S.A ENGINEERING COLLEGE, CHENNAI – 77

An Autonomous Institution Affiliated to Anna University

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATION-2020

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR B.E ELECTRICAL AND ELECTRONICS ENGINEERING

Programme Educational Objectives

Graduates will be able

1. To demonstrate enhanced competence for successful career in the core and allied fields of Electrical & Electronics Engineering.
2. To explore challenges in higher education and research with a multidisciplinary perspective and effective communication for lifelong learning.
3. To inculcate entrepreneurial skills, upholding professional ethics, cultural aspects, societal and environmental factors for sustainable development.
4. To adapt evolving technologies and stay contemporary to cultivate leadership quality through effective collaboration.

Programme Outcomes

The graduates will have the ability to

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and

need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest

PEO \PO	1	2	3	4	5	6	7	8	9	10	11	12
1	√	√	√	√	√	√	√					√
2	√	√	√	√	√	√	√	√		√		

PROGRAMME SPECIFIC OUTCOMES (PSOs)
Students will be able to:

1. Utilize coherent theoretical and practical methodologies to design and implement Electrical and Electronics systems.
2. Assimilate facts of basic Electronics to Power Electronics, power systems and recent embedded technologies for governing, consistent and workable Electrical and Electronics Systems.
3. Apply computing platform and developing software for power grids and hybridizing the new renewable energy to overcome the power demand.

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B.E ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM AND SYLLABUS FROM I TO VIII SEMESTER

SEMESTER –I

SL. NO.	SUBJECT CODE	SUBJECT	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY:								
1.	**HS1101**	Technical English	**HS**	**3**	**3**	**0**	**0**	**3**
2.	**MA1101**	Calculus And Its Applications	**BS**	**4**	**3**	**1**	**0**	**4**
3.	**PH1101**	Applied Physics	**BS**	**3**	**3**	**0**	**0**	**3**
4.	**CY1101**	Engineering Chemistry	**BS**	**3**	**3**	**0**	**0**	**3**
5.	**CS1101**	Problem Solving And Python Programming	**ES**	**3**	**3**	**0**	**0**	**3**
6.	**ME1101**	Engineering Graphics	**ES**	**4**	**2**	**0**	**2**	**3**
7.	**CI1101**	Indian Constitution	**MC**	**2**	**2**	**0**	**0**	**0**
PRACTICALS:								
8.	**BS1101**	Physics and Chemistry Laboratory	**BS**	**4**	**0**	**0**	**4**	**2**
9.	**CS1102**	Problem Solving and Python Programming Laboratory	**ES**	**4**	**0**	**0**	**4**	**2**
			TOTAL	**30**	**19**	**1**	**10**	**23**

SEMESTER –II

SL. NO.	SUBJECT CODE	SUBJECT	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY:								
1.	**HS1201**	English for Communication	**HS**	**3**	**3**	**0**	**0**	**3**
2.	**MA1201**	Complex Variables and Transforms	**BS**	**4**	**3**	**1**	**0**	**4**
3.	**PH1201**	Materials Science	**BS**	**3**	**3**	**0**	**0**	**3**
4.	**ME1201**	Basic Civil and Mechanical Engineering	**ES**	**3**	**3**	**0**	**0**	**3**
5.	**CS1201**	Programming in C	**ES**	**3**	**3**	**0**	**0**	**3**
6.	**EE1205**	Circuit Theory	**PC**	**6**	**2**	**2**	**2**	**4**
7.	**CY1201**	Environmental Science and Engineering	**MC**	**2**	**2**	**0**	**0**	**0**
PRACTICALS:								
8.	**CS1203**	Programming in C Laboratory	**ES**	**4**	**0**	**0**	**4**	**2**

9.	**GE1201**	Engineering Practices Laboratory	**ES**	**4**	**0**	**0**	**4**	**2**
			TOTAL	**32**	**19**	**3**	**10**	**24**

SEMESTER –III

SL. NO.	SUBJECT CODE	SUBJECT	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY:								
1.	**MA1302**	Transforms and Partial Differential Equations	**BS**	**4**	**3**	**1**	**0**	**4**
2.	**EE1301**	Electrical Machines – I	**PC**	**3**	**3**	**0**	**0**	**3**
3.	**EE1302**	Electromagnetic Theory	**PC**	**3**	**3**	**0**	**0**	**3**
4.	**EE1303**	Electron Devices and Circuits	**PC**	**3**	**3**	**0**	**0**	**3**
5.	**EE1304**	Digital Logic Circuits	**PC**	**5**	**3**	**0**	**2**	**4**
6.	**EE1305**	Measurements and Instrumentation	**PC**	**3**	**3**	**0**	**0**	**3**
PRACTICALS:								
7.	**EE1306**	Electron Devices and Circuits Laboratory	**PC**	**2**	**0**	**0**	**2**	**1**
8.	**EE1307**	Electrical Machines Laboratory - I	**PC**	**4**	**0**	**0**	**4**	**2**
			TOTAL	**27**	**18**	**1**	**8**	**23**

SEMESTER –IV

SL. NO.	SUBJECT CODE	SUBJECT	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY:								
1.	**MA1402**	Numerical Methods	**BS**	**4**	**3**	**1**	**0**	**4**
2.	**EE1401**	Electrical Machines – II	**PC**	**3**	**2**	**2**	**0**	**3**
3.	**EE1402**	Transmission and Distribution	**PC**	**3**	**3**	**0**	**0**	**3**
4.	**EE1403**	Linear Integrated Circuits and Applications	**PC**	**5**	**3**	**0**	**2**	**4**
5.	**EE1404**	Control Systems	**PC**	**3**	**2**	**2**	**0**	**3**
6.	**HV1401**	Universal Human values	**HS**	**3**	**2**	**2**	**0**	**3**
PRACTICALS :								
7.	**EE1405**	Electrical Machines Laboratory II	**PC**	**4**	**0**	**0**	**4**	**2**
8.	**EE1406**	Control and Instrumentation Laboratory	**PC**	**4**	**0**	**0**	**4**	**2**
			TOTAL	**29**	**15**	**7**	**10**	**24**

SEMESTER –V

SL. NO.	SUBJECT CODE	SUBJECT	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY:								
1.	**EE1501**	Power Electronics	**PC**	**3**	**3**	**0**	**0**	**3**
2.	**EE1502**	Power System Analysis	**PC**	**3**	**3**	**0**	**0**	**3**
3.	**IT1301**	Object Oriented Programming	**ES**	**3**	**3**	**0**	**0**	**3**
4.	**EE1503**	Microprocessors and Microcontrollers	**PC**	**3**	**3**	**0**	**0**	**3**
5.	**EE1504**	Digital Signal Processing	**PC**	**3**	**2**	**2**	**0**	**3**
6.		Open Elective I	**OE**	**3**	**3**	**0**	**0**	**3**
PRACTICALS:								
7.	**EE1505**	Microprocessors and Microcontrollers Laboratory	**PC**	**4**	**0**	**0**	**4**	**2**
8.	**IT1302**	Object Oriented Programming Laboratory	**ES**	**4**	**0**	**0**	**4**	**2**
9.	**HS1501**	Professional Communication Laboratory	**HS**	**2**	**0**	**0**	**2**	**1**
			TOTAL	**28**	**17**	**2**	**10**	**23**

SEMESTER –VI

SL. NO.	SUBJECT CODE	SUBJECT	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY:								
1.	**EE1601**	Solid State Drives	**PC**	**3**	**3**	**0**	**0**	**3**
2.	**EE1602**	Protection and Switchgear	**PC**	**3**	**3**	**0**	**0**	**3**
3.	**EE1603**	Power System Operation and Control	**PC**	**3**	**3**	**0**	**0**	**3**
4.		Professional Elective I	**PE**	**3**	**3**	**0**	**0**	**3**
5.		Professional Elective II	**PE**	**3**	**3**	**0**	**0**	**3**
PRACTICALS:								
6.	**EE1604**	Power Electronics and Drives Laboratory	**PC**	**2**	**0**	**0**	**2**	**1**
7.	**EE1605**	Power System Simulation Laboratory	**PC**	**2**	**0**	**0**	**2**	**1**
8.	**EE1606**	Technical Seminar	**EEC**	**2**	**0**	**0**	**2**	**1**
			TOTAL	**21**	**15**	**0**	**6**	**18**

SEMESTER –VII

Sl.NO.	SUBJECT CODE	SUBJECT	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY:								
1.	**EE1701**	Embedded systems	**PC**	**3**	**3**	**0**	**0**	**3**
2.	**EE1702**	Renewable Energy Systems	**PC**	**3**	**3**	**0**	**0**	**3**
3.		Professional Elective III	**PE**	**3**	**3**	**0**	**0**	**3**
4.		Professional Elective IV	**PE**	**3**	**3**	**0**	**0**	**3**
5.		Open Elective II	**OE**	**3**	**3**	**0**	**0**	**3**
PRACTICALS:								
6.	**EE1703**	Renewable Energy Systems Lab	**PC**	**2**	**0**	**0**	**2**	**1**
7.	**EE1704**	Project/Phase-I	**EEC**	**8**	**0**	**0**	**8**	**4**
			TOTAL	**25**	**15**	**0**	**10**	**20**

SEMESTER –VIII

Sl.NO.	SUBJECT CODE	SUBJECT	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY:								
1.		Professional Elective V	**PE**	**3**	**3**	**0**	**0**	**3**
2.		Professional Elective VI	**PE**	**3**	**3**	**0**	**0**	**3**
PRACTICALS:								
3.	**EE1801**	Project Work/Phase-II	**EEC**	**12**	**0**	**0**	**12**	**6**
		TOTAL		**18**	**6**	**0**	**12**	**12**

PROFESSIONAL ELECTIVES

SL.NO.	SUBJECT CODE	SUBJECT	Category	L	T	P	C
PROFESSIONAL ELECTIVE –I							
1.	EE1611	Advanced Control System	PE	3	0	0	3
2.	EE1612	Modern Power Converters	PE	3	0	0	3
3.	EE1613	Special Electrical Machines	PE	3	0	0	3
4.	EE1614	Design of Electrical Apparatus	PE	3	0	0	3
5.	EE1615	Control of Electrical Drives	PE	3	0	0	3
6.	EE1616	SMPS and UPS	PE	3	0	0	3
PROFESSIONAL ELECTIVE – II							
1.	EE1621	Electric and Hybrid Vehicles	PE	3	0	0	3
2.	EE1622	Flexible AC Transmission Systems	PE	3	0	0	3

3.	EE1623	Battery Technologies for Electric Vehicles	PE	3	0	0	3
4.	EE1624	High Voltage Direct Current Transmission	PE	3	0	0	3
5.	EE1625	Power Quality	PE	3	0	0	3
PROFESSIONAL ELECTIVE – III							
1.	EE1731	Restructured Power System	PE	3	0	0	3
2.	EE1732	Micro and Smart Grid	PE	3	0	0	3
3.	EE1733	Energy Management and Auditing	PE	3	0	0	3
4.	EE1734	Modeling of Electrical Machines	PE	3	0	0	3
5.	EE1735	High Voltage Engineering	PE	3	0	0	3
PROFESSIONAL ELECTIVE – IV							
1.	EE1741	Biomedical Instrumentation	PE	3	0	0	3
2.	EE1742	Soft Computing	PE	3	0	0	3
3.	EE1743	VLSI Design	PE	3	0	0	3
4.	EE1744	Microcontroller Based System Design	PE	3	0	0	3
5.	EE1745	Sensors and Transducers	PE	3	0	0	3
PROFESSIONAL ELECTIVE – V							
1.	EE1851	Big Data Analytics	PE	3	0	0	3
2.	EE1852	Smart System Automation	PE	3	0	0	3
3.	EE1853	Introduction to Artificial Intelligence	PE	3	0	0	3
4.	EE1854	Machine learning	PE	3	0	0	3
5.	EE1855	Fiber Optics and Laser Instrumentation	PE	3	0	0	3
PROFESSIONAL ELECTIVE – VI							
1.	EE1861	Intellectual Property Rights	PE	3	0	0	3
2.	EE1862	Foundation Skills in Integrated Product Development	PE	3	0	0	3
3.	EE1863	Total Quality Management in Electrical Industry	PE	3	0	0	3
4.	EE1864	Principles of Management	PE	3	0	0	3
5.	EE1865	Industrial Management	PE	3	0	0	3

OPEN ELECTIVES OFFERED BY EEE DEPARTMENT TO OTHER DEPARTMENTS

SL.NO.	SUBJECT CODE	SUBJECT	Category	L	T	P	C
1.	OEE501	Basics of Biomedical Instrumentation	OE	3	0	0	3
2.	OEE502	Sensors and Transducers	OE	3	0	0	3
3.	OEE701	Renewable Energy sources	OE	3	0	0	3
4.	OEE702	Electric Vehicles	OE	3	0	0	3

Course code Definitions

BS	Basic Science
ES	Engineering Science
HS	Humanities and Sciences
PC	Professional core
PE	Professional Elective
OE	Open Elective
EEC	Employability Enhancement Courses
MC	Mandatory courses

CURRICULUM –CREDITS SUMMARY

S.No	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	Total
1.	**HS**	3	3	0	3	1	0	0	0	**10**
2.	**BS**	12	7	4	4	0	0	0	0	**27**
3.	**ES**	8	10	0	0	5	0	0	0	**23**
4.	**PC**	0	4	19	17	14	11	7	0	**72**
5.	**PE**	0	0	0	0	0	6	6	6	**18**
6.	**OE**	0	0	0	0	3	0	3	0	**6**
7.	**EEC**	0	0	0	0	0	1	4	6	**11**
8.	**MC**	0	0	0	0	0	0	0	0	**0**
	TOTAL	**23**	**24**	**23**	**24**	**23**	**18**	**20**	**12**	**167**

SEMESTER-I

HS1101 TECHNICAL ENGLISH

L	T	P	C
3	0	0	3

PREREQUISITE SUBJECTS:

- Basic Language Proficiency.

COURSE OBJECTIVES:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Nurture their ability in technical writing like to prepare professional job applications and effective reports.
- Develop their speaking skills by participating in various speaking activities.
- Strengthen their listening skill to comprehend lectures and talks in their areas of specialization. Improve their ability to explicit their excellence in all modes of technical communication

UNIT I **9**

Reading- Reading short texts Listening- Listening to different formal / informal conversations Writing- Instructions, Jumbled sentences Speaking- Self introduction Language development- Parts of speech, Prepositions Vocabulary development- Word formation- root words from foreign language and their use in English.

UNIT II **9**

Reading-Skimming and Scanning to find specific information Listening- Listening to INK talks Writing- Job Application – cover letter, resume writing Speaking- Asking and Giving directions Language development- Conjunctions, Types of Nouns Vocabulary development- Prefixes and Suffixes.

UNIT III **9**

Reading- Reading for predicting the content Listening- Listening to situational short talks Writing- Types of paragraphs- Descriptive/Analytical/ compare and contrast Speaking- Mini presentations, Expressing greeting and thanks Language development- Adjectives, Numerical Adjectives, Conditional Clauses Vocabulary development- Homophones, Homonyms.

UNIT IV **9**

Reading- Practice in speed reading Listening- Listening to short texts and fill the data Writing- Interpretation of Graphics / Information, Note making Speaking-Contributing for Group Discussion Language development- Active, Passive, Impersonal passive voice Vocabulary development- Definitions, Nominal Compounds.

UNIT V **9**

Reading- Reading short stories Listening- Listening for note taking Writing- Report writing, E-mail Writing Speaking- Picture descriptions, Speaking in familiar situations Language development- Tenses Vocabulary development- British and American Vocabulary

Total Periods: 45 hours

OUTCOMES:

The Students will be able to

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialization successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write correctly, clearly and concisely with coherence and cohesion.
- Prepare job applications and resume in an inspiring manner
- Demonstrate the communication skills (LSRW) in academic, professional and social environments

Extensive Reading

1. Khera, Shiv. You can Win, Macmillan, 2000.

Reference

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York:Rutledge,2011.
2. Comfort, Jeremy, et al. Speaking Effectively : Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint2011
3. Darlene Smith-Worthington,Sue Jefferson, Technical writing for Success, South-Western Cengage Learning,USA-2011
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA:2007
5. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice.Oxford University Press: New Delhi, 2014
6. Swan Michael, Practical English Usage. Oxford University Press, Eighth impression2002.

Recommended Websites

bbc.co.uk/1learning english oxfordonlineenglish.com/
cambridgeenglish.org
inktalks.com/talks/ manageyourwriting.com

MA1101 CALCULUS AND ITS APPLICATIONS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To understand the concepts of limits, continuity, differentiation and use it to find maxima and minima of functions of one variable.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations of first and second order that model in various engineering problems.
- To familiarize the student with functions of several variables that is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I **12**

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules – Maxima and Minima of functions of one variable.

