NETWORKS 9

Introduction to intelligent systems- Soft computing techniques- Conventional Computing versus Swarm Computing - Single objective and multi-objective problems -Neuron- Nerve structure and synapse- Artificial Neuron and its model- activation functions- Neural network architecture- single layer and multilayer feed forward networks- Mc Culloch Pitts neuron model- perceptron model- Adaline and Madaline- multilayer perception model- back propogation learning methods- effect of learning rule coefficient -back propagation algorithm-

UNIT II ARTIFICIAL NEURAL NETWORKS AND ASSOCIATIVE MEMORY9

Counter propagation network- architecture- functioning & characteristics of counter Propagation network- Hopfield/ Recurrent network configuration - stability constraints associative memory and characteristics- limitations and applications- Hopfield v/s Boltzman machine- Adaptive Resonance Theory- Architecture- classifications- Implementation and training - Associative Memory.

UNIT III FUZZY LOGIC SYSTEM 9

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control- Fuzzification inferencing and defuzzification - Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems. Self organizing fuzzy logic control- Fuzzy logic control for nonlinear time delay system.

UNIT IV GENETIC ALGORITHM **9**

Introduction- working principle, Basic operators and Terminologies like individual, gene, encoding, fitness function and reproduction, Genetic modeling: Significance of Genetic operators, Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, GA optimization problems, JSPP (Job Shop Scheduling Problem), TSP (Travelling Salesman Problem), Differences & similarities between GA & other traditional methods, Applications of GA.

UNIT V HYBRID CONTROL SCHEMES **9**

Fuzzification and rule base using ANN–Neuro fuzzy systems-ANFIS –Optimization of membership function and rule base using Genetic Algorithm –- Evolutionary Programming- Case study – Familiarization of NN, FLC and ANFIS Tool Box.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Laurene V. Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Pearson Education.1994
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India, 2010.

REFERENCE BOOKS:

1. Zimmermann H.J. "Fuzzy set theory and its Applications", Springer international edition, 2015.
2. David E.Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2009.
3. W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press", 1996.
4. T. Ross, "Fuzzy Logic with Engineering Applications", Tata McGraw Hill, New Delhi, 1995.
5. EthemAlpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)", MIT Press, 2004.
6. Corinna Cortes and V. Vapnik, "Support - Vector Networks, Machine Learning", 1995.

WEB REFERENCES:

1. https://www.digimat.in/nptel/courses/video/106105173/L01.html

ONLINE RESOURCES:

1. https://freevideolectures.com/course/4565/nptel-introduction-soft-computing

OUTCOMES:

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

1. Develop ANN based models and control schemes for non-linear systems.(K4)
2. Understand the different operations on the fuzzy sets.(K2)
3. Understand ANN architectures, algorithms and their limitations.(K2)
4. Apply Fuzzy logic for modeling and control of non-linear system.(K3)
5. Understand the hybrid control schemes, P.S.O and support vector systems.(K2)

CO, PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - V

20EEEL805 SDG NO.3,4,9	AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To define the glossary related to vehicle electrical and electronic system.
- To understand the need for starter batteries, starter motor and alternator in the vehicle.
- To differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols.
- To list common types of sensor and actuators used in vehicles and to understand networking in vehicles

UNIT I INTRODUCTION AND AUTOMOTIVE BATTERIES 9

Introduction - Overview of vehicle electrical systems- Electrical circuits - Electrical power supply in conventional vehicle- Dimensioning of wires- Circuit diagrams and symbols - Electromagnetic Compatibility and interference suppression. Batteries – Battery design – Method of operation –

Lead acid battery construction – Battery ratings and testing- Maintenance -free batteries – Battery – Substitute, versions, special cases.

UNIT II STARTING AND CHARGING SYSTEM 9

Alternators – Generation of electrical energy in vehicle- physical principles- Alternator and voltage regulations versions – power losses – characteristics curve- Alternator operation in the vehicle- Alternator circuitry. Starter Motors – Development and Starting requirements in the IC engines- starter motor design – Starter motor design variations – starter motor control and power circuits

UNIT III IGNITION, LIGHTING AND AUXILLARY SYSTEM 9

Ignitions System - Ignition fundamentals- Electronic ignition- Programmed ignition- Distributor less ignition -Direct ignition - Spark plugs. Automotive lighting Technology – Technical demands – Development of lighting technology- Light sources – physical principles – Front and rear lighting system- Interior lighting system – Special purpose lamps – Adaptive Lighting system - Instrument clusters - Wiper and Washer systems- electric horns

UNIT IV AUTOMOTIVE ELECTRONICS AND SENSORS AND ACTUATORS 9

Automotive Electronics- overview and demands- Basic principles of semiconductor technology -Electronic Components- semiconductor components- Microcontrollers - Sensor-Signal Processing - Data Processing in the vehicle - Glossary for automotive microelectronics. Automotive Sensors – Basics – Sensors : Position, speed, Acceleration/Vibrational , Force/Torque, Flow meters, Gas/ Concentration , Temperature- Measured Quantities, Measuring Principles and automotive applications Automotive Actuators - Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines 131

UNIT V VEHICLE NETWORKING 9

Data transfer between automotive Electronics systems - Basic principles of networking- Network topology- Network organization- OSI reference model- Control mechanisms - communication protocols in embedded systems-- Vehicle Communication Protocols – Cross-system functions - Requirements for bus systems- Classification of bus systems- Applications in the vehicle - Coupling of networks- Examples of networked Vehicles - Bus system- CAN, LIN, Flexray – MOST etc.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5
2. Uwe Kiencke and Lars Nielson, Automotive Control System, SAE Publications, 2006

REFERENCES:

1. Barry Holembeak, "Automotive Electrical and Electronics" , Delmar Publishers, Clifton Park,USA,2010
2. James D Halderman, " Automotive Electrical and Electronics" , Prentice Hall, USA, 2013
3. Tom Denton, "Automotive Electrical and Electronics Systems," Third Edition, 2004, SAE International
4. William Ribbens, "Understanding Automotive Electronics - An Engineerin g Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.
5. Benjamin C.Kuo and Farid Golnaraghi,'' Automatic Control System'' John Wiley & Sons, Eight edition, 2003.
6. Liptak B.G., "Instrument and Automation Engineers' Handbook: Process Measurement and Analysis", Fifth Edition, CRC Press, 2016.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc20_de06
2. https://nptel.ac.in/courses/107/106/107106088/

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=Dm0IheybeUU
2. https://www.youtube.com/watch?v=TY7lCT7CwFM
3. https://www.youtube.com/watch?v=Qvz_RNwq-Yg

OUTCOMES:

Upon completion of the course, the student should able to:

1. Understand the construction, working, selection and calibration of temperature, pressure, flow and level sensors.(K2)
2. Understand the working principle of different chemical analyzers.(K2)
3. Understand the role of Safety Instrumented System in the Industry and to state the associated standards.(K2)
4. Understand protection layers and to determine SIL.(K2)

5. Develop the documents used to define instruments and control systems for a typical project, including P&IDs, loop diagrams, instrument lists, logic diagrams, installation details, and location plans.(K3)
6. Design and interpret the block diagram and process flow diagram for process industries.(K3)

CO, PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	1	2	-	-	-	-	-	-	1	3
CO2	2	1	2	2	1	2	-	-	-	-	-	-	2	2
CO3	2	1	2	2	-	3	-	-	-	-	-	-	2	2
CO4	2	1	2	2	-	2	-	-	-	-	-	-	2	3
CO5	2	2	1	1	-	2	-	-	-	-	-	-	2	3
CO6	2	2	-	-	3	3	-	-	-	-	-	-	3	1

PROFESSIONAL ELECTIVES - V

20EEEL806 SDG NO. 7,9,13	CONTROL OF ELECTRIC VEHICLE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of control system used in automobiles
- To recognize the electronically controlled system used in driving mechanics.
- To understand the working principle of driver modelling and power train control systems.
- To identify the control system used in hybrid and electrical vehicles.
- To illustrate the need for automated transport systems.