UNIT II **12**

Basic concepts- Separable differential equations - Exact differential equations - Integrating factors - Linear differential equations - Bernoulli's equation - Geometric Applications- Orthogonal trajectories - Physical Applications - Simple electronic circuits-Newton law of cooling-Heat flow-Rate of decay of radioactive materials-Chemical reaction and solutions.

UNIT III **12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

UNIT IV **12**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT V **12**

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

Total Periods: 60 hours

OUTCOMES:

- Understand the basic concepts of differentiation rules and functions to find maxima and minima for function of one variable.
- Apply the knowledge of basic application problems involved in first Order Differential Equation.
- Apply the knowledge of basic application problems described by second order linear differential equations with constant coefficients.

- Demonstrate the concept of ordinary derivatives into partial derivatives and apply them to find extreme values of the functions of two variables and series approximation of the function of two variables.
- Evaluate double and Triple integration techniques over a region in two dimensional and three dimensional geometry
- Apply various first order techniques in many physical applications in engineering field.

TEXTBOOKS:

1. Grewal, B.S., Higher Engineering Mathematics, 43rd Edition, Khanna Publishers,2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, Inc.,2016.

REFERENCE BOOKS:

1. Bali,N.P. ,Goyal,M.,Watkins,C.,Advanced Engineering Mathematics, Laxmi Publications Pvt. Limited,2007.
2. Boyce,W.E.,and DiPrima,R.C.,Elementary Differential Equations and Boundary Value Problems, Wiley India,2012.
3. O'Neil. P. V., "Advanced Engineering Mathematics", 7th Edition, Cengage Learning India Pvt., Ltd, New Delhi, 2011.
4. T.Veerarajan , Engineering Mathematics , McGrawhill Publications , New Delhi2017

PH1101 APPLIED PHYSICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

UNIT I **9**

Elasticity- plasticity – Different Types of Stress and Strain- concept of stress-strain diagram and its application - three types of modulus of elasticity- Poisson's Ratio – Bending of beams- Expression for bending moment –- young's modulus uniform and Non uniform bending : Theory and Experiment – I Shape girders – **Torsional oscillation Theory and Experiment-** Application of Elastic Materials.

UNIT II **9**

Laser:characteristicsoflaser-Principleofspontaneousemissionandstimulatedemission–Laseraction– Einstein A & B coefficients - Population inversion - Pumping – Basic requirement of laser – Types of laser : Nd-YAG and CO_2 – Applications : Welding , Drilling & Cutting – Medicalfield

Fiber optics: **Introduction**- Principle and propagation of light – Numerical aperture and acceptance angle – classification of optical fibers – **Losses in optical fibers(Qualitative) –** Fiber optics communication system (Block Diagram) – Advantages with fiber optic communication system.

UNIT III **9**

Modes of heat transfer- thermal conduction, convection and radiation – Specific heat capacity- thermal conductivity- Newton's law of cooling - **Searle's** and Lee's disc methods: theory and experiment - conduction through compound media (series and parallel) – **thermal expansion of solids, liquids and gases** - Applications: heat exchangers, refrigerators and solar water heaters.

UNIT IV **9**

Inadequacy of Classical Mechanics - Development of quantum theory- **Planck's Black body radiation and Distribution Laws(Qualitative) – Compton Effect (Derivation)** - De Broglie wavelength – properties of matter waves – Experimental Verification (G.P Thomson experiment) – Heisenberg's uncertainty principle - Schrodinger's wave equation – time dependent – time independent wave equations – physical significance of Wave function – applications: particle in a one dimensional potential box.

UNIT V **9**

Single crystalline, polycrystalline and amorphous materials Lattice - unit cell- Crystal systems-Bravais lattices- Lattice planes- Miller indices- Interplanar- d- Spacing in cubic Lattice- calculation of number of atoms per unit cell – atomic radius – packing factor for SC, BCC, FCC and HCP structures- **Crystal Defects – types.**

Total Periods: 45 hours

OUTCOMES:

At the end of this course,

- Gain knowledge on the basics of properties of matter and its applications
- Acquire knowledge on the concepts of optical devices and their applications
- Get adequate knowledge on the concepts of thermal properties of materials and their applications

in expansion joints and heat exchangers

- Get knowledge on advanced physics concepts of quantum theory and its application
- Understand the basics of crystals , their structures and different crystal growth techniques
- Acquire knowledge on solid state laser, graphite and zinc blende structures.

TEXTBOOKS:

1. Gupta S.L. and Sanjeev Gupta, Modern Engineering Physics, Dhanpat Rai Publishers, 2015.
2. R. K. Gaur and S.C. Gupta, Engineering Physics, Dhanpat Rai Publication(P) Ltd, New Delhi, 2014.
3. Bhattacharya, D.K. and Poona, T. Engineering Physics, Oxford University Press, 2015.

REFERENCE BOOKS:

1. C. Kittel ,Introduction to Solid State Physics 8thEdition , Wiley Eastern Ltd,2004.
2. Halliday, D., Resnick,R. and Walker, J. Principles of Physics. Wiley, 2015.
3. Tipler, P.A. and Mosca, G. Physics for Scientists and Engineers withModern Physics, W.H.Freeman,2007.
4. Einstein coefficient calculation,https://youtu.be/TvfiZHXUtXg(Videolecture)
5. Lattice structures, https://youtu.be/Rm-i1c7zr6Q(Videolecture)

CY1101 ENGINEERING CHEMISTRY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- It enables the students to gain information about Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells
- It deals with the information about the types of fuels, calorific value calculations and manufacture of solid, liquid and gaseous fuels.
- To impart knowledge about the nonmaterial's synthesis, properties and applications.

UNIT I **9**

Introduction – characteristics, Water quality parameters -hardness– types, Determination-EDTA method, Alkalinity ,boiler feed water requirements-boiler troubles – scale & sludge - Caustic Embrittlement , boiler explosion -softening of hard water - external treatment process - demineralization and zeolite, internal treatment - boiler compounds (phosphate, calgon, carbonate and colloidal conditioning methods) – desalination of brackish water –reverse osmosis.

UNIT II **9**

Phase rule: Introduction, definition of terms with examples, One Component System- water system,Sulphur,CO_2 system, Thermal Analysis and cooling curves, Reduced phase rule - Two Component Systems- classification – lead-silver system-problems. Alloys: Introduction- Definition- Properties of alloys- Significance of alloying, Functions and effect of alloying elements- Ferrous alloys- Nichrome and Stainless steel – heat treatment of steel.

UNIT III **9**

Energy – Types – Non-renewable energy - Nuclear energy -renewable energy - solar energy conversion - solar cells. Introduction to Electrochemistry, Nernst Equation-Electrochemical cells – reversible and irreversible cells –Cell construction and representation - Batteries -types of batteries – characteristics – construction and working of primary battery (dry cell) - secondary battery (lithium-ion-battery) - fuel cells (H_2-O_2).

UNIT IV **9**

Fuel: Introduction- classification of fuels- calorific value- higher and lower calorific values- 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 – dieseloil-cetanenumber–naturalgas-compressednaturalgas(CNG)-liquefiedpetroleumgases(LPG)- producer gas-water gas. Power alcohol and bio diesel. Combustion of fuels: introduction- theoretical calculation of calorific value- ignition temperature- explosive range – flue gas analysis (ORSAT Method).

UNIT V **9**

Basics - distinction between nanoparticles and bulk materials; size-dependent properties.,nano cluster, nano rod, nanotube(CNT)-Types of CNT and nanowire. Synthesis: precipitation, thermolysis, chemical vapour deposition, Properties, Characterizations and applications.

Total Periods: 45 hours

OUTCOMES:

- Understand the hardness of water, related problems and its treatment
- Apply Phase rule to study Phase diagrams and alloying
- Describe the conventional and non-conventional energy sources and its applications, basics of electrochemistry, Types of batteries, their reactions and the importance
- Describe the conventional and non-conventional energy sources and its applications, basics of electrochemistry, Types of batteries, their reactions and the importance
- Apprehend the basics, types, preparation methods and recent trends in nanomaterial.
- Recognize the classification and application of polymers.

TEXTBOOKS:

1. Jain P.C. and Monica Jain, "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd., New Delhi, 2010

REFERENCE BOOKS:

1. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi2010
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3. Ozin G. A. and Arsenault A. C., "Nano chemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.

COURSE COORDINATOR HOD/EEE

CS1101 PROBLEM SOLVING AND PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures –- lists, tuples,dictionaries.
- To do input/output with files in Python.

UNIT I **9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II **9**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points

UNIT III **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV **9**

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; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

UNIT V **9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file- **Case study: Simple Graphics using Turtle**: Draw a Random Pattern of Circle, Square and Rectangle; Draw a Pattern of Straight Lines, **Plotting Graphs in Python**: Menu Driven Program to Create Mathematical 3D Objects.

Total Periods: 45 hours

OUTCOMES:

Upon completion of the course, students will be able to

- Understand the basic of algorithmic problem solving.
- Be familiar with data expressions and statements.
- Understand control flow and functions problems.
- Comprehend list, tuples and dictionaries.
- Understand Object oriented programming concepts.

- Understand Object oriented programming concepts.

TEXTBOOKS:

1.Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, UpdatedforPython3,Shroff/O'ReillyPublishers,2016(http://greenteapress.com/wp/thinkpython/

2. ReemaThareja, Problem Solving and Programming with python, 2nd edition, Oxford University press,2019.

3.Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network TheoryLtd.,2011.

REFERENCE BOOKS :

1. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem- Solving Focus, Wiley IndiaEdition,2013.
2. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press,2013.
3. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGELearning,2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition,PragmaticProgrammers,LLC,2013.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt.Ltd.,2016.
6. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) PrivateLtd.,,2015

ME1101 ENGINEERING GRAPHICS

L	T	P	C
2	0	2	3

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.
- **CONCEPTS AND CONVENTIONS (Not for Examination)** **1**
- Importance of graphics in engineering applications –Use of drafting instruments – BIS conventions and specifications – Size and layout of drawing sheets – Lettering and dimensioning.

UNIT I **12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization principles – Layout of views- Orthographic projection of multiple views(Free Hand Sketching) from pictorial views of objects-Principal planes-Projection of points-Demo using CAD software for above topics.

UNIT II **12**

Orthographic projections-principles-Principal planes-First angle projection-Projection of points- Projection of straight lines (only First angle projections) inclined to one of the principal planes - Determination of true lengths and true inclinations - Projection of planes (polygonal and circular surfaces) inclined to one of the principal planes - Demo using CAD software for above topics.

UNIT III **12**

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-Demo using CAD software for above topics.

UNIT IV **12**

Sectioning of above solids in simple vertical position - the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones-Demo using CAD software for above topics.

UNIT V **12**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions – Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method-Demo using CAD software for above topics

Total Periods: 61 hours

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- Students able to understand the fundamentals and standards of Engineering graphics.
- Students able to understand the freehand sketching of basic geometrical constructions

and multiple views of objects.

- Students able to determine the orthographic projections of lines and plane surfaces.
- Students able to understand the projections of solids.
- Students able to understand the section of solids and apply the development of lateral surfaces.
-

TEXTBOOKS:

1. NatrajanK.V., "A text book of Engineering Graphics", DhanalakshmiPublishers,Chennai,2009.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited,2008.

REFERENCE BOOKS

1. BhattN.D.andPanchalV.M.,"EngineeringDrawing",Charotar Publishing House,50th Edition,2010.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, NewDelhi,2008.
3. Gopalakrishna K.R.,"Engineering Drawing"(Vol.I&II combined),SubhasStores,Bangalore,2007.
4. 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, NewDelhi,2005.
5. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, NewDelhi,2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson,2nd Edition,2009.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation–Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings –Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either-or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each makingatotalof100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solutionwithinA3size.
4. The examination will be conducted in appropriate sessions on the same day

CS1102 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- Design simple programs using conditionals and loops.
- Write functions to solve mathematical problems
- Use strings for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries
- Identify to read and write data from and to files in python
- Use turtle for drawing object and Python for using 3D Objects

LIST OF EXPERIMENTS:

1. Write a program to display the largest number among three numbers.
2. Write a program to display the Fibonacci series by using looping constructs.
3. Write a function to compute the GCD of two numbers.
4. Explore String Functions
5. With the help of strings, array or list, display a simple calendar in python program without using the calendar module.
6. With the help of list perform linear search and Binary search.
7. Write a program to perform Selection sort, Insertion sort, Merge sort
8. Create a text file using python file I/O. Read the content of the file and change them from lower to upper case characters.
9. Programs that take command line arguments (word count)
10. Find the most frequent words in a text read from a file
11. Simulate bouncing ball using Pygame

Total Periods: 60 hours

OUTCOMES:

- Understand the basic of algorithmic problem solving
- Be familiar with data expressions and statements.
- Understand control flow and functions problems.
- Comprehend list, tuples and dictionaries
- Understand Object oriented programming concepts.
- Understand Object oriented programming concepts.

BS1101 PHYSICS AND CHEMISTRY LABORATORY

L	T	P	C
0	0	4	2

PHYSICS LABORATORY

COURSE OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

Total Periods: 30 hours

OUTCOMES:

- Apply principles of optics, sound and thermal properties for engineering
- Apply principles of elasticity and band gap for engineering applications
- Analyze the viscosity of a liquid

CHEMISTRY LABORATORY

COURSE OBJECTIVES:

To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.

LIST OF EXPERIMENTS (**Any seven experiments to be conducted):**

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
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 TDS of water sample.
5. Determination of strength of acids in a mixture of acids using conductivity meter.
6. Estimation of iron content of the given solution using potentiometer.
7. Estimation of iron content of the water sample using spectrophotometer (1, 10- Phenanthroline / thiocyanate method).
8. Determination of molecular weight of polyvinyl alcohol using Ostwaldviscometer.
9. Conductometric titration of strong acid vs strong base.

Total Periods: 30 hours

OUTCOMES:

- Apply hands-on knowledge in the quantitative chemical analysis of water
- Carry out the basics of instrumental analysis-conductivity meter, and potentiometer
- Analyze the chloride content in water sample

CI1101 INDIAN CONSTITUTION

L	T	P	C
2	0	0	0

PREREQUISITES:

- Basic Law

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India

9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article19
15. Scope of the Right to Life and Personal Liberty under Article21

SEMESTER-II

HS1201 ENGLISH FOR COMMUNICATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The Course enables the second semester Engineering and Technology students to:

- Improve their language ability to improve the four basic skills of communication (LSRW).
- Enhance the skills and methods to enrich their reading and comprehending ability.
- Strengthen their skills to listen to the lectures and talks related to their fields of studies.
- Foster their ability to write effectively in all contexts.
- Cultivate their oral presentation skills through technical presentations and contribution in group discussions.

UNIT– I **9**

Reading- Reading for detailed comparison **Listening**- Listening to interviews **Writing**- Developing hints, summarizing **Speaking**- Talk about future plans, arrangements intensions **Language development**- Sentence structures **Vocabulary development-** Synonyms, Antonyms, Adverbs.

UNIT–II **9**

Reading-Extended reading **Listening**- Listening to telephonic conversations **Writing**- Formal Letter Writing - Letters for bona fide certificate - to the principal for permission for in plant training, industrial visit, paper presentations, inter college events, Letter to the Editor, Recommendations **Speaking**- Formal conversation **Language development**-Use of Punctuation, Modal verbs **Vocabulary development-** One word substitutes, Common Phrasal verbs

UNIT–III **9**

Reading- Identify topic sentences by reading a short story **Listening**- Listening to TED talks **Writing**- Process/product description **Speaking**- Formal Conversations **Language development**- Relative Clauses, Concord, Error correction **Vocabulary development-** Idioms & Phrases, Minimal pairs.

UNIT IV **9**

Reading- Reading newspaper articles **Listening**- Listening to inspirational speeches **Writing**- Essays, Checklist **Speaking**- Technical Presentations **Language development**- Degrees of Comparison **Vocabulary development-** Articles, Cause and Effect Expressions

UNIT V **9**

Reading- Close reading **Listening-** Listening for summarizing **Writing**- Dialogue conversations **Speaking**- Movie/ Book Review **Language development**- Wh Questions, Yes/ no Questions **Vocabulary development-** Foreign Expressions and its applications, Reference words.