UNIT I INTRODUCTION TO VEHICLE CONTROL SYSTEM 9

Trends, overview and examples of vehicle control system, Sensors, actuators and controller modules, Vehicle communication Network, System Engineering V diagram, Algorithm Development, Steps in vehicle control system design, Degree of freedom for vehicle control, selection of controlled, manipulated, measured disturbance variables, classification of the variables in various automotive systems like engines, suspension, braking, air conditioning – General types of vehicle controller configurations, Feedback, Inferential, Feed-Forward, Ratio control.

UNIT II CONTROL SCHEMES, CRUISE AND HEADWAY CONTROL 9

Feed, Forward control, Cascade control, Design considerations for cascade control, Time delay compensation, Inferential control, Nonlinear control, Adaptive control etc. Cruise control design, Autonomous cruise control, Anti locking brakes, Traction control system, Vehicle stability control, linear and non-linear vehicle model, VSC Design Principles – four-wheel steering , Goals of 4WS Algorithms , active suspensions.

UNIT III DRIVER MODELING AND POWERTRAIN CONTROL SYSTEMS 9

Driving simulators, percentage of road departure, Driver modelling, Transfer function models, Preview/ Predictive models, longitudinal driver models Control oriented engine modelling, Air intake model, Fuel dynamics model, Air Fuel ratio dynamics, Engine Control Loops, Air Fuel Ratio control, EGR Control, Spark Timing control, Idle speed control, Knock control, Adaptive knock control, Combustion torque estimation, Transmission control.

UNIT IV CONTROL OF HYBRID AND FUEL CELL VEHICLES 9

Series, Parallel, Split Hybrid Configurations, Hybrid Vehicle Control Hierarchy, Control Concepts of Series Hybrids, Equivalent Consumption minimization strategy, control concepts for split hybrid modelling of fuel cell systems, fuel stack model, control of fuel cell system.

UNIT V HUMAN FACTORS AND INTELLIGENT TRANSPORT SYSTEM 9

Human factors in vehicle automation, cross over model principle, Risk, Homeostatic Theory, Driving simulators, percentage of road departure Advanced traffic management system, Advanced traveller information system, commercial vehicle operation, Advanced vehicle control system, Preventing collisions, Longitudinal motion control and platoons, Site specific information, comparison of longitudinal control approaches, String stability, Automated steering and lateral control – Lane sensing, automated lane change and follow control.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Galip Ulsoy, Huei Peng , Melih Çakmakci,"Automotive Control System", First Edition Cambridge University Press, 2012
2. Uwe Kiencke and Lars Nielson," Automotive Control System", Second Edition, Springer, 2005.

REFERENCE BOOKS:

1. Robert Bosch ,"Automotive Handbook",Tenth Edition, SAE International, 2018

2. Benjamin C.Kuo and Farid Golnaraghi,"Automatic Control System", Ninth edition, John Wiley & Sons, 2014
3. Katsuhiko Ogata,"System Dynamics", Fourth Edition, Pearson,2003
4. Richard C.Dorf and Robert H.Bishop,"Modern Control Systems", Twelfth edition, Pearson, 2014

OUTCOMES:

At the end of the course the student will be able to:

1. Describe the basics of control system used in automobiles (K2)
2. Discuss the different control schemes used in Electric vehicle control(K2)
3. Explain the working principle of driver modelling and power train control systems(K2)
4. Summarize the different control configurations, concepts and models in hybrid and fuel cell vehicles(K2)
5. Describe the need of intelligent transport systems(K2)

CO, PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - V

20EEEL807 SDG NO. 4,9	ADVANCED MICROPROCESSORS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts in the internal programming model of Intel family of microprocessors.
- To introduce the programming techniques using MASM, DOS and BIOS function calls.
- To introduce the basic architecture of Pentium family of processors.and microcontroller.
- To introduce the concepts and architecture of RISC processor