Total Periods: 45 hours

OUTCOMES:

At the end of the course the students will be able to:

- Read for comprehending and responding in general and professional settings.
- Demonstrate the communication skills (LSRW) in academic, professional and social Environment.
- Participate effectively in formal and informal conversations and express findings and opinions with proper language ability.
- Comprehend conversations and short talks delivered in English.
- Use the language effectively to write with clarity and accuracy in general and technical contexts.
- Attain fluency in English language to speak convincingly, express their opinions clearly, initiate a discussion, negotiate and comprehend using appropriate

Extensive Reading:

Kalam, Abdul Dr.A.P.J. - The Wings of Fire, Universities press:1999

Reference:

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford:2014
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford:2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan:Hyderabad,2015
4. Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013
5. Means,L. Thomas and Elaine Langlois. English & CommunicationFor Colleges.CengageLearning ,USA:2007.

Recommended websites:

- TED.com
- learningenglish.voanews.com
- islcollective.com
- examenglish.com
- englishclass101.com

MA1201 COMPLEX VARIABLES AND TRANSFORMS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- Understand the concept of Divergence and curl and use it in evaluating Line, Surface and Volume integrals.
- Understand C-R equations and use it in the construction of Analytic Functions.
- Understand the methods of Complex Integration using Cauchy's Integral Formula and Cauchy Residue theorem, finding Taylor's and Laurent's Series expansions.
- Find the Laplace Transforms of standard Functions and to find the Inverse Laplace Transform of a function and use it in solving Differential Equations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems

UNIT I VECTOR CALCULUS **12**

Gradient and directional derivative – Divergence and curl – Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral – Area of a curved surface – Volume integral – Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals-simple applications involving cubes and rectangular parallelopipeds.

UNIT II ANALYTIC FUNCTIONS **12**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates – Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping–Mapping by functions($w = 1z, w = z^2, w = e^z, w = \sin hz, w = \cos hz$)–Bilinear transformation.

UNIT III COMPLEX INTEGRATION **12**

Line integral – Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNITIV LAPLACE TRANSFORMS **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 – Inverse transforms – Convolution theorem –Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS **12**

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

Total Periods: 60 hours

OUTCOMES

On successful completion of this course, the student will be able to

- Solve problems using divergence and curl and evaluate line, Surface and Volume integrals.
- Solve problems in Analytic functions and construction of analytic functions using C-R Equations.
- Evaluate problems using Cauchy's integral formula and Cauchy residue theorem and find Taylor's and Laurent's series expansion of a given function.
- Obtain the Laplace Transforms of standard functions.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.
- Transformation play a vital role in diverse areas of science and technology such as electrical analysis, communication engineering, control engineering, linear systems

TEXTBOOKS

1. Grewal, B.S., Higher Engineering Mathematics, 43rd Edition, Khanna Publishers,2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, Inc.,2016.

REFERENCE BOOKS

1. Bali,N.P.,Goyal,M.,Watkins,C.,Advanced Engineering Mathematics,Laxmi Publications Pvt. Limited,2007.
2. Boyce,W.E.,andDiPrima,R.C.,ElementaryDifferentialEquationsandBoundaryValue Problems, Wiley India,2012.
3. O'Neil. P. V. "Advanced Engineering Mathematics", 7th Edition, Cengage LearningIndia Pvt., Ltd, New Delhi,2011.
4.T. Veerarajan, Engineering Mathematics, Tata Mcgraw Hill publications co. ltd, New Delhi.2017.

PH1201 MATERIALS SCIENCE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To enrich the understanding of various types of materials and their applications in engineering and technology.

UNIT I CONDUCTING MATERIALS **9**

Conductors – classical free electron theory of metals – Electrical and thermal conductivity –Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory –Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states –carrier concentration in metals.

UNIT II SEMICONDUCTING MATERIALS **9**

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination –Elemental and Compound Semiconductors

– **N-type and P-type semiconductor (Qualitative)** – Hall effect –Determination of Hall coefficient – Applications.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism –Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials –Ferrites and its applications. **Electro static Discharge (ESD)-**Superconductivity: properties – Type I and Type II superconductors–BCS theory of superconductivity (Qualitative) - High Tc superconductors – Electrical, medical, magnetic and computer application of superconductors.

UNIT IV DIELECTRIC MATERIALS 9

Electrical susceptibility – dielectric constant – electronic, ionic, orientation and space charge polarization – frequency and temperature dependence of polarisation – **Clausiusmosotti relation -** dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer).

UNITV ADVANCED ENGINEERINGMATERIALS 9

Metallic glasses - melt spinning process, applications - shape memory alloys: Ni-Ti alloy, applications – nanomaterials: preparation (bottom up and top down approaches), properties and applications- Bio materials – introduction- properties of bio materials-examples- medical applications- Ophthalmology- bio sensors-characteristics.

Total Periods: 45 hours

OUTCOMES:

At the end of this course,

- The students will gain knowledge of conducting materials and variation of its properties with temperature.
- Acquire knowledge on basics of semiconductor physics and its applications in various devices.
- Gain adequate knowledge on magnetic and super magnetic materials and its application.
- Gain knowledge on polarization in dielectric materials and its application.
- Understand the properties of metallic glass, SMA, nanomaterial's , Bio sensors and bio materials and their application.
- Acquire knowledge on application of semiconducting materials and preparation of nano materials

TEXT BOOKS:

1. S.Mohan, Principles of Materials Science, MJP Publishers,2018.
2. Jasprit Singh, Semiconductor Devices, Basic Principles, Wiley2012.
3. Umesh K Mishra and Jasprit Singh, Semiconductor Device Physics and Design‖, Springer,2008.

REFERENCES:

1. Wahab, M.A. Solid State Physics: Structure and Properties of Materials‖, Narosa Publishing House,2009.
2. William D.CallisterJr, David G. Rethwisch, Materials Science and Engineering, An Introduction,Wiley India (P) Ltd., 8th Edition,2009.
3. Pillai S.O., Solid State Physics, New Age International (P) Ltd., Publishers,2009.
4. Semiconductor Introduction, https://youtu.be/k6ZxP9Yr02E(Videolecture)
5. Superconductivity, https://youtu.be/D-9M3GWOBrw(Videolecture)

ME1201 BASIC CIVIL AND MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart basic knowledge on Civil and Mechanical Engineering.
- To familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures.
- To enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

CIVIL ENGINEERING

UNIT I SURVEYING AND CIVILENGINEERING MATERIALS 9

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours – Introduction to astronomical & hydrographic surveying – Modern equipments. Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel - timber – modern materials.

UNIT II BUILDING COMPONENTSANDSTRUCTURES 9

Foundations: Types of foundations-Bearing capacity and settlement–Requirement of good foundations. Civil Engineering Structures: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to highway and railway.

MECHANICAL ENGINEERING

UNIT III POWER PLANTSANDBOILERS 9

Classification of Power Plants-Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants -Classification of boilers- working principle of Water Tube Boilers, Fire Tube Boilers and Turbines.

UNIT IV I.C. ENGINESANDPUMPS 9

Internal combustion engines – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines. Classification of Pumps - Working Principle of Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps.

UNIT V REFRIGERATIONANDAIRCONDITIONINGSYSTEM 9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system– Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

Total Periods: 45 hours

OUTCOMES:

On successful completion of this course, the student will be able to

- appreciate the Civil and Mechanical Engineering components of Projects.

- explain the usage of construction material and proper selection of construction materials.
- measure distances and area by surveying
- identify the components used in power plant cycle.
- demonstrate working principles of petrol and diesel engine.
- elaborate the components of refrigeration and Air conditioning cycle.

TEXTBOOKS:

1.Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", Tata McGraw HillPublishingCo., NewDelhi,1996.

REFERENCES:

1. Ramamrutham S., "Basic Civil Engineering", DhanpatRai Publishing Co.(P)Ltd.1999.
2. SeetharamanS.,"BasicCivilEngineering",AnuradhaAgencies,2005.
3. ShanthaKumar SRJ., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.
4. Venugopal K.and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers,Kumbakonam,2000.

CS1201 PROGRAMMING IN C

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To develop C Programs using basic programming constructs.
- To develop C programs using arrays and strings.
- To develop applications in C using functions and functions.
- To develop applications in C using structures.
- To do input/output and file handling in C.

UNIT I BASICS OF C PROGRAMMING 9

Introduction to programming paradigms - Structure of C program - C programming: Identifiers- Keywords- Data Types - Variables - Constants. Operators: Precedence and Associativity –Expressions - Input/ Output statements - Decision making statements - Switch statement - Looping statements - Pre- processor directives - Compilation process

UNIT II ARRAYS AND STRINGS 8

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- String operations – String Arrays

UNIT III FUNCTIONS AND POINTERS 10

Introduction to functions: Function prototype, function definition, function call, Built-in functions (string functions, math functions) - Recursion-Types of Recursion - Example Program: Computation of Sine series, Scientific calculator using built-in functions, Binary Search using recursive functions-Storage Classes - Pointers - Pointer operators - Null Pointers- 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 number sand changing the value of a variable using pass by reference

UNIT IV STRUCTURES 9

Structures-Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure – Passing structures to functions – Array of structures – Pointers to structures – Union - Programs using structures and Unions, Enumerated data type-Dynamic Memory Allocation

UNIT V FILE PROCESSING 9

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: Payroll System and Transaction processing using random access files - Command line arguments

Total Periods: 45 hours

OUTCOMES:

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

- Develop simple applications in C using basic constructs
- Design and implement applications using arrays and strings
- Develop and implement applications in C using functions and pointers.
- Develop applications using structures.

- Design applications using sequential and random access file Processing.
- Understand the advanced concepts in dynamic memory allocation

TEXTBOOKS:

1. Reema Thareja,"Programming in C", Oxford University Press, Second Edition,2016.
2. Kernighan,B. Wand Ritchie,D.M,"The C Programming language ",Second Edition, Pearson Education,2006

REFERENCES:

1. PaulDeitelandHarveyDeitel,"CHowtoProgram",Seventhedition,PearsonPublication
2. Juneja,B.LandAnitaSeth,"ProgramminginC",CENGAGELearningIndiapvt.Ltd.,2011
3. Pradip Dey, Manas Ghosh," Fundamentals of Computing and Programming in C", First Edition, Oxford UniversityPress,2009.
4. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling
5. Kindersley(India)Pvt.Ltd.,PearsonEducationinSouthAsia,2011.
6. ByronS.Gottfried,"Schaum's Outline of Theory and Problems of Programming with C", McGraw-HillEducation,1996.

EE1205 CIRCUIT THEORY

L	T	P	C
2	2	2	4

COURSE OBJECTIVES:

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

UNIT I BASICS OFCIRCUITANALYSIS **12**

Ohm's Law – Kirchhoff's laws –Resistors, Inductors and Capacitors in series and parallel circuits- Mesh current and node voltage method of analysis for D.C and A.C. circuits. Simulation and Experimental verification of KCL and KVL.

UNIT II NETWORK REDUCTIONANDTHEOREMS **12**

Network reduction: voltage and current division, source transformation – star delta conversion. Thevenin's and Norton's Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity theorem for dc and ac circuits. Simulation and Experimental verification of basic Theorems.

UNIT III TRANSIENTRESPONSE ANALYSIS **12**

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

UNIT IV THREE PHASE CIRCUITS **12**

A.C. circuits – Average and RMS value - Phasor Diagram – Power, Power Factor and Energy.- Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced– phasor diagram of voltages and currents – power measurement in three phase circuits. Simulation of Three phase balanced circuit.

UNIT V RESONANCE AND COUPLED CIRCUITS **12**

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

Total Periods: 45 hours

OUTCOMES:

- Explain the circuit's behavior using circuit laws
- Apply mesh analysis/ nodal analysis / network theorems to determine behavior of the given DC and AC circuit
- Compute the transient response of first order and second order systems to step and sinusoidal input
- Compute power, line/ phase voltage and currents of the given three phase circuit
- Analyze the frequency response of series and parallel RLC circuits
- Explain the behavior of magnetically coupled circuits.

TEXT BOOKS:

1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, “EngineeringCircuits Analysis”, McGraw Hill publishers, edition, New Delhi,2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of ElectricCircuits”, Second Edition, McGraw Hill,2013.
3. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”,Cengage Learning India,2013.

REFERENCES:

1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), DhanpathRai& Sons, New Delhi,1999.
2. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill,2015.
3. Joseph A. Edminister, MahmoodNahri, “Electric circuits”, Schaum’s series, McGraw- Hill, New Delhi, 2010.
4. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, NewDelhi,2015.
5. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India PvtLtd, New Delhi,2015.
6. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc.2015.
7. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill,2015.

CY1201 ENVIRONMENTAL SCIENCE AND ENGINEERING

L	T	P	C
2	0	0	0

COURSE OBJECTIVES:

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

UNIT I ENVIRONMENT, ECO SYSTEMS AND BIO DIVERSITY 14

Definition, scope and importance of environment – need for public awareness – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of major ecosystem – Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water – Mineral resources: environmental effects of extracting and using mineral resources, case studies – Food resources: changes caused by agriculture and overgrazing, effects of modern agriculture, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soilerosion and desertification – 12 Principles of Green chemistry, role of an individual in conservation of natural resources – Equitable use of resources for sustainable life styles.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies – environment protection act – Air

(Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act –- central and state pollution control boards.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health.

Total Periods: 45 hours

OUTCOMES:

- Students will be able to understand the functions of ecosystems and appreciate the biodiversity.
- Students will be able to know the measures to control environmental pollution.
- Students will be able to understand the usage as well as the effects of over exploitation of natural resources.
- Students will have knowledge about finding technological, economic and political solutions to environmental problems with various Environmental Protection Act in mind.
- Students will be able to understand the interrelationship between population explosion and the environment and also role of IT in environment and human health.
- Students will be able to understand that Environmental problems can only be solved by Public participation in all aspects and cannot be solved by mere laws.

TEXT BOOKS:

1. Environmental Science and Engineering by Anubha Kaushik and C.P.Kaushik-New Age International Publishers. New Delhi, 2017.

REFERENCES:

1.Benny Joseph , Environmental Studies, Tata mcgraw-Hill Publishing Company, Ltd., New Delhi,2006.
2.Dr.B.S.Chauhan,. Environmental Studies , University Science Press, New Delhi,2011

CS1203 PROGRAMMING IN C LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To develop programs in C using basic constructs.
- To develop programs in C using control statements.
- To develop applications in C using arrays, strings, pointers.
- To develop applications in C using functions, structures.
- To develop applications in C using file processing

LIST OF EXPERIMENTS:

1.Input and Output statements

2. Control statements – Branching &Looping

a) Write a C program to generate Pascal's triangle.

b) Write a C program, which takes two integer operands and one operator form the user, performs the operation and then prints the result. (Consider the operators +,-,*,/,% and use Switch Statement)

c) Write a C program to find the sum of individual digits of a positive integer.

d) A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.

e) Write a C program to generate all the prime numbers between 1 and n, where n is a value Supplied by the user.

f) Write a C program to swap Numbers Using Temporary Variables.

3. Arrays

a) Write a C program to search an array element using linear search.

b) Write a C program to find both the larges and smallest number in a list of integers.

c) Write a C program that uses functions to perform the following:

i)Addition of Two Matrices ii)Multiplication of Two Matrices

d) Write a C program to implement Bubble sort.

4.Strings

a)Write a C program that uses functions to perform the following operations:

i) To insert a sub-string in to given main string from a given position.

ii) To delete n Characters from a given position in a given string.

b) Write a C program to determine if the given string is a palindrome or not

5.Functions &Pointers:

Write C programs that use recursive functions

i) To find factorial of given number.

ii) To solve Towers of Hanoi Problem.

iii) To swap the variables using call by value and call by reference.

6. a) Generate mark sheet of students using structures.

b) Compute salary slip for five employees using structures and functions.

7. Insert, Update, delete and append telephone details of an individual or a company into a telephone directory using random access file.

Total Periods: 60 hours

OUTCOMES:

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

- Develop C programs for simple applications making use of basic constructs.
- Design and implement applications using string and array
- Design and implement applications in C using functions and pointers
- Develop applications using Structures
- Develop applications using sequential and random access file processing
- Understand the advanced concepts in dynamic memory allocation

GE1201 ENGINEERING PRACTICES LABORATORY

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COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS:

GROUP A (CIVIL & MECHANICAL)

I CIVILENGINEERINGPRACTICE 13

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, Unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 18

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding

practice Basic Machining:

(a) Simple Turning and Taperturning
(b) Drilling Practice Sheet

Metal Work:

(a) Forming &Bending:
(b) Model making – Trays andfunnels.
(c) Different type of joints.

Assembly practice:

(a) Study of centrifugal pump

(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step conepulley.

(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

III ELECTRICAL ENGINEERING PRACTICE **13**

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.

IV ELECTRONICS ENGINEERING PRACTICE **16**

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.