UNIT I ADVANCED MICROPROCESSOR ARCHITECTURE 9

Internal Microprocessor Architecture-Real mode memory addressing – Protected Mode Memory addressing –Memory paging - Data addressing modes – Program memory addressing modes – Stack memory addressing modes – Data movement instructions – Program control instructions-Arithmetic and Logic Instructions

UNIT II MODULAR PROGRAMMING AND ITS CONCEPTS 9

Modular programming –Using keyboard and Video display –Data Conversions- Disk files- Interrupt hooks- using assembly languages with C/ C++.

UNIT III PENTIUM PROCESSORS 9

Introduction to Pentium Microprocessor – Special Pentium registers- Pentium memory management – New Pentium Instructions –Pentium Processor –Special Pentium pro features – Pentium 4 processor

UNIT IV 16-BIT MICRO CONTROLLER 9

8096/8097 Architecture-CPU registers –RALU-Internal Program and Data memory Timers-High speed Input and Output –Serial Interface-I/O ports –Interrupts –A/D converter-Watch dog timer –Power down feature –Instruction set- External memory Interfacing –External I/O interfacing.

UNIT V RISC PROCESSORS 9

The RISC revolution – Characteristics of RISC Architecture – The Berkeley RISC – Register Windows – Windows and parameter passing – Window overflow – RISC architecture and pipelining – Pipeline bubbles – Accessing external memory in RISC systems – Reducing the branch penalties – Branch prediction

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Barry B.Brey, The Intel Microprocessors 8086/8088, 80, 86, 80286, 80386 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming and interfacing, Prentice Hall of India Private Limited, New Delhi, 8th Edition, 2008.
2. John Peatman, Design with Microcontroller McGraw Hill Publishing Co Ltd, New Delhi.

REFERENCES:

1. Alan Clements, "The principles of computer Hardware", Oxford University Press, 3rd Edition, 2003

2. Rajkamal, The concepts and feature of micro controllers 68HC11, 8051 and 8096; S Chand Publishers, New Delhi.
3. Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey ,Prentice Hall of India, 2007.

WEB REFERENCES:

1. https://nptel.ac.in/courses/117/104/117104072/
2. https://nptel.ac.in/courses/108/107/108107029/

ONLINE RESOURCES:

1. https://microcontrollerslab.com/getting-started-pic-microcontrollers/
2. https://www.coursera.org/learn/embedded-software-hardware

OUTCOMES:

Upon completion of the course, the student should have:

1. Explain the architecture of advanced processor with its memory structure and instruction sets (K2)
2. Apply the instruction sets for developing an assembly language program with C/C++ (K3)
3. Discuss the architecture of Pentium processor and its memory management (K2)
4. Summarize the architecture of 16-bit microcontroller with its instruction sets
5. Outline the architecture of RISC processor (K2)

CO, PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - V

20EEEL808 SDG NO. 4	HIGH SPEED DIGITAL DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To identify sources affecting the speed of digital circuits
- To introduce methods to improve the signal transmission characteristics
- To understand Clock transmission and clock oscillators.

UNIT I SIGNAL PROPAGATION ON TRANSMISSION LINES 9

Transmission line equations, wave solution, wave vs. circuits, initial wave, delay time, Characteristic impedance , wave propagation, reflection, and bounce diagrams Reactive terminations – L, C , static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching , input impedance into a transmission-line section, reflection coefficient, skin-effect, dispersion.

UNIT II MULTI-CONDUCTOR TRANSMISSION LINES AND CROSSTALK 9

Multi-conductor transmission-lines, Coupling physics, Per unit length parameters, Near and far end crosstalk, Minimizing cross-talk (stripline and microstrip) Differential signalling, termination, balanced circuits, S-parameters, Lossy and Lossless models.

UNIT III NON-IDEAL EFFECTS 9

Non-ideal signal return paths – gaps, BGA fields, via transitions, Parasitic inductance and capacitance, Transmission line losses – Rs, tan δ, routing parasitic, Common-mode current, differential-mode current, Connectors.

UNIT IV POWER CONSIDERATIONS AND SYSTEM DESIGN 9

SSN/SSO, DC power bus design, Layer stack up, SMT decoupling, Logic families, power consumption and system power delivery, Logic families and speed Package types and parasitic, SPICE, IBIS models, Bit streams, PRBS and filtering functions of link-path components, Eye diagrams, jitter, inter-symbol interference, Bit-error rate, Timing analysis.

UNIT V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9

Timing margin, Clock slew, Low impedance drivers, Terminations, Delay adjustments, canceling parasitic capacitance, Clock jitter.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Johnson .H. W and Graham . M, "High-Speed Digital Design: A Handbook of Black Magic", Pearson Education, First Edition,2003.
2. Douglas Brooks, "Signal Integrity Issues and Printed Circuit Board Design", Prentice Hall PTR 2003.

REFERENCES:

1. Hall. S, Hall .G, and McCall. J, "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", Wiley-Interscience Publication, 2000.
2. Eric Bogatin , "Signal Integrity – Simplified" , Prentice Hall PTR, Second edition, 2004.
3. Eric Bogatin , "Signal and Power Integrity – Simplified" , Pearson Education, Second edition, 2009.
4. Howard Johnson, "High Speed Signal Propagation: Advanced Black Magic" , Prentice Hall PTR, First edition, 2003.
5. Stephen C.Thierauf," High Speed Circuit Board Signal Integrity". Artech House Publishers, Second Edition, 2017.

ONLINE RESOURCES:

1. SPICE, source - http://www-cad.eecs.berkeley.edu/ Software/ software.html
2. HSPICE from synopsis, www.synopsys.com/products/ mixed signal/hspice/ hspice.html
3. SPECCTRAQUEST from Cadence, http://www.specctraquest.com

OUTCOMES:

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

1 Understand the high-speed signal propagation on transmission lines and transmission line characteristics. (K2)
2 Explain the crosstalk phenomena in the signal transmission lines. (K2)
3 Discuss the non-ideal effects and transmission line losses. (K2)
4 Outline the power consideration in a high-speed system design. (K2)
5 Illustrate the concept of clock distribution and clock oscillators. (K3)
6 Describe the concept of transmission line parameters in printed circuit boards with eye diagrams. (K2)

CO, PO, PSO MAPPING :

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

PROFESSIONAL ELECTIVES - V

20EEEL809 SDG NO. 4	BIG DATA ANALYTICS FOR SMART GRID	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Smart Grid technologies, different smart meters and advanced metering infrastructure.
- The different data models to be formed in Smart Grid.
- The high performance computing for Smart Grid applications by data analytics

UNIT 1 Need of intelligence and communication in Smart Grid 9

Basics of Smart Grid, Use of Satellite Communication in Modern Power System, Challenges and Solutions in Power Systems, Need for Big Data Analytics in Smart Grid, PMU: An Intelligent Data Collection Device in Smart Grid, Role of PMU in Smart Grid, Emerging Trends and Big Data Analytics at Distribution level Grid.

UNIT II Data models to smart grid Analytics 9

Introduction -Understanding Analytical Models -Descriptive Models & Diagnostic Models for Analytics - Predictive Analytics -Prescriptive Analytics - An Optimization Model for the Utility - Energy Forecasting -Asset Management -Demand Response and Energy Analytics -Dynamic-Pricing Analytics - Revenue-Protection Analytics

UNIT III Grid Sensing and Data collection Methods 9

Big Data Architecture and Platforms ; Application of Big Data in Smart Grids - Intelligent Sensing : missing sensor restoration (MSR) , Monitoring and

Identification Forecasting - time series analysis, regression analysis and other statistical methods; ANN short-term load forecaster, Physics-based numerical weather prediction (NWP) ,

UNIT IV Security and Control networks **9**

Scheduling : deterministic optimization methods , Security Assessment: Online dynamic security assessment (DSA) , Power System Control: Wide-Area Damping Control Local damping controllers, Wide-Area Power Flow Control; Power System Protection: Intelligent/Adaptive Relays, Current Limiters , Intelligent Auto-Reclosers, Intelligent Fault Locating, Distribution optimization ; Nanoscale Communication Networks.