Total Periods: 60 hours

OUTCOMES:

On successful completion of this course, the student will be able to

- Fabricate carpentry components and pipe connections including plumbing works.
- Use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

SEMESTER-III

MA1302 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
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COURSE OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS-I **12**

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation –Integral surface passing through a curve-surface orthogonal to a system of surface-Non linear partial differential equation –Charpit's method-special methods of solution applicable to certain standard forms- Jacobi's Method

UNIT II PARTIAL DIFFERENTIAL EQUATIONS-II **12**

Homogenous Linear partial differential equations of second and higher order with constant coefficients –Non homogeneous Linear partial differential equations of second and higher order with constant coefficients- Partial differential equation reducible to equation with constant coefficients-partial differential equation of order two with variable coefficients

UNIT III FOURIER SERIES **12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT V FOURIER TRANSFORMS **12**

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

Total Periods: 45 hours

OUTCOMES :

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

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.

- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.
- Gain knowledge to use different software packages like AUTOCADD, MATLAB and OCTAVE

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2.Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES :

1.Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
2.Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3.Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4.Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
5.Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

EE1301 ELECTRICAL MACHINES –I

L	T	P	C
3	0	0	3

PREREQUEST SUBJECTS:

- Circuit Theory
- Basic Civil & Mechanical Engineering

COURSE OBJECTIVES:

- To study the magnetic circuit analysis and understand the basic concepts in rotating machines.
- To understand the Working principles of DC Generator, types, determination of their noload/load characteristics,
- To analyze the speed-torque characteristics of DC motors and understand the starting and methods of speed control of DC motors.
- To understand the Constructional details, the principle of operation of single phase and three phase transformers.
- To study the different testing methods of DC machines & Transformers.

UNIT I ELECTRO MAGNETIC INDUCTION AND BASIC CONCEPTS IN ROTATING MACHINES **9**

Introduction to Magnetic Circuits – Magnetically Induced EMF and Force – AC Operation of Magnetic Circuits –. Energy in Magnetic Systems – Field Energy & Mechanical Force – Single and Multiple Excited Systems. MMF of Distributed Windings – Magnetic Fields in Rotating Machines

UNIT II – DC GENERATORS **9**

Constructional features of DC machine – Principle of operation of DC generator – EMF equation – Types of excitation – No load and Load Characteristics of DC generators – Commutation – Armature Reaction – Parallel operation of DC generators

UNIT III – DC MOTORS **9**

Principle of operation of DC motors-Back EMF – Torque equation –Types of DC motors-Speed – Torque characteristics of DC motors – Starting of DC motors: 2 point starter, 3 point starter, 4 point starter – Speed control: Field control, Armature control, voltage control – Losses and efficiency –Applications

UNIT IV– TRANSFORMERS **9**

Principle of operation – Constructional features of single phase and three phase transformers – EMF equation – Transformer on No load and Load –Phasor diagram - Equivalent Circuit – Regulation - Three Phase Transformer Connections-Parallel Operation of single phase and three phase transformer- Auto transformers.

UNIT V– TESTING OF DC MACHINES & TRANSFORMERS **9**

Losses and efficiency –Condition for maximum efficiency – Testing of DC machines: Brake test, Swinburne's test, Retardation test, Hopkinson's test- Testing of transformer: Polarity Test, load test(single phase and three phase transformers), Open Circuit and Short Circuit test, Sumpner's test – All day efficiency.

Total Periods: 45 hours

OUTCOMES:

- Implement the concepts of magnetic-circuits and electromechanical energy conversion in single and multiple excited system.

- Distinguish the working principles and characteristics of DC Generator.
- Experiment the working principles, losses and the speed control of DC Motor
- Examine the working principle, losses and equivalent circuit of transformers.
- Execute the different test methods of DC machines and Transformers.
- Select appropriate DC Motors and DC Generators for industrial applications.

TEXT BOOKS:

1.Kothari.D.P and Nagrath.I.J., "Electrical Machines", Tata McGraw Hill Publishing Co.Ltd, New Delhi, 5th edition 2017.
2.Bimbhra.P.S, "Electrical Machines", Khanna Publishing; Second edition 2017.

REFERENCES:

1.Dr. MurugeshKumar.K. "DC Machines & Transformers", Vikas Publishing House Pvt Ltd.,2nd edition 2017.
2.Fitgerald, A.E., Charles Kingsely Jr. Stephen D.Umans, "Electric Machinery" McGraw Hill Books Company,6th edition 2002.
3.Hill Stephen, Chapman.J, "Electric Machinery Fundamentals", McGraw Hill Book Co., New Delhi, 4th edition 2017.
4.Albert E Clayton and Hancock.N.N, "The performance and design of direct current Machines", Oxford and IBH publishing company Pvt. Ltd., New Delhi 1990

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EE1302 ELECTROMAGNETIC THEORY

L	T	P	C
3	0	0	3

PREREQUEST SUBJECTS:

- Circuit Theory

COURSE OBJECTIVES:

To impart knowledge on the concepts of

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

UNIT I ELECTROSTATICS – I **9**

Electromagnetic spectrum - Sources and effects of electromagnetic fields – Coordinate Systems: Cartessian, Cylindrical and Spherical system– Transformations of Vector fields –Gradient, Divergence, Curl – Divergence and stokes theorems and its applications – Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges(line, circular ring, infinite sheet of charge) – Gauss's law and applications.

UNIT II ELECTROSTATICS – II **9**

Electric potential, potential due to circular coil –Electric dipole, Electric field and equipotential plots, Uniform and Non-Uniform field,Utilization factor – 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 **9**

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

UNIT IV ELECTRODYNAMIC FIELDS **9**

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

UNIT V ELECTROMAGNETIC WAVES **9**

Electromagnetic wave generation and equations – Wave parameters: velocity, intrinsic impedance, propagation constant, attenuation constant and Phase constant- Waves in free space, conductor, lossy and lossless dielectrics, conductors- skin depth – Poynting vector and Poynting theorem– Plane wave reflection and refraction-Brewsters angle.

Total Periods:45 hours

COURSE OUTCOMES:

- Recall the basic mathematical concepts of co ordinate systems, gradient, divergence, curl and theorems related to electromagnetic vector fields and Coulomb's Law, Gauss's law and its applications
- Explain the concepts of Electrostatics and their applications, Boundary condition capacitance, and to derive energy density and Poisson's and Laplace's equations
- Explain the concepts of magneto statics and their applications, Boundary condition , Inductance and to derive Energy density, scalar and vector potential
- Describe the concepts of Maxwell's equations and compare relation between field theory and circuit theory.
- Describe the concepts of wave equation for free space, lossy and lossless dielectrics, conductors and their parameters and Pointing vector.
- Use electromagnetic simulation software for analysis of electromagnetic fields

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, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2017.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, July 2017.

REFERENCES

1. V.V.Sarwate, 'Electromagnetic fields and waves', First Edition, Newage Publishers, June 2018
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, 2013.
4. S.P.Ghosh, LipikaDatta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2017.

EE1303 ELECTRON DEVICES AND CIRCUITS

L	T	P	C
3	0	0	3

PREREQUEST SUBJECTS:

- Materials Science
- Circuit Theory

COURSE OBJECTIVES:

The student should be made to:

- Understand the structure of basic electronic devices and applications of electronic devices.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and applications of transistors and thyristors.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

UNIT I PN JUNCTION DEVICES 9

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier- clippers and clamper (qualitative treatment)-Zener Diode-operation and characteristics , Zener as regulator-Display devices- Basic operation of LED, Laser diodes, Photo diode and Phototransistor .

UNIT II TRANSISTORS AND THYRISTORS 9

Bipolar Junction Transistors-structure, operation and characteristics of BJT in CB, CE and CC configurations- Biasing- Fixed, emitter feedback and Voltage divider bias- JFET, MOSFET- structure, Operation, Characteristics and JFET as a voltage controlled resistor –FET Biasing-Self bias and Voltage divider bias - UJT- structure, operation ,characteristics and UJT as saw tooth oscillator. Introduction to thyristors and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS 9

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis using BJT – Differential amplifier using FET– Single tuned amplifiers– Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Feedback concept-Advantages of negative feedback – voltage / current, series and Shunt feedback –positive feedback – Condition for oscillations, phase shift ,Wien bridge, Hartley, Colpitts and Crystal oscillators.

Total Periods: 45 hours

OUTCOMES:

Upon Completion of the course, the students will be ability to:

- Understand the Characteristics of various types of diodes, Half wave and full wave
- Identify the features of BJT and its various configurations.
- Choose and adapt the required component to execute an amplifier circuit using small signal analysis
- Obtain the basic Knowledge on multistage amplifiers and differential amplifiers.

- Apply the knowledge to develop and analyses feedback amplifiers and oscillators.
- Apply the various electronic devices to improve the efficiency related to Power Electronics in various applications

TEXT BOOKS:

1. David A. Bell ,"Electronic devices and circuits", Oxford University higher education, 5th edition 2010.
2. Sedra and smith, "Microelectronic circuits",7thEd., Oxford University Press

REFERENCES:

1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition2014.
2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
3. Millman J, Halkias.C.andSathyabrada Jit, Electronic Devices and Circuits, 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2015
4. Robert L. Boylestad and Louis Nasheresky, ―Electronic Devices and Circuit Theory‖, 11th Edition, Pearson Education, 2013

EE1304 DIGITAL LOGIC CIRCUITS

L	T	P	C
3	0	2	4

COURSE OBJECTIVES:

- 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, Encoders and Decoders-Experimental verification of combinational circuits.

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- Counters, state diagram; state reduction; state assignment - Experimental verification of sequential circuits.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES 9

Asynchronous sequential logic circuits-Transition tability, flow tability-race conditions, hazards&errors in digital circuits; analysis of asynchronous sequential logic circuits: - Introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA .

UNIT V VHDL 9

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (VHDL Simulation: adders, counters, flip flops, Multiplexers & De multiplexers).

Total Periods: 45(T)+30(P)=75 hours

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 checking
4. Encoders and Decoders
5. Sequential Logic: Study of Flip-Flop, Counters (synchronous and asynchronous), Shift

Registers using suitability IC's.
6. Study of multiplexer and de multiplexer
7.Analysis of Digital circuits using simulation software

OUTCOMES:

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

TEXT BOOKS:

1. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
2. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.

REFERENCES

1. Comer "Digital Logic & State Machine Design, Oxford, 2012.
2. Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
3. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.
4. Thomas L.Floyd, 'Digital Fundamentals', 11th edition, Pearson Education, 2015.
5. Charles H.Roth, Jr, LizyLizy Kurian John, 'Digital System Design using VHDL, Cengage,2013.
6. Gaganpreet Kaur, VHDL Basics to Programming, Pearson, 2013.

EE1305 MEASUREMENTS AND INSTRUMENTATION

L	T	P	C
3	0	0	3

PREREQUEST SUBJECTS:

- Circuit Theory

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- Basic functional elements of instrumentation and their characteristics.
- Fundamentals of electrical and electronic instruments
- D.C and A.C. bridges
- Various transducers
- Various storage and display devices and the data acquisition systems

UNIT I INTRODUCTION **9**

Principle of measurement – absolute, comparative, direct reading and null balance methods. 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 multi meters – Single and three phase watt meters 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 D.C AND A.C BRIDGES **9**

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

UNIT IV TRANSDUCERS **9**

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers -Biomedical Transducers

UNIT V STORAGE, DISPLAYAND DATA ACQUISITION SYSTEMS **9**

SSD, Digital storage oscilloscope, Digital plotters and printers, CRT display, digital CRO, LED, LCD– Data Loggers- Hologram-Elements of data acquisition system –Smart sensors(Level, Temperature, Pressure, Infrared, Proximity sensor) - Thermal Imagers- Block diagram of PC based measurements.

Total Periods: 45 hours

OURSE OUTCOMES:

- Apply the knowledge on basic functional block elements in various measuring instruments and errors in the measurement system.
- Identify the suitable instrument for measuring various electrical and magnetic parameters
- construct a suitable Bridge circuit to determine the values of various resistor, inductor and capacitor.
- Compare the various types of transducer and explain their functions
- Interpret the knowledge on various types of storage and display devices

- Explain the functions of different blocks involved in data acquisition systems

TEXT BOOKS:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, JAN 2015
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria& Sons, Delhi, 2013.
3. 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. David Bell, ' Electronic Instrumentation & Measurements', Oxford University Press,2013.
4. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.
5. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.

EE1306 ELECTRON DEVICES AND CIRCUITS LABORATORY

L	T	P	C
0	0	2	1

PREREQUEST SUBJECTS:

- Engineering Practice Lab
- Circuit Theory

COURSE OBJECTIVES:

- To enability the students to understand the behavior of semiconductor device based on Experimentation and Simulation.

LIST OF EXPERIMENTS:

1. Study of CRO and DSO -Frequency and phase measurements
2. Zener diode
   a) Characteristics
   b) Voltage regulator
3. Clipper and Clamper using diode.
4. Characteristics of photo diode & photo transistor, Study of light activated relay circuit
5. Characteristics of JFET and determination of parameters.
6. Characteristics of UJT and generation of saw tooth waveforms.
7. Design and Frequency response of a Common Emitter amplifier (Fixed and Voltage divider Bias).
8. Differential amplifiers using FET.
9. Design and testing of Current series and Voltage shunt feedback amplifiers.
10. Design and testing of RC phase shift and LC oscillators.
11. Design of regulated power supply.
12. Realization of passive filters
13. Analysis of basic electronic circuits using simulation software (PSPICE/Ngspice)

Total Periods: 30 hours

OUTCOMES:

- Concept formation helps in categorizing different types of devices (e.g., resistors, capacitors, transistors) and
- understanding their functions and interrelationships with thorough analysis which helps in problem solving ability encompasses of FET and UJT circuits.
- understanding their functions and interrelationships with thorough analysis which helps in problem solving ability encompasses of FET and UJT circuits.
- Observing the use of FET as an amplifier and filter. Also, remembering the impedance level on source and output side.
- multiple platforms. This enables the learner to develop a new technique with efficient and precise manner.
- Familiarizing the concept of turn on and turn off characteristics of thyristor family devices

EE1307 ELECTRICAL MACHINES LABORATORY –I

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To Rig up circuits for testing a given machine.
- To Obtain the performance characteristics of machines.

LIST OF EXPERIMENTS:

CYCLE I

1. Open circuit characteristics of DC generator (Self and Separately Excited)
2. Load test on DC generators.
3. Speed Control of DC Motor: Field control, Armature control.
4. Load test on DC motors.
5. Swinburne's test.
6. Hopkinson's test.

CYCLE II

1. Open circuit & Short circuit test on single phase transformer.
2. Parallel operation of single phase transformers.
3. Separation of no-load losses in single phase transformer.
4. Load test on single phase transformer.
5. Sumpner's test on 1-phase transformers.
6. 3-phase transformer connections.
7. Load test on 3-phase phase transformer.

Total Periods: 60 hours

- **OUTCOMES:**

- Obtain the open circuit characteristics of DC generators and the impact of different excitation methods (self and separately excited) on performance.
- Analyze the performance and efficiency of DC generators and motors through load tests
- Demonstrate various methods of speed control in DC motors to evaluate their effectiveness in different applications
- Conduct and interpret Swinburne's and Hopkinson's tests to estimate the efficiency and performance of DC machines
- Examine the performance characteristics of single-phase transformers through open circuit, short circuit, and load tests
- Explore three-phase transformer connections and assess their load performance, as well as apply Sumpner's test for evaluating transformer efficiency

SEMESTER IV

MA1402	NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF LINEAR ALGEBRAIC EQUATIONS AND EIGEN VALUE PROBLEMS 12 12

Solution of algebraic and transcendental equations –Bisection method-Regular Falsi method-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 ,Jacobi's method and Householder's method

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Piecewise interpolation and spline interpolation-Bivariate Interpolation- Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae-Least square approximation.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule, Simpson's 3/8 rule – Romberg's Method - Two point and three point Gaussian quadrature formulae- Evaluation of double integrals by Trapezoidal and Simpson's 1/3rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY 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 - Bash forth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Initial value problem method-shooting method -Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

Total Periods: 60 hours

OUTCOMES

- Understand the basic concepts and techniques of solving algebraic and transcendental equations.
- Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
- Apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.
- Apply the basic numerical methods required for typical engineering and business applications. Students should implement and study some of the numerical methods using C++, C, FORTRAN, MATLAB or some other high-level language

TEXTBOOKS :

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning,2016.

2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi,2015.

REFERENCES :

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi,2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi,2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall,1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

EE1401 ELECTRICAL MACHINES – II

L	T	P	C
2	2	0	3

PREREQUEST SUBJECTS:

- Electrical Machines – I
- Electromagnetic Theory

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- Construction and performance of salient and non – salient type synchronous generators.
- Principle of operation and performance of synchronous motor.
- Construction, principle of operation and performance of induction machines.
- Starting and speed control of three-phase induction motors.
- Construction, principle of operation and performance of single phase induction motors and special machines.