UNIT V Machine learning for data analytics **9**

Countering Data Issues: Machine Learning Countermeasures/Analytics: the need for better bad data detectors, using machine learning methods such as SVM, nearest neighbour, recurrent neural networks, and LSTMs to design enhanced BDDS that include anomaly detectors for real-time situational awareness

TOTAL : 45 PERIODS

TEXT BOOK:

1. Stephen F. Bush, "Smart Grid: Communication-Enabled Intelligence for the Electric Power Grid" ISBN: 978-1-119-97580-9 March 2014 Wiley-IEEE Press
2. Bart Baesens "Analytics in a Big data world" Wiley Publications,2014
3. Carol L. Stimmel "Big Data Analytics Strategies for the Smart Grid" CRC Press Taylor & Francis Group, 2015

REFERENCES:

1. Bishnu P. Bhattarai , Sumit Paudyal , Yusheng Luo " Big data analytics in smart grids: state-of-theart, challenges, opportunities, and future directions" IET Smart Grid, 2019, Vol. 2 Iss. 2, pp. 141-154
2. Ahmed F. Zobaa "Big Data Analytics in Future Power Systems" CRC Press Taylor & Francis Group, 2020

ONLINE RESOURCES:

1. https://www.coursera.org/lecture/electric-utilities/5-2-smart-grid-YUPgW
2. https://onlinecourses.swayam2.ac.in/arp19_ap60/course

OUTCOMES:

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

1. Acquire Knowledge in smart grid ,models of data analytics, grid sensor and basic machine learning algorithms (K2)
2. Understand the smart grid technologies by sensors,security and control networks (K2)
3. Apply the different data analytics in smart grid based on their control and communication network (K3)
4. Analyses the various platforms for data analytics in smart grid application (K3)
5. Evaluate the smart grid based on different algorithm in machine learning (K3)
6. Create the big data analytics strategist for future power system (K4)

CO, PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	1	-	2	-	-	-	-	-	-	-	2	1
CO2	-	1	-	2	2	-	-	-	-	-	1	-	2	2
CO3	-	2	1	1	2	-	-	-	-	-	-	-	2	3
CO4	1	2	1	2	2	-	-	-	-	-	-	1	2	1
CO5	2	-	1	-	1	-	-	-	-	-	1	-	3	2
CO6	1	2	-	1	1	-	-	-	-	-	1	1	1	2

PROFESSIONAL ELECTIVES - V

20EEEL810 SDG NO. 4,9	WORK ETHICS, CORPORATE SOCIAL RESPONSIBILITY AND GOVERNANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To have grounding on theory through the understanding of real life To situations and cases.
- Learn the rights and responsibilities
- Responsibilities of employee, team member and a global citizen.
- Understand the importance of Values and Ethics

UNIT I INTRODUCTION **9**

International Business –Definition – Internationalizing business-Advantages –factors causing globalization of business- international business

environment – country attractiveness –Political, economic and cultural environment – Protection Vs liberalization of global business environment.

UNIT II ETHICS THEORY AND BEYOND 9

Management of Ethics - Ethics analysis [Hosmer model]; Ethical dilemma; Ethics in practice - ethics for managers; Role and function of ethical managers- Comparative ethical behaviour of managers; Code of ethics; Competitiveness, organizational size, profitability and ethics; Cost of ethics in Corporate ethics evaluation. Business and ecological / environmental issues in the Indian context and case studies.