UNIT I SYNCHRONOUS GENERATOR **12**

Constructional details – Types of rotors –winding factors- emf equation – Synchronous reactance – Armature reaction – Phasor diagrams of non salient pole synchronous generator connected to infinite bus-- Synchronizing and parallel operation – Synchronizing torque -Change of excitation and mechanical input- Voltage regulation – EMF, MMF, ZPF and A.S.A methods – steady state power- angle characteristics– Two reaction theory –slip test -short circuit transients - Capability Curves – Introduction to sequence impedance of alternators.

UNIT II SYNCHRONOUS MOTOR **12**

Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Equivalent circuit and phasor diagram-Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed-Hunting – synchronous condenser.

UNIT III THREE PHASE INDUCTION MOTOR **12**

Constructional details – Types of rotors –- Principle of operation – Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Double cage induction motors – Induction generators – Synchronous induction motor.

UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR **12**

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 using conventional method -Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES **12**

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Types of single-phase induction motors – applications- Special Machines - Shaded pole induction motor - Linear induction motor – Repulsion motor -Hysteresis motor - AC series motor- Stepper motors –PMBLDC Motor – Permanent Magnet Synchronous Motor – Introduction to Magnetic levitation systems.

Total Periods: 60 hours

OUTCOMES:

- Comprehensive understanding of the operation, design, and performance characteristics of synchronous generators
- Implement the principles of operation, torque equations, and phasor diagrams to analyze and improve the performance of synchronous motors in various industrial applications
- Demonstrate various methods of speed control in DC motors to evaluate their eff Utilize the knowledge of constructional details, rotor types, and operational principles to diagnose, optimize, and enhance the performance and efficiency of induction machines in various applications
- Apply various starting methods, speed control techniques, and braking mechanisms to effectively manage the operation and performance of three-phase induction motors in industrial applications
- Acquire knowledge on the principles of construction, operation, and performance analysis of single phase induction motors and special machines to optimize their use in various practical applications.
- Examine the performance characteristics of single-phase transformers through open circuit, short circuit, and load tests
- Effectively analyze and optimize performance characteristics offvarious types of electrical motors and special machines, using software packages

TEXT BOOKS:

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 2017.
2. Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016.
3. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 2017.

REFERENCES:

1. D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd, 2017.
2. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2017.
3. M.N. Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009.
4. B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers,3rd Edition ,Reprint 2015.
5. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, 2016.
6. A textbook of Electrical Technology – AC and DC machines – Volume II by B.L.Theraja, A.K.Theraja, S. Chand, New Delhi,2020

EE1402 TRANSMISSION AND DISTRIBUTION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the structure of electric power system and to develop expressions for the computation of transmission line parameters.
- To obtain the equivalent circuits for the transmission lines based on distance and to determine 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 types, construction of cables and methods to improve the efficiency.
- To study about distribution systems, types of substations, methods of grounding, EHVAC, HVDC and FACTS.

UNIT I TRANSMISSION LINE PARAMETERS 9

Structure of Power System –Comparison of D.C. and A.C. Transmission -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, conductor types and electrical parameters of EHV lines.

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 - Power Circle diagrams - methods of voltage control, Ferranti effect-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 - DC cables.

UNIT V DISTRIBUTION SYSTEMS 9

Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions-distributed and concentrated loads-Types of Substations -Methods of Grounding – Trends in Transmission and Distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).

Total Periods: 45 hours

OUTCOMES:

- Analyze the transmission line parameters and their impact on power systems.
- Analyze the performance of different types of transmission lines using equivalent circuits and phasor diagrams.
- Design mechanical components of transmission lines, insulators.
- Understand and apply the knowledge on construction, capacitance and grading of underground cables
- Assess various distribution systems and emerging technologies in transmission and distribution
- Assess various distribution systems and emerging technologies in transmission and distribution

TEXT BOOKS:

1. D.P.Kothari, I.J. Nagarath, 'Power System Engineering', Mc Graw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.
2. C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2009.
3. 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. LucesM.Fualken berry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
3. ArunIngole, "power transmission and distribution" Pearson Education, 2017
4. J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2012.
5. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.
6. V.K.Mehta, Rohit Mehta, 'Principles of power system', S. Chand & Company Ltd, New Delhi, 2013.

EE1403 LINEAR INTEGRATED CIRCUITS AND APPLICATIONS

L	T	P	C
3	0	2	4

PREREQUEST SUBJECTS:

- Electron Devices and Circuits
- Electron Devices and Circuits Lab

COURSE OBJECTIVES:

To impart knowledge on the following topics

- IC fabrication procedure.
- Signal analysis using Op-amp based circuits.
- Applications of Op-amp.
- Functional blocks and the applications of special ICs like Timers and PLL circuits
- Various Voltage regulator ICs.

UNIT I IC FABRICATION **9**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realisation of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, FETs and PV Cell.

UNIT II CHARACTERISTICS OF OPAMP **9**

Basic Concepts of OP-AMP, Ideal characteristics, DC characteristics, AC characteristics, frequency response of OP-AMP; Basic applications of op-amp – Inverting and Non-inverting amplifiers, summer, differential amplifier ,Voltage follower, differentiator and integrator, Log and Antilog amplifiers-Schmitt trigger -V/I & I/V converters.

UNIT III APPLICATIONS OF OPAMP **9**

Instrumentation amplifier and its applications for transducer Bridge- Analog multiplier & Divider-first and second order active filters(Sallen key and Butterworth**)**, comparators ,multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters (Successive approximation and Flash type)using opamp.

UNIT IV SPECIAL ICs **9**

Functional block, characteristics of 555 Timer its PWM applications –IC566 Voltage controlled oscillator, IC565 Phase locked loop IC and its applications (Frequency synthesizing and clock synchronisation), AD633 Analog multiplier –AD623 Instrumentation Amplifier and application as load cell weight measurement-ICL8038 function generator IC.

UNIT V Voltage Regulator ICs **9**

IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variability voltage regulators, switching regulator ICs- SMPS.

Total Periods: 45 hours

OUTCOMES:

- Ability to acquire knowledge in IC fabrication procedure
- Ability to analyze the characteristics of Op-Amp

- Gain knowledge to construct linear applications using operational amplifiers.
- Demonstrate and understand construction of digital to analog (D/A) and analog to digital (A/D) converters
- Interpret functional blocks, characteristics, and applications of special ICs like Timers, PLL circuits, and VCO.
- Construct and Analyse various voltage regulator ICs.

TEXT BOOKS:

1. David A. Bell, 'Op-amp & Linear ICs', Oxford, 2013.
2. D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', IV edition, New Age, 2018.

REFERENCES

1. RamakantA. Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, Published by Pearson (February 1st 2020) - Copyright © 2000
2.Fiore,"Opamps& Linear Integrated Circuits Concepts & applications", Cengage, 2010.
3. Floyd ,Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.
4. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2003.
5. Robert F.Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', Pearson, 6th edition,2012.
6. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', McGraw Hill, 2016.

LIST OF EXPERIMENTS:

1. Design and testing of inverting and non-inverting amplifiers.
2. Design and testing of Adder, comparator.
3. Design and testing of Integrator and Differentiator.
4. Design of Schmitt trigger
5. Design and testing of Active Filters
6. Design and testing of waveform generators using Opamp((sine, triangular & square wave)
7. Design and testing of D/A converter and A/D converter
8. Design and testing of Weinbridge oscillator using Opamp
9. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.
10. Fixed and Variability Voltage Regulator.(using IC LM7905 and IC LM317).
11. Study of Phase Locked Loop and VCO.

Total Periods: 30 hours

OUTCOMES:

At the end of the course, the student should have the:

- Ability to acquire knowledge on Applications of Op-Amp.
- Ability to design and implement linear applications of operational amplifiers such as filters, multivibrator, waveform generators and oscillator.
- Ability to analyze the D/A and A/D converters using Op-Amp.
- To understand the PWM circuits using Timer IC.
- To understand the design and practically demonstrate the applications based on IC555 and IC566.

EE1404 CONTROL SYSTEMS

L	T	P	C
2	2	0	3

COURSE 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 and design of compensators.
- To introduce state variable representation of physical systems.

UNIT I SYSTEMS AND REPRESENTATION 12

Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – AC and DC servomotors – Gear Trains- Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE 12

Time response: – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effects of P, PI, PID modes of feedback control –Time response analysis.

UNIT III FREQUENCY RESPONSE 12

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

UNIT IV STABILITY AND COMPENSATOR DESIGN 12

Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria – Effect of Lag, lead and lag-lead compensation on frequency response-Design of Lag, lead and lag lead compensator using bode plots.

UNIT V STATE VARIABLE ANALYSIS 12

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.

Total Periods (L: 45+T:15): 60 hours

COURSE OUTCOMES

At the end of the course, the student should have the :

- Identify the basic elements and structure of feedback control systems, derive linear models, their transfer function representations for multi-input multi-output systems and use the signal
- Correlate the pole-zero configuration of transfer functions and their time-domain response to known test inputs,construct and recognize the properties of root-locus for feedback control systems such as P, PI, PID

- Construct Bode and polar plots for rational transfer functions and to specify control system performance
- Apply Routh-Hurwitz criterion and Nyquist stability criterion to determine the stability of linear time-invariant systems. Also to design appropriate compensators for the given specifications
- Applytheconceptofcontrollabilityandobservabilitytoanalyzelinear,nonlinear, time–invariantor time varying systems
- Ability to understand and apply control theory in various electrical engineering problems

TEXT BOOKS

1. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2018.
2. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2018.

REFERENCES

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
2. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education,2010.
3. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2013.
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. NPTEL Video Lecture Notes on "Control Engineering "by Prof. S. D. Agashe, IIT Bombay.

HV1401 UNIVERSAL HUMAN VALUES **L T P C**
(Common to all B.E / B.TECH Branches) **2 2 0 3**

Universal Human Values : Understanding Harmony

COURSE OBJECTIVES:

The objective of the course is four fold:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

COURSE TOPICS:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

Module 3: Understanding Harmony in the Family and Society- Harmony in Human Human Relationship

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

14. Understanding the meaning of Trust; Difference between intention and competence
15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all pervasive space
21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics
22. Natural acceptance of human values
23. Definitiveness of Ethical Human Conduct
24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
25. Competence in professional ethics:
    a. Ability to utilize the professional competence for augmenting universal human order
    b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems,
    c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
26. Case studies of typical holistic technologies, management models and production systems
27. Strategy for transition from the present state to Universal Human Order:
    a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
    b. At the level of society: as mutually enriching institutions and organizations
28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

COURSE OUTCOMES:

- Understand and analyze the essentials of human values and skills, self-exploration, happiness and prosperity.
- Evaluate harmony in human being.
- Identify and evaluate the role of harmony in family, society and universal order.

- Understand and associate the holistic perception of harmony at all levels of existence.
- Develop appropriate technologies and management patterns to create harmony in professional and personal lives
- Able to understand the real life situation and able to live with right understanding by realizing universal human values

Total Periods (L: 30+T:15): 45 hours

REFERENCE BOOKS :

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)13. Gandhi - Romain Rolland (English)

EE1405 ELECTRICAL MACHINES LABORATORY -II

L	T	P	C
0	0	4	2

PREREQUEST SUBJECTS:

- Electrical Machines – I
- Electrical Machines Lab-I

COURSE 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. Speed Control of Slip Ring Induction motor & Study of Induction motor Starters.
10. Load test on single-phase induction motor.
11. No load and blocked rotor test on single-phase induction motor.

Total Periods: 60 hours

OUTCOMES:

At the end of the course, the student should have the :

- Gain a comprehensive understanding of various methods (EMF, MMF, ZPF, ASA) to determine the voltage regulation of three-phase alternators.
- Develop the skills to measure negative sequence and zero sequence impedances of alternators
- Analyze the performance characteristics of three-phase synchronous motors by plotting and interpreting V and inverted V curves
- Perform load tests and conduct no-load and blocked rotor tests on both three-phase and single-phase induction motors
- Learn to separate and analyze no-load losses in three-phase induction motors
- Understand the methods of speed control for slip ring induction motors and study various types of motor starters.

EE1406 CONTROL AND INSTRUMENTION LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To provide knowledge on analysis and design of control system along with basics of instrumentation

LIST OF EXPERIMENTS:

CONTROLSYSTEMS:

1. P,PI and PID controllers
2. Stability Analysis(using MAT lab)
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 (To find R, L & C)
9. Dynamics of Sensors/Transducers
   a. Temperature
   b. Pressure
   c. Displacement
   d. Optical
   e. Strain
   f. Flow
10. Study of Power and Energy Measurement
11. Signal Conditioning
    a. Instrumentation Amplifier
    b. Analog–Digital and Digital–Analog converters (ADC and DACs)

Total Periods: 30 hours

Course Outcomes:

After successful completion of this course students will be able to:

- Understand control theory and how to apply them over electrical engineering problems.
- Analyze the characterize of position control system and Synchro transmitter and receiver
- Ability to design compensators
- Understand the various types of bridge network and Sensors for different applications
- Understand the basics of signal conditioning circuits.
- Study the simulation packages.

SEMESTER-V

EE1501	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

PREREQUISITE :

- Electron Devices and circuits

COURSE OBJECTIVES:

To impart knowledge about the following topics:

- Different types of power semiconductor devices and their switching
- Operation, characteristics and performance parameters of controlled rectifiers
- Operation, switching techniques and basics topologies of DC-DC switching regulators.
- Different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- Operation of AC voltage controller and various configurations

UNIT I POWER SEMI-CONDUCTOR DEVICES 9

Study of switching characteristics: SCR, TRIAC, GTO, Power transistor, MOSFET, IGBT and IGCT-Triggering and commutation circuit for SCR- Introduction to Driver and snubber circuit.

UNIT II PHASE-CONTROLLED CONVERTERS 9

Single phase semi converter and full converters, three phase semi and full converters– performance parameters –Effect of source inductance–Firing Schemes for converter–Dual converters-Application: Light dimmer, Excitation system, Solar PV system.

UNIT III DC TO DC CONVERTER 9

Step-down and step-up chopper-control strategy–Introduction to types of chopper-A,B,C,D and E-Switched mode regulators- Buck, boost, buck- boost converter, Introduction to Resonant Converters-applications-Battery operated vehicles.

UNIT IV INVERTERS 9

Single phase and three phase voltage source inverters(both120degree modeand180 degree mode)–Voltage& harmonic control–PWM techniques: Sinusoidal PWM, modified sinusoidal PWM – multiple PWM –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.-Application-Welding

Total Periods: 45 hours

OUTCOMES:

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

- Realize a power electronic converters with proper choice of semiconductor devices
- Evaluate the performance parameters of a controlled rectifier system.
- Analyze the operation, switching techniques and basics topologies of DC-DC converters
- Analyze the different modulation techniques of pulse width modulated inverters and to understand the modes of operation inverter and harmonic reduction methods.
- Evaluate the operation of single phase and three phase AC voltage controller and cycloconverters

TEXT BOOKS:

1. M.H.Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, PHI IVth Edition, New Delhi, 2017.
2. P.S.Bimbra "Power Electronics" Khanna Publishers, Sixth Edition, 2018.
3. Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint, 2003.

REFERENCES:

1. Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.
2. Umanand, " Power Electronics Essentials and Applications", Wiley, 2010
3. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2012 Edition.
4. Ned Mohan, Tore. M. Undel and, William. P. Robbins,' Power Electronics: Converters, Applications and Design', John Wiley and sons, third edition,2003.
5. S.Rama Reddy, 'Fundamentals of Power Electronics', Narosa Publications, 2014.
6. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, 2017
7.Daniel.W.Hart, "Power Electronics", Indian Edition, McGraw Hill Education, 2nd edition, 2013

EE1502 POWER SYSTEM ANALYSIS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge about the following topics:
- To model the power system under steady state operating condition.
- To understand and apply iterative techniques for power flow analysis.
- 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– basic components of a power system. Single line diagram– per phase and per unit analysis–Generator-transformer, transmission line and load representation for different power system studies-Reactance and Impedance diagram- Primitive network- Construction of Y-bus using inspection and singular transformation methods.

UNIT II POWER FLOW ANALYSIS **9**

Importance of power flow analysis in planning and operation of power systems- statement of power flow problem - classification of buses- Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method –Newton-Raphson method.Introduction to unbalanced power flow problems.

UNIT III SYMMETRICAL FAULT ANALYSIS **9**

Importance of short circuit analysis-assumptions in fault analysis- Symmetrical short circuit analysis using Thevenin's theorem- Z bus formulation by bus building algorithm-Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level – Current limiting reactors. Case study of fault analysis in transmission lines.

UNIT IV UNSYMMETRICAL FAULT ANALYSIS **9**

Unsymmetrical fault analysis – symmetrical component transformation – sequence impedances - sequence networks - sequence circuits of synchronous machine, transformer and transmission lines –Unsymmetrical fault analysis of single line to ground, line to line, double line to ground faults

UNIT V STABILITY ANALYSIS **9**

Concept of stability in power system- classification of power system stability - steady and transient state stability – rotor angle stability–voltage stability – Single Machine Infinite Bus (SMIB) system: swing equation – power angle equation and curve – equal area criterion – critical clearing angle and time – solution of swing equation by modified Euler's method (qualitative treatment only)

Total Periods: 45 hours

OUTCOMES:

- Identify the basic components of a power system and the need for system planning and operational studies.
- Apply power flow analysis techniques to analyse and solve power system problems.
- Analyze symmetrical faults in power systems using appropriate methods and algorithms
- Analyze unsymmetrical faults in power systems using sequence networks and sequence impedance calculations
- Analyze power system stability and understand the concepts of rotor angle stability and voltage stability
- Apply power system analysis techniques to practical case studies and solve problems related to power system faults, Stability, and operation

TEXT BOOKS:

1. Nagrath.I.J, Kothari.D.P, "Modern Power System Analysis", Tata McGraw Hill,4th Ed., 2011.
2. HadiSaadat, "Power System Analysis", Tata McGraw Hill Pub Co. Ltd., New Delhi, 2010.
3.John J. Grainger & William Stevenson JR., "Power system Analysis by Tata McGraw-Hill New Delhi, 1st Ed., 2017

REFERENCES:

1. Gupta B.R., 'Power System - Analysis and Design', S. Chand Publishing, 2008.
2. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, ' Power System Analysis &Design',Cengage Learning, Fifth Edition, 2012
3. Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

IT1301 OBJECT ORIENTED PROGRAMMING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads and generics classes
- To design and build simple Graphical User Interfaces

UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 9

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java –Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays, Packages.

UNIT II INHERITANCE AND INTERFACES 9

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Object cloning -inner classes, ArrayLists - Strings

UNIT III EXCEPTION HANDLING AND I/O 9

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files

UNIT IV MULTITHREADING AND GENERIC PROGRAMMING 9

Understanding Threads, Thread Priorities, Synchronizing Threads, Thread life cycle, Inter-thread communication. Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations-Introduction to JDBC, JDBC Drivers and Architecture, Accessing Databse with JDBC.

UNIT V EVENT DRIVEN PROGRAMMING 9

Graphics programming - Frame – Components - working with 2D shapes - Using color, fonts, and images - Basics of event handling - event handlers - adapter classes -actions - mouse events - Introduction to Swing – Swing GUI Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes. Swing packages-Swing Control classes and Methods

Total Periods: 45 hours

OUTCOMES:

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

- Develop Java programs using OOP principles
- Develop Java programs with the concepts of inheritance and interfaces
- Build Java applications using exceptions and I/O streams
- Develop Java applications with Threads, generics classes and JDBC.

- Create a Database connectivity and manipulate database using JDBC
- Develop interactive desktop applications using Swing and JDBC
- Create Mini Project using KOTLIN

TEXT BOOKS:

1 Herbert Schildt, ―Java The complete reference‖, 8th Edition, McGraw Hill Education, 2011.

2.Cay S. Horstmann, Gary cornell, ―Core Java Volume –I Fundamentals‖, 9th Edition, Prentice Hall, 2013.

REFERENCES

1. Paul Deitel, Harvey Deitel, ―Java SE 8 for programmers‖, 3rd Edition, Pearson, 2015.

2. Steven Holzner, ―Java 2 Black book‖, Dreamtech press, 2011.

3. Timothy Budd, ―Understanding Object-oriented programming with Java‖, Updated Edition, Pearson Education, 2000.

EE1503 MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	C
3	0	0	3

PREREQUEST SUBJECTS:

- Digital Logic Circuits

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- Architecture of 8085Microprocessor& its programming.
- Need & use of peripheral/ interfacing ICs.
- Architecture, Addressing modes & instruction set of 8051.
- Simple programming and applications development with 8051.
- Microprocessor and Microcontroller based Real time applications.

UNIT I 8085 MICROPROCESSOR 9

Functional Blocks of Processor, pinouts- Memory Interfacing-I/O Interfacing–Instruction set and addressing modes -Timing Diagram -Timing Diagram of STA, LDA,IN, OUT and INR M-Interrupts. Programming: Loop structure with counting & Indexing – Look up table- Subroutine instructions - stack.

UNIT II PERIPHERAL INTERFACING 9

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254,8279, 8251, Interfacing of Analog to Digital Converter – Digital to Analog Converter –Basic concepts of Communication Interface and Sensor Interface with 8085.

UNIT III 8051 MICRO CONTROLLER 9

Architecture of 8051 Micro controller-pinouts –Memory Organization and Structure of Random Access Memory –Special Function Registers- – I/OPorts- Timers/Counters -Interrupts-Instructions and addressing modes.

UNIT IV MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9

Simple Programming: Loop structure with counting & Indexing – Look up table - key board and display interface -Control of servo motor- stepper motor control- Temperature control system - Washing Machine Control.

UNIT V REAL TIME APPLICATIONS 9

Pulse Generator, Frequency measurement Interface -Introduction to Arduino, usage of IDE, Real-time applications for Microcontroller in IoT Environments: Automation System and code based control system

Total Periods: 45 hours

OUTCOMES:

- 1 Interpret the architecture of the 8085 microprocessor and demonstrate proficiency in its instruction set, addressing modes, and programming techniques
- Understand the concept of Peripheral Interfacing with the Configuration IC's ,ADCs DACs and communication interface
- Demonstrate comprehensive knowledge of the 8051 microcontroller's architecture, memory organization, interrupts, and instructions.

- Build simple program development with loop structures and counting techniques, and proficiently design applications with the 8051 microcontroller
- Construct a pulse generator using Arduino and implement a frequency measurement interface to measure external signals.
- Apply microcontrollers in real-time applications within the Internet of Things (IoT) environment

TEXT BOOKS:

1. Sunil Mathur&Jeebananda Panda, "Microprocessor and Microcontrollers", PHILearning Pvt. Ltd, 2016.
2. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Mohammad Ali Mazidi, Janice GillispieMazidi, " The 8051 Microcontroller and Embedded Systems ", Pearson education, 2nd Edition, 2014.

REFERENCES

1. ArshdeepBahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015
2. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture,Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
3. Ajay V.Deshmukh, 'Microcontroller Theory &Applications', McGraw Hill Edu,2016

EE1504 DIGITAL SIGNAL PROCESSING

L	T	P	C
2	2	0	3

PREREQUEST SUBJECTS:

- Transforms and partial differential equations

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- Continuous Time Signals and systems & their mathematical representation.
- Discrete time Signals and systems.
- Transformation techniques & their computation.
- Discrete Time system analysis.
- Filters and their design for digital implementation.

UNIT I CONTINUOUS TIME SIGNALS AND SYSTEMS 12

Continuous time signals – Representation of signals – Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential signals, Mathematical operations on the signals – Classification of continuous time signals – Continuous time systems – Classification of system – Convolution.

UNIT II DISCRETE TIME SIGNALS AND SYSTEMS 12

Discrete and Digital Signals – Mathematical representation of signals Classification and operations on DT signals, Classifications of discrete time systems- Continuous, discrete, linear, causal, stability, dynamic, recursive, Time variance. Sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect, Antialiasing filter.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 12

Discrete Fourier Transform- properties, magnitude and phase representation -Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – ButterflyStructure.

UNIT IV DISCRETE TIME SYSTEM ANALYSIS 12

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response –Convolution .

UNIT V DESIGN OF DIGITAL FILTERS 12

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.

Total Periods: 60 hours

OUTCOMES:

- Exemplify the mathematical representation of Continuous Time Signals and systems.
- Interpret the mathematical representation of Discrete Time Signals and systems
- Compute the Transformation techniques**.**
- Solve the Discrete Time system
- Implement the types of filter & their design
- Compare the signal processing methods

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI. 2021.
2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw HillEdu, 2013.
3. Lonnie C.Ludeman ,"Fundamentals of Digital Signal Processing",Wiley,2013

REFERENCE:

1.Nagoorkani A, "Signals and Systems" McGraw Hill Edu, 2010.
2. Poorna Chandra S, Sasikala. B ,Digital Signal Processing, Vijay Nicole/TMH,2013.
3. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning,2014.
4. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford UniversityPress, 2010 3. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing withMat Lab', CRC Press, 2009.
5. DimitrisG.Manolakis, Vinay K. Ingle, applied Digital Signal Processing,Cambridge,2012

EE1505 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

L	T	P	C
0	0	4	2

PREREQUEST SUBJECTS:

- Digital Logic Circuits Lab

COURSE OBJECTIVES:

- To provide training on programming of microprocessors and microcontrollers and understand the interface requirements.
- To simulate various microprocessors and microcontrollers using KEIL or Equivalent simulator.

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) Hex / ASCII / BCD code conversions.
3 Interface Experiments: with 8085- 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:
Conditional jumps , looping and 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. Generating pulse for AC voltage signal.
11.Interfacing of Temperature sensor
12. Development of programs for IoT applications

Total Periods: 60 hours

OUTCOMES:

- Illustrate the assembly language programming.
- Design circuits for various applications using microcontroller
- Apply the concepts of microcontroller on real- time applications
- Evaluate the results of 8086 and 8051 programs
- Use standard test and measurement equipment to evaluate analog/digital interfaces.
- Analyze abstract problems and apply a combination of hardware and software to address the problem

IT1302 OBJECT ORIENTED PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, arraylist, exception handling and file processing.
- To develop applications using generic programming and event handling.

LIST OF EXPERIMENTS:

1. Develop a java application using classes & objects
2. Develop a java application using packages.
3. Develop a java application using Inheritance.
4. Design a Java interface for ADT Stack. Provide necessary exception handling.
5. Write a program to perform string operations using Array List. Write functions for the following
   a. Append – add at end
   b. Insert – add at particular index
   c. Search
   d. List all string starts with given letter.
6. Write a Java Program to create an abstract class named and demonstrate polymorphism.
7. Write a Java program to implement user defined exception handling.
8. Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes.
9. Write a java program that implements multi-threading.
10. Write a java program to create generic function.
11. Design a calculator using event-driven programming paradigm of Java with the following options.
    a) Decimal manipulations
    b) Scientific manipulations
12. Develop a simple student database management system using event-driven and concurrent programming paradigms of Java. Use JDBC to connect a back-end database.

Total Periods: 60 hours

OUTCOMES:

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

- Develop and implement Java programs for simple applications that make use of classes, packages and interfaces.
- Develop and implement Java Programs with Array list.
- Develop and implement Java programs with exception handling and multithreading.
- Design applications using file processing, generic programming and event handling.
- Ability to solve real world problems using features of Object Oriented Programming
- Ability to write, debug and document well-structured Java Applications.

HS1501 PROFESSIONAL COMMUNICATION LABORATORY

L	T	P	C
0	0	2	1

LIST OF EXPERIMENTS:

SOFT SKILLS

Hard Skills & Soft Skills
Career Skills

Professional Grooming with Values

Emotional Intelligence

GENERAL AWARENESS

General Awareness of Current Affairs

PRESENTATION SKILLS

Oral Presentations

Presenting the Visuals/Graphics Effectively

Mini Presentations

Group Discussions

Job Interviews - Tips and Practice for Attending Interviews

WORK ETHICS

Group and Teamwork

Multitasking

Stress Management

Respecting Social Protocols

Developing a Long-term Career plans

Making career changes

Total Periods: 30 hours

SEMESTER-VI

EE1601 SOLID STATE DRIVES **L T P C**
3 0 0 3

PREREQUISITE :

- Electron Devices and circuits

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- Steady state operation and transient dynamics of a motor load system.
- Analyze the operation of the converter/chopper fed dc drive, both qualitatively and quantitatively.
- Operation and performance of AC motor drives.
- Analyze and design the current and speed controllers for a closed loop solid state DC motor drive and study of digital control drives.

UNIT I DRIVE CHARACTERISTICS 9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Thermal model of motor for heating and cooling-Classes of duty cycle- Determination of motor rating - Selection of motor.

UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 9

Steady state analysis of the single and three phase converter fed separately excited DC motor drive–continuous conduction – Time ratio and current limit control – 4 quadrant operation of converter /chopper fed drive-Applications.

UNIT III INDUCTION MOTOR DRIVES 9

Stator voltage control – V/f control– Rotor Resistance control-qualitative treatment of slip power recovery drives-closed loop control - AC chopper fed induction motor drives- Voltage source inverter- current source inverter - Z – source inverter fed induction motor drive – Cyclo-converter fed induction motor drives-Applications.

UNIT IV SYNCHRONOUS MOTOR DRIVES 9

V/f control and self-control of synchronous motor: Margin angle control and power factor control-Three phase voltage/current source fed synchronous motor- Applications.

UNIT V DESIGN OF CONTROLLERS FOR DRIVES AND DIGITAL CONTROL OF DRIVES AND ITS APPLICATIONS 9

Design of controllers: current controller and speed controller -Digital technique in speed control-Advantages and Limitations - Microprocessor based control of drives-Solar powered pump drives-Selection of drives and control schemes for paper mills-Selection of drives for lifts and cranes.

Total Periods: 45 hours

OUTCOMES:

- Explain an appropriate power electronic converter for solid-state DC and AC drives
- Instantiate a suitable drive for the given application.
- Illustrate the steady-state operation and transient dynamics of a motor load system.
- Analyze the operation of the phase-controlled converter and DC choppers-fed DC drives.
- Analyze the operation of the phase-controlled converter and control strategies of AC voltage controllerfed AC drives.
- Analyze and design the current and speed controllers for a closed-loop solid state DC drive.

TEXT BOOKS:

1.Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, Reprint 2020.
2. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2015.
3. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson, 2001.

REFERENCES:

1. Vedam Subramanyam, " Electric Drives Concepts and Applications ", 2e, McGraw Hill, 2016
2. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis Group), 2013.
3. John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier2012.
4. Theodore Wildi, " Electrical Machines ,Drives and power systems ,6th edition, Pearson Education ,2015
5. N.K. De., P.K. SEN" Electric drives" PHI, 2012.

EE1602 PROTECTION AND SWITCHGEAR

L	T	P	C
3	0	0	3

PREREQUISITE :

- Electrical Machines –I
- Electrical Machines-II

COURSE OBJECTIVES:

- To educate the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
- To introduce the characteristics and functions of relays and protection schemes.
- To impart knowledge on apparatus protection
- To introduce static and numerical relays
- To impart knowledge on functioning of circuit breakers

UNIT I PROTECTION SCHEMES 9

Principles and need for protective schemes –nature and causes of faults –types of faults –fault current calculation using symmetrical components –Methods of Neutral grounding –Zones of protection and essential qualities of protection –Protection schemes

UNIT II RELAYS 9

Operating principles of relays -the Universal relay –Torque equation –R-X diagram –Electromagnetic Relays – Overcurrent, Directional, Distance, Differential, Negative sequence and Under frequency relays.Digital protection relays, Earth leakage Relay

UNIT III STATIC RELAYS AND NUMERICAL PROTECTION 9

Static relays –Phase, Amplitude Comparators –Synthesis of various relays using Static comparators –Block diagram of Numerical relays –Overcurrent protection, transformer differential protection

UNIT IV APPARATUS PROTECTION 9

Current transformers and Potential transformers and their applications in protection schemes, Protection of transformer, generator, motor, busbars and transmission line, Three stepped distance protection**.**

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 Periods: 45 hours

OUTCOMES:

- Discus the causes and effects of faults in power systems, Gain concept of neutral grounding and protection
- Explain the operation of electromagnetic relays and draw the characteristics curve.
- Understand Principle of operation of over current, directional, differential and distance relays, cooperation of static and numerical relays
- Device protection methods for alternators, transformers, bus-bars and transmission line and select the suitable protection schemes
- Examine RRRV, critical resistance value Make out the application of different types of circuits breakers in power systems
- Model and analyze any of the Circuit break operation and fault analyze using Matlab

TEXT BOOKS:

1. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, 2008.
2. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., First Edition 2011.
3. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, 'A Text Book on Power System Engineering', DhanpatRai& Co.,1998.

REFERENCES:

1.BadriRam ,B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age International Pvt 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. RavindraP.Singh, ' Switchgear and Power System Protection', PHI Learning Private Ltd., New Delhi,2009.
5. BhaveshBhalja, R.P. Maheshwari, Nilesh G. Chotani,'Protection and Switch gear'Oxford University Press, 2011.