UNIT III LEGAL ASPECTS OF ETHICS 9

Political – legal environment; Provisions of the Indian constitution pertaining to Business; Political setup – major characteristics and their implications for business; Prominent features of MRTP & FERA. Social – cultural environment and their impact on business operations, Salient features of Indian culture and values.

UNIT IV ENVIRONMENTAL ETHICS 9

Economic Environment; Philosophy of economic grow and its implications for business, Main features of Economic Planning with respect to business; Industrial policy and framework of government contract over Business; Role of chamber of commerce and confederation of Indian industries.

UNIT V CORPORATE SOCIAL RESPONSIBILIY AND GOVERNANCE 9

Definition- Evolution- Need for CSR; Theoretical perspectives; Corporate citizenship; Business practices; Strategies for CSR; Challenges and implementation; Evolution of corporate governance; Governance practices and regulation; Structure and development of boards; Role of capital market and government; Governance ratings; Future of governance- innovative practices; Case studies with lessons learnt.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.A. Sherlekar, Ethics in Management, Himalaya Publishing House, 2009.
2. William B. Werther and David B. Chandler, Strategic corporate social responsibility, Sage Publications Inc., 2011
3. Robert A.G. Monks and Nell Minow, Corporate governance, John Wiley and Sons, 2011.
4. Satheesh kumar, Corporate governance, Oxford University, Press, 2010.

REFERENCES:

1. W.H. Shaw, Business Ethics, Cengage Learning, 2007.
2. Beeslory, Michel and Evens, Corporate Social Responsibility, Taylor and Francis, 1978.
3. Philip Kotler and Nancy Lee, Corporate social responsibility: doing the most good for company and your cause, Wiley, 2005.
4. Subhabrata Bobby Banerjee, Corporate social responsibility: the good, the bad and the ugly, Edward Elgar Publishing, 2007.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc21_mg46
2. https://nptel.ac.in/courses/110/105/110105081/

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=n44r10uTheo
2. https://www.youtube.com/watch?v=8uUkKm2gVYohttps://www.youtube.com/watch?v=UycPljfrnWo

OUTCOMES:

Upon completion of the course, the student should have:

1. Understand Ethical and social responsibility sensitivity. (K2)
2. Analyzing and assessing various ethical situations in society. (K3)
3. Understand and create organizational and management strategies in facilitating ethical socially responsible decision making. (K2)
4. Analyze corporate social Responsibility. (K3)
5. Analyze the Employees conditions and Business Ethics (K3)
6. Explain interaction between evolution of moral and social instruction. (K2)

CO, PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Co1	-	-	-	-	-	1	1	2	1	2	3	3	1	2
CO2	-	2	-	1	1	-	-	2	1	1	2	3	2	2
CO3	-	-	-	-	-	-	1	1	1	2	3	2	1	3
CO4	1	1	1	1	-	-	1	2	2	2	3	3	1	3
Co5	-	-	-	-	-	1	2	3	2	3	3	3	1	3
Co6	1	1	1	1	-	-	1	2	2	2	3	3	1	3

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We have GOOD HEALTH AND WELL BEING QUALITY EDUCATION and full GENDER EQUALITY everywhere.

There is CLEAN WATER AND SANITATION for everyone. AFFORDABLE AND CLEAN ENERGY

which will help to create DECENT WORK AND ECONOMIC GROWTH. Our prosperity shall be fuelled

by investments in INDUSTRY, INNOVATION AND INFRASTRUCTURE that will help us to

REDUCE INEQUALITIES by all means. We will live in SUSTAINABLE CITIES AND COMMUNITIES.

RESPONSIBLE CONSUMPTION AND PRODUCTION will help in healing our planet.

CLIMATE ACTION will reduce global warming and we will have abundant,

flourishing LIFE BELOW WATER, rich and diverse LIFE ON LAND.

We will enjoy PEACE AND JUSTICE through STRONG INSTITUTIONS

and will build long term PARTNERSHIPS FOR THE GOALS.

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