EE1603 POWER SYSTEM OPERATION AND CONTROL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To have an overview of power system operation and control,
- To model power-frequency dynamics and to design power-frequency controller.
- To model reactive power -voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
- To study the economic operation of power system.
- To teach about SCADA and its application for real time operation and control of power systems

UNIT I PRELIMINARIES ON POWER SYSTEM OPERATION AND CONTROL 9

Power scenario in Indian grid – National and Regional load dispatching centers – requirements of good power system - necessity of voltage and frequency regulation – real power vs frequency and reactive power vs voltage control loops - system load variation, load curves and load-duration curve-load factor-diversity factor and basic concepts of load dispatching - load forecasting - plant level and system level controls- sped load characteristics – regulation of two generators in parallel.

UNIT II REAL POWER – FREQUENCY CONTROL 9

Basics of speed governing mechanism and modelling - Load Frequency Control (LFC) of single area system-static and dynamic analysis of uncontrolled and controlled cases – LFC of two area system – tie line modeling – block diagram representation of two area system – static and dynamic analysis – tie line with frequency bias control – state variability model

UNIT III REACTIVEPOWER–VOLTAGECONTROL 9

Generation and absorption of reactive power – basics of reactive power control – Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR lop – static and dynamic analysis – stability compensation – voltage drop in transmission line – methods of reactive power injection – tap changing transformer, SVC (TCR + TSC) and STATCOM for 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 loses (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 problem

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 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 - weighted least square estimation - various operating states - state transition diagram.

Total Periods: 45 hours

OUTCOMES:

- Explain the structure and functions of the Indian power grid, analyse voltage and frequency regulation, and interpret system load variations, load dispatching, and forecasting
- Illustrate the Load Frequency Control (LFC) of single and two area systems, including static and dynamic analysis, tie line modelling, and state variability for frequency bias control
- Compute the generation and absorption of reactive power, and the operation of Automatic Voltage Regulators (AVR) and methods of reactive power injection.
- Compute the generation and absorption of reactive power, and the operation of Automatic Voltage Regulators (AVR) and methods of reactive power injection.
- Describe the need for computer control, energy control centers, and their functions, and understand SCADA, EMS, and state estimation problems..
- Examine the SCADA systems for real-time operation, including monitoring, data acquisition, and control of power systems

TEXT BOOKS

1. Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2003.

2. V.Ramanathan, P.S.Manoharan, 'Power System Operation and Control' Third Edition, 2015, Charulatha Publications, Chennai.

3. Chakrabarti & Halder, "Power System Analysis: Operation and Control", Prentice Hall of India, 2004 Edition

REFERENCE BOOKS

1. P.Kundur, 'Power System Stability and Control' MC Craw Hill Publisher, USA, 1994.

2. Olle.I.Elgerd, 'Electric Energy Systems theory an introduction' Tata McGraw Hill Publishing Company Ltd. New Delhi, Second Edition 2003.

3. Leon K. Kirchmayer, 'Economic operation of power systems' Wiley, 2008.

4. D.P. Kothari and I.J. Nagrath, 'Modern Power System Analysis', Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.

EE1604 POWER ELECTRONICS AND DRIVES LABORATORY

L	T	P	C
0	0	2	1

PREREQUEST SUBJECTS:

- Electron Devices and Circuits Lab

COURSE OBJECTIVES:

To impart knowledge about the following topics:

- To know the triggering of SCR
- To draw the static characterization of the semiconductor devices
- To understand the conversion of AC to DC supply and speed control of DC motor
- To understand the conversion of DC to AC supply and speed control of AC motor
- To acquire knowledge on DC-DC DC converters

LIST OF EXPERIMENTS:

1. Characteristics of SCR and TRIAC
2. Characteristics of MOSFET and IGBT
3. Characteristics of GTO & IGCT
4. Gate Pulse Generation using R, RC and UJT.
5. AC to DC half controlled converter
6. AC to DC fully controlled Converter fed DC motor
7. Step down and step up MOSFET based choppers
8. IGBT based single phase PWM inverter
9. IGBT based three phase PWM inverter fed AC motor
10. Generation of PWM.
11. AC Voltage controller
12. Simulation of PE circuits(1Φ&3Φsemiconverter,1Φ&3Φfullconverter,dc-dc converters, ac voltage controllers).
13. Characteristics of PMBLDC motor

Total Periods: 30 hours

OUTCOMES:

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

- Understand the characteristics of power electronic devices
- Understand the triggering circuits of SCR
- Analyze about AC to DC converter circuits
- Aanalyze about DC to AC circuits.
- Analyze about AC to AC converters
- Develop skills in simulating power electronics circuits using MATLAB software.

EE1605 POWER SYSTEM SIMULATION LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To provide better understanding of power system analysis through digital simulation

LIST OF EXPERIMENTS:

1. Computation of Transmission Line Parameters and Modeling of Transmission Lines.
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 fault analysis.
6. Unsymmetrical fault analysis.
7. Transient stability analysis of SMIB System.
8. Economic Dispatch in Power Systems.
9. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems.
10. Electromagnetic Transients in Power Systems: Transmission Line Energization.
11. Line-Cable Parameter Calculation.
12. State estimation: Weighted least square estimation.

Total Periods: 30 hours

OUTCOMES:

- Analyze Transmission Line Parameters and Model Transmission Lines
- Construct and Analyze Bus Admittance and Impedance Matrices.
- Perform Power Flow Analysis Using Iterative Methods using Gauss-Seidel and Newton-Raphson.
- Conduct symmetrical and unsymmetrical Fault Analysis in Power Systems
- Evaluate Transient Stability and Economic Dispatch in Power Systems
- Apply Advanced Techniques in Power System Analysis

EE1606 TECHNICAL SEMINAR **L T P C**
0 0 2 1

OBJECTIVES:

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

METHOD OF EVALUATION:

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

Total Periods: 30 hours

SEMESTER-VII

EE1701 EMBEDDED SYSTEMS L T P C
3 0 0 3

PREREQUEST SUBJECTS:

- Micro Processor and Micro Controllers

COURSE OBJECTIVES:

- To impart knowledge on Building Blocks of Embedded System
- To study about Embedded Networking Development Strategies
- To acquire the knowledge on Embedded Firmware Development Environment
- To understand the basics of Real Time Operating System
- To analyze various Embedded System Processor and its Application

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 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) – need for device drivers.

UNIT III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 9

Embedded Product Development Life Cycle - objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

UNIT IV RTOS BASED EMBEDDED 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, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance.

UNIT V EMBEDDED PROCESSOR AND ITS APPLICATIONS 9

ARM - Board details, Raspberry Pi - Interfaces - Python Programming – Communications Programming.
Case Study of Washing Machine – Electric Vehicle Application- Smart card System Application - ATM machine – Digital camera

Total Periods: 45 hours

COURSE OUTCOMES:

- Ability to understand the knowledge on Building Blocks of Embedded System
- Ability to study about Embedded Networking Development Strategies
- Ability to acquire the knowledge on Embedded Firmware Development Environment
- Ability to understand the basics of Real Time Operating System
- Ability to analyze various Embedded System Processor and its Application

- Ability to study about Embedded System Processor in an Automation application.

TEXT BOOKS:

1. Peckol, “Embedded system Design”, John Wiley & Sons,2010
2. Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2013
3. Shibu. K.V, “Introduction to Embedded Systems”, 2e, Mc graw Hill, 2017.

REFERENCES:

1. Raj Kamal, ‘Embedded System-Architecture, Programming, Design’, Mc Graw Hill, 2013.
2. C.R.Sarma, “Embedded Systems Engineering”, University Press (India) Pvt. Ltd, 2013.
3. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.
4. Han-Way Huang, “Embedded system Design Using C8051”, Cengage Learning, 2009.
5. Rajib Mall “Real-Time systems Theory and Practice” Pearson Education, 2007.

EE1702 RENEWABLE ENERGY SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- Awareness about renewable Energy Sources and technologies.
- Adequate inputs on a variety of issues in harnessing renewable Energy.
- Recognize current and possible future role of renewable energy sources.

UNIT I RENEWABLE ENERGY (RE) SOURCES 9

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

UNIT II WIND ENERGY 9

Power in the Wind – Types of Wind Power Plants(WPPs) – Components of WPPs-Working of WPPS - Siting of WPPs-Grid integration issues of WPPs.

UNIT III SOLAR PV AND THERMAL SYSTEMS 9

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants - Solar Photovoltaic systems : Basic Principle of SPV conversion – 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, Design of solar PV system, Applications.

UNIT IV BIOMASS ENERGY 9

Introduction-Bio mass resources –Energy from Bio mass : conversion processes-Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.

UNIT V OTHER ENERGY SOURCES 9

Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves ,wave power devices. Ocean Thermal Energy Conversion (OTEC) - Hydrogen Production and Storage- Fuel cell: Principle of working- various types - construction and applications. Energy Storage System - Hybrid Energy Systems.

Total Periods: 45 hours

COURSE OUTCOMES:

- Comprehend of the technology, constraints in renewable energy sources.
- Identify the adequate input on a variety of issues in harnessing of wind energy
- Summarize the construction of solar energy system and its types.
- Acquire the basics of hydropower, geothermal, and biomass energy
- Summarize the various renewable Energy Sources and technologies and their applications
- Recognize the current and possible future role of renewable energy sources

TEXTBOOKS:

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi, second edition, 2017.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, third edition 2022.
3. Scott Grinnell, "Renewable Energy & Sustainable Design", CENGAGE Learning, USA, 2016.

REFERENCE:

1. A.K. Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011
2. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015.
3. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
4. Bradley A. Striebig, Adebayo A.Ogundipe and Maria Papadakis," Engineering Applications in Sustainable Design and Development", Cengage Learning India Private Limited, Delhi, 2016.
5. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
6. Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education ,2015.

EE1703 RENEWABLE ENERGY SYSTEMS LABORATORY **L T P C**
0 0 2 1

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- To train the students in Renewable Energy Sources and technologies.
- To provide adequate inputs on a variety of issues in harnessing Renewable Energy.
- To recognize current and possible future role of Renewable 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 and 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. Study on Performance Assessment of 100W Fuel Cell
11. Simulation study on Intelligent Controllers for Hybrid Systems.

Total Periods: 30hours

OUTCOMES:

- Analyze and simulate the performance of Solar PV Energy Systems.
- Evaluate the VI-Characteristics, Efficiency, and shadowing effects of a 1kWp Solar PV System.
- Assess the performance of Grid-connected and Standalone Solar Power Systems.
- Perform simulation studies and assess the performance of Wind Energy Generators.
- Conduct performance assessment and simulation of Hybrid (Solar-Wind) Power Systems.
- Explore and simulate intelligent controllers for hybrid renewable energy systems.

EE1704 PROJECT WORK/PHASE-I **L T P C**
0 0 8 4

COURSE OBJECTIVES:

- To develop their own innovative prototype of ideas.
- To train the students in preparing mini project reports and examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department and prepares a comprehensive project work/phase-I report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of four reviews. The review committee may be constituted by the Head of the Department. A project work /phase-I report is required at the end of the semester. The project work /phase-I is evaluated based on oral presentation and the project work /phase-I report jointly by external and internal examiners constituted by the Head of the Department.

Total Periods: 60 hours

COURSE OUTCOMES:

- Model and solve real world problems by applying knowledge across domains
- Develop products, processes or technologies for sustainable and socially relevant applications
- Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks
- Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms.
- Identify technology/research gaps and propose innovative/creative solutions
- Organize and communicate technical and scientific findings effectively in written and oral forms.

SEMESTER-VIII

EE1801 PROJECT WORK/PHASE-II L T P C
0 0 12 6

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 in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. 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.

Total Periods:180 hours

OUTCOMES:

- Solve real-life problems related to industry and identify topical research areas.
- Apply the guiding precepts of Energy Systems / Power Electronics and Power Systems
- Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks.
- Apply relevant theoretical and practical tools for problem solution.
- Prepare technical papers for publication in journals or conferences to enrich the research findings.
- Organize and communicate technical and scientific findings effectively in written and oral forms.

PROFESSIONAL ELECTIVE-I

EE1611	**ADVANCED CONTROL SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide knowledge on design state feedback control and state observer.
- To provide knowledge in sampled data analysis.
- To give basic knowledge in phase plane analysis.
- To study the stability analysis of both linear and no linear systems.
- To study the design of optimal control..

UNIT I 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 II 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 III NON LINEAR SYSTEMS **9**

Introduction-A class of Non Linear Systems : Separable Non linearities, Filtered Nonlinear system – The describing function Analysis, Describing functions of common Nonlinearities, Stability analysis by the describing function method, Fundamental types of Phase portraits , System analysis of the Phase plane.

UNIT IV STABILITY ANALYSIS **9**

Introduction, Basic Concepts, Stability definitions, Stability Theorems, Lyapunov's function for Nonlinear systems, Lyapunov's function for linear systems -Krasovski's theorem on Lyapunov function

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**.**

COURSE OUTCOMES:

- Able to design state feedback controller and state observer.
- Able to understand and analyse the sampled data systems.
- Able to understand and analyse nonlinear systems using phase plane method.
- Able to understand and the stability analysis of both linear and nonlinear systems.
- Able to understand and design the optimal control.
- Ability to apply advanced control strategies to practical engineering problems.

Total Periods: 45 hours

TEXT BOOKS:

1. M.Gopal, "Digital Control and State Variable Methods", 4th edition, McGraw Hill India, 2017
2. K. Ogata, 'Modern Control Engineering', 5th Edition, Pearson, 2015.
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 20**16.**

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

EE1612 MODERN POWER CONVERTERS

L	T	P	C
3	0	0	3

Prerequisite : Power Electronics

COURSE OBJECTIVES:

To impart knowledge about the following topics:

- To Suggest converter for SMPS
- To gain knowledge on synchronous rectification and matrix Converter
- To analyze different multilevel inverters
- To know the operation of Soft switched converters
-

UNIT I SWITCHED MODE POWER SUPPLIES (SMPS) 9

Introduction - Linear power supply - Switched mode dc power supplies – without isolation , buck, boost , buck-boost converters ,Sepic Converter– with isolation, Flyback converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter - single and multiple outputs.

UNIT II AC-DC CONVERTERS 9

Switched mode AC-DC converters.synchronous rectification - single and three phase topologies - switching techniques - high input power factor . reduced input current harmonic distortion. improved efficiency. with and without input-output isolation. performance indices design examples

UNIT III DC-AC CONVERTERS 9

Multi-level Inversion - concept, classification of multilevel inverters, Principle of operation, main features and analysis of Diode clamped, Flying capacitor and cascaded multilevel inverters; Introduction to carrier based PWM technique for multi-level inverters

UNIT IV AC-AC CONVERTERS WITH AND WITHOUT DC LINK 9

Matrix converters. Basic topology of matrix converter; Commutation – current path; Modulation techniques - scalar modulation, indirect modulation; Matrix converter as only AC-DC converter; AC-AC converter with DC link - topologies and operation - with and without resonance link - converter with dc link converter; Performance comparison with matrix converter with DC link converters.

UNIT V SOFT-SWITCHING POWER CONVERTERS 9

Resonant Converters Introduction , Need of resonant converters, Classification of resonant converters, Load resonant converters, Resonant switch converters, zero voltage switching dc-dc converters, zero current switching dc-dc converters; Performance comparison of hard switched and soft switched converters.

Total Periods: 45 hours

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

- Ability to suggest converters for SMPS

- Analyze the operation of synchronous rectification
- Apply the concept of various types of multilevel inverters.
- Understand the importance of matrix converters.
- Know the operation of different Resonant Converters

TEXT BOOKS:

1. Power Electronics Handbook, 4th edition M.H.Rashid, Elsevier Publication, 2018.
2. Andrzej M. Trzynadlowski, " Introduction To Modern Power Electronics", John Wiley & Sons, 2016.
3. Control in Power Electronics- Selected Problem, Marian P.Kazmierkowski, R.Krishnan and FredeBlaabjerg, Academic Press (Elsevier Science), 2002.
4. Advanced DC/DC Converters, Fang Lin Luo and Fang Lin Luo, CRC Press, NewYork, 2004.

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1. Power Electronic Circuits, IssaBatarseh, John Wiley and Sons, Inc.2004
2. Krein Philip T, Elements of Power Electronics, Oxford University press, 2008
3. L. Umanand, Power Electronics: Essentials & Applications, John Wiley and Sons, 2009
4. V.Ramanarayanan, “Course Material on Switched Mode Power Conversion” IISC, Banglore, 2007
5. Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics converters, Applications and design Third Edition- John Wiley and Sons- 2006
6. Power Electronics for Modern Wind Turbines, FredeBlaabjerg and Zhe Chen, Morgan & Claypool Publishers series, United States of America, 2006.

EE1613 SPECIAL ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on Construction, principle of operation and performance of synchronous reluctance motors.
- To impart knowledge on the Construction, principle of operation, control and performance of stepping motors.
- To impart knowledge on the Construction, principle of operation, control and performance of switched reluctance motors.
- To impart knowledge on the Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
- To impart knowledge on the Construction, principle of operation and performance of permanent magnet synchronous motors.
- Construction, principle of operation and performance of other special Machines.

UNIT I STEPPER MOTORS **9**

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi-stack configurations – Torque equations – Modes of excitation – Characteristics – Drive circuits – Microprocessor control of stepper motors – Closed loop control-Concept of lead angle– Applications..

UNIT II SYNCHRONOUS RELUCTANCE MOTORS **9**

Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance Motors – Voltage and Torque Equations - Phasor diagram - performance characteristics – Applications

UNIT III SWITCHED RELUCTANCE MOTORS (SRM) **9**

Constructional features – Rotary and Linear SRM - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensor less operation – Characteristics and Closed loop control– Applications.

UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS **9**

Permanent Magnet materials – Minor hysteresis loop and recoil line-Magnetic Characteristics – Permeance coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Commutation - Power Converter Circuits and their controllers – Motor characteristics and control– Applications.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) **9**

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature MMF – Synchronous Reactance – Sine wave motor with practical windings - Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements– Applications- Introduction to Axial based motor.

Total Periods: 45 hours

COURSE OUTCOMES:

- Ability to analyze and design controllers for special Electrical Machines.
- Ability to acquire the knowledge on construction and operation of stepper motor.
- Ability to acquire the knowledge on construction and operation of stepper switched reluctance motors.
- Ability to construction, principle of operation, switched reluctance motors.

- Ability to acquire the knowledge on construction and operation of permanent magnet brushless D.C. motors.
- Ability to acquire the knowledge on construction and operation of permanent magnet synchronous motors.
- Ability to select a special Machine for a particular application.

TEXT BOOKS:

1. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2014.
2. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.
3. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1995.

REFERENCES:

1. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus London, 1982.
3. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.

EE1614 DESIGN OF ELECTRICAL APPARATUS

L	T	P	C
3	0	0	3

Prerequisite:
Basic knowledge on construction and working principles of Electrical machines.

OBJECTIVES: To impart knowledge about the following topics:

- Magnetic circuit parameters and basics of design considerations for rotating and static electrical machines
- Core, yoke, windings and cooling systems of transformers. The importance of computer aided design method
- Design of Armature and field systems for D.C. machines and the importance of computer aided design method
- Design of stator and rotor of induction machines and synchronous machines and the importance of computer aided design method.
- Design of stator and rotor of induction machines and synchronous machines and the importance of computer aided design method.

UNIT I DESIGN OF FIELD SYSTEM AND ARMATURE 9

Major considerations in Electrical Machine Design – Materials for Electrical apparatus –
Design of Magnetic circuits – Magnetising current – Flux leakage – Leakage in Armature. Design of lap winding and wave winding

UNIT II DESIGN OF TRANSFORMERS 9

Construction - KVA output for single and three phase transformers – Overall dimensions –
design of yoke, core and winding for core and shell type transformers – Estimation of No load current – Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers. Computer program: Complete Design of single phase core transformer

UNIT III DESIGN OF DC MACHINES 9

Construction - Output Equations – Main Dimensions – Choice of specific loadings –
Selection of number of poles – Design of Armature – Design of commutator and brushes – Design of field - Computer program: Design of Armature main dimensions

UNIT IV DESIGN OF INDUCTION MOTORS 9

Construction - Output equation of Induction motor – Main dimensions – choice of specific loadings – Design of squirrel cage rotor and wound rotor –Magnetic leakage calculations –Operating characteristics : Magnetizing current - Short circuit current –Computer program: Design of slip-ring rotor

UNIT V DESIGN OF SYNCHRONOUS MACHINES 9

Output equations – choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field MMF – Design of field winding – Design of turbo alternators -Computer program: Design of Stator main dimensions-Brushless DC Machines

Total Periods: 45 hours

OUTCOMES:

- Ability to understand basics of design considerations for rotating and static electrical machines
- Ability to design single and three phase transformer.
- Ability to design armature and field of DC machines.
- Ability to design stator and rotor of induction motor.
- Ability to design and analyze synchronous machines.

TEXT BOOKS:

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai& Sons, New **Delhi, January 2016.**
2. M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Ltd,2011.
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes',Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2009.

REFERENCES

1. A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint 2011.
2. 'Electrical Machine Design', Balbir Singh, Vikas Publishing House Private Limited, 1982.
3. V Rajini, V.S Nagarajan, 'Electrical Machine Design', Pearson, 2017.
4. K.M.Vishnumurthy 'Computer aided design of electrical machines' B S Publications,2008

EE1615 CONTROL OF ELECTRICAL DRIVES

L	T	P	C
3	0	0	3

OBJECTIVES:

To impart knowledge about the following topics:

- To analyze and design the Digital control for drives.
- To study and analyze the SRM and BLDC motor drive control.
- To study and understand the Synchronous motor drive control.
- To study and analyze the Induction motor drive control.
- To understand the DC drive control.

UNIT I CONTROL OF DC DRIVES 9

Losses in electrical drive system, Energy efficient operation of drives, block diagram/ transfer function of self, separately excited DC motors -closed loop control-speed control- current control - constant torque/power operation - P, PI and PID controllers–response comparison.

UNIT II CONTROL OF INDUCTION MOTOR DRIVE 9

VSI and CSI fed induction motor drives-principles of V/f control-closed loop variable frequency PWM inverter with dynamic braking- static Scherbius drives- power factor considerations– modified Kramer drives-principle of vector control- implementation-block diagram, Design of closed loop operation of V/f control of Induction motor drive systems.

UNIT III CONTROL OF SYNCHRONOUS MOTOR DRIVES 9

Open loop VSI fed drive and its characteristics–Self control–Torque control –Torque angle 114 control –Power factor control–Brushless excitation systems—Field oriented control – Design of closed loop operation of Self control of Synchronous motor drive systems.

UNIT IV CONTROL OF SRM AND BLDC MOTOR DRIVES 9

Construction and Working Principle of SRM and BLDC Motor - SRM construction - Principle of operation - SRM drive design factors-Torque controlled SRM- Block diagram of Instantaneous Torque control using current controllers and flux controllers. Construction and Principle of operation of BLDC Machine -Sensing and logic switching scheme,-Sinusoidal and trapezoidal type of Brushless dc motors – Block diagram of current controlled Brushless dc motor drive.

UNIT V DIGITAL CONTROL OF DC DRIVE 9

Phase Locked Loop and micro-computer control of DC drives–Program flow chart for constant constant torque and constant horse power operations Speed detection and current sensing circuits and feedback elements.

Total Periods: 45 hours

COURSE OUTCOMES:

- Ability to understand the analyze and design the Digital control for drives.

- Ability to understand the analyze of SRM and BLDC motor drive control.
- Ability to understand the Synchronous motor drive control.
- Ability to understand the analyze of Induction motor drive control.
- Ability to understand the DC drive control.

TEXT BOOKS:

1. Dubey, G.K, Power semiconductor controlled devices, Prentice Hall International New jersey, 1989.
2. R.Krishnan,, Electric Motor Drives - Modeling, Analysis and ControlPrentice- Hall of India Pvt. Ltd., New Delhi, 2003.
3. Murphy, J.M.D, Turnbull F.G, Thyristor control of AC motors,., Pergamon press, Oxford, 1988.

REFERENCES

1. Bin Wu, High-Power Converters and AC Drives, Wiley-IEEE Press
2. Buxbaum, A.Schierau, and K.Staughen, A design of control systems for DC drives, Springer-Verlag, Berlin, 1990.
3. Bimal K. Bose, Modern Power Electronics and AC Drives, Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003.
4. R. Krishnan, Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications, CRC press, 2001.
5. Werner Leonhard, Control of Electrical Drives, 3rd Edition, Springer, Sept., 2001.
6. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC press, 2001.

EE1616 SMPS & UPS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To impart knowledge about the following topics:

- Modern power electronic converters and its applications in electric power utility.
- Resonant converters and UPS

UNIT I DC-DC CONVERTERS **9**

Principles of step down and step up converters – Analysis and state space modeling of Buck, Boost, Buck-Boost and Cuk converters.

UNIT II SWITCHED MODE POWER CONVERTERS **9**

Analysis and state space modeling of fly back, Forward, Push pull, Luo, Half bridge and full bridge converters-control circuits and PWM techniques- Case study on Design of 1W SMPS.

UNIT III RESONANT CONVERTERS **9**

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS , Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters-Voltage control.

UNIT IV DC-AC CONVERTERS **9**

Single phase and three phase inverters, control using various (sine PWM, SVPWM and PSPWM) techniques, various harmonic elimination techniques- Multilevel inverters- Concepts - Types: Diode clamped- Flying capacitor- Cascaded types- Applications.

UNIT V POWER CONDITIONERS, UPS & FILTERS **9**

Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications – Selection of capacitors- Case study on Design of 1KVA UPS .

Total periods:45 Hours

COURSE OUTCOMES:

- Ability to analyze the state space model for DC – DC converters
- Ability to acquire knowledge on switched mode power converters.
- Ability to understand the importance of Resonant Converters.
- Ability to analyze the PWM techniques for DC-AC converters
- Ability to acquire knowledge on modern power electronic converters and its applications in electric power utility.
- Ability to acquire knowledge on filters and UPS

TEXT BOOKS:

1. Rashid M.H., 'Power Electronics-Circuits, Devices and Applications', Prentice Hall India, New Delhi, 4/E International Edition 2018.
2. KjeldThorborg, "Power Electronics – In theory and Practice", Overseas Press, First Indian Edition 2005.
3. Simon Ang, Alejandro Oliva," Power-Switching Converters", Third Edition, CRC Press, 2010.

REFERENCES

1. Philip T Krein, " Elements of Power Electronics", Oxford University Press
2. Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics converters, Applications and design- Third Edition- John Wiley and Sons- 2006
3. M.H. Rashid – Power Electronics circuits, devices and applications- third edition Prentice Hall of India New Delhi, 2007.
4. Erickson, Robert W, "Fundamentals of Power Electronics", Springer, second edition, 2010.

EE1621 ELECTRIC AND HYBRID VEHICLES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES: To impart knowledge on the following Topics

- To understand the basics and architecture of Electric and Hybrid vehicles
- To learn various controls of AC and DC drives used for EV
- To analyze and model energy storage systems
- To configure Electric and Hybrid vehicles
- To understand the various concepts of hybrid vehicle charging stations

UNIT I -ELECTRIC VEHICLE **9**

History of Electric and hybrid Vehicles - 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 .

UNIT II ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS **9**

Architecture of EV's and HEV's – Plug-n Hybrid Electric Vehicles (PHEV) - Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT III CONTROL OF DC AND AC DRIVES **9**

DC/DC chopper based four quadrant operations of DC drives – Inverter based V/f Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor based vector control operation – Switched reluctance motor (SRM) drives

UNIT IV ENERGY STORAGE SYSTEM **9**

Battery : Basics – Different Types, Battery Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge - Battery modeling
Alternate sources: Fuel cells, Ultra capacitors, Fly wheels

UNIT V HYBRID VEHICLE **9**

Types – series, parallel and series-parallel combination – Design of series hybrid and parallel hybrid train design. Introduction to Hybrid vehicle charging stations.

Total Periods: 45 hours

COURSE OUTCOMES:

- Understand the architecture and vehicle dynamics of electric and hybrid vehicles
- Analyze and model the power management systems for electric and hybrid vehicles
- Devise power electronics based control strategies for electric and hybrid vehicles
- Analyze and design various components of electric and hybrid vehicles with environment concern
- Analyse about hybrid vehicle charging stations.

TEXT BOOKS

1. Iqbal Husain, "Electric and Hybrid Electric Vehicles", CRC Press, 2011.
2. James Larminie and John Lowry, "Electric Vehicle Technology Explained", Second Edition 2012.
3. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles Fundamentals”, CRC Press, 2010.

REFERENCES

1. Wei Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, WILEY, 2017

2. Ali Emadi, Mehrdad Ehsani, John M.Miller Vehicular Electric Power Systems, Special Indian Edition, Marcel dekker, Inc 2010

EE 1622 FLEXIBLE AC TRANSMISSION SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES

To impart knowledge about the following topics:

- To expose the students to the start-of-art of the power system
- To analyze the performance of power systems with FACTS controllers.
- To model FACTS controllers for load flow and dynamic analysis

UNIT I INTRODUCTION **9**

Real and reactive power control in electrical power transmission lines–loads & system compensation-Uncompensated transmission line–shunt and series compensation. Basic concepts of Static Var Compensator (SVC)–Thyristor Controlled Series Capacitor (TCSC) –Unified Power Flow Controller (UPFC) - Unified Power quality conditioner (UPQC).

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS **9**

Voltage control by SVC–Advantages of slope in dynamic characteristics–Influence of SVC on system voltage–Design of SVC voltage regulator–Modelling of SVC for power flow and fast transient stability– Applications: Enhancement of transient stability – Steady state power transfer –Enhancement of power system damping.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) ANDAPPLICATIONS **9**

Operation of the TCSC–Different modes of operation–Modelling of TCSC, Variable reactance model–Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit–Enhancement of system damping.

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS **9**

Static Synchronous Compensator (STATCOM)–Principle of operation–V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability-prevention of voltage instability. SSSC-operation of SSSC and the control of power flow–modelling of SSSC in load flow and transient stability studies.

UNIT V CO-ORDINATION OF FACTS CONTROLLERS **9**

Controller interactions–SVC–SVC interaction–Co-ordination of multiple controllers using linear control techniques –Control co-ordination using genetic algorithms.

Total Periods: 45 hours

COURSE OUTCOMES:

- Able to understand, analyze and develop analytical model of FACTS controller for power system application.
- Ability to understand the concepts about load compensation techniques.
- Ability to acquire knowledge on facts devices.
- Ability to understand the start-of-art of the power system
- Ability to analyze the performance of steady state and transients of facts controllers.
- Ability to study about advanced FACTS controllers

TEXTBOOKS

1. R. MohanMathur, Rajiv K.Varma,"Thyristor–BasedFactsControllersforElectrical Transmission Systems", IEEE press andJohnWiley&Sons,Inc,2002.
2. Narain G. Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors,Delhi-110006,2011.
3. T.J.E. Miller, Power Electronics in power systems, John Wiley and sons

REFERENCES

1. K.R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008
2. A.T. John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.
3. V.K. Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004,KluwerAcademic Publishers,2004.

EE1623 BATTERY TECHNOLOGIES FOR ELECTRIC VEHICLES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES: To impart knowledge on the following Topics

- To understand the fundamentals of Battery Systems in Electric -Vehicles
- To analyse and evaluate the state of energy estimation.
- To understand the health and state of power estimation
- To understand the Optimal Charging methods of battery charging and battery balancing
- To analyse battery management systems**.**

UNIT I INTRODUCTION 9

Electric Vehicle Fundamentals - Requirements for Battery Systems in Electric -Vehicles - Battery Systems - Key Battery Management Technologies - Battery Management Systems - Battery Modelling: Electrochemical Models - Black Box Models -Equivalent Circuit Models - Model Uncertainties - Other Battery Models

UNIT II BATTERY STATE OF CHARGE AND STATE OF ENERGY ESTIMATION 9

Classification - Model-Based SOC Estimation Method with Constant Model Parameters - Model-Based SOC Estimation Method with Identified Model Parameters in Real-Time - Model-Based SOE Estimation Method with Identified Model Parameters in Real-Time

UNIT III BATTERY STATE OF HEALTH AND STATE OF POWER ESTIMATION 9

State of Health Estimation: Experimental Methods - Model-Based Methods - Joint Estimation Method - Dual Estimation Method - State of Power Estimation: Instantaneous SOP Estimation Methods - Continuous SOP Estimation Method

UNIT IV BATTERY CHARGING AND BATTERY BALANCING 9

Battery Charging: Basic Terms for Evaluating Charging Performances - Charging Algorithms for Li-Ion Batteries - Optimal Charging Current Profiles for Lithium Ion Batteries - Lithium Titanate Oxide Battery with Extreme Fast Charging Capability – Battery Balancing: Battery Sorting - Battery Passive Balancing - Battery Active Balancing - Battery Active Balancing Systems.

UNIT V BATTERY MANAGEMENT SYSTEMS IN ELECTRIC VEHICLES 9

Battery Management Systems - Typical Structure of BMSs - Representative Products - Key Points of BMSs in Future Generation.

Total Periods: 45 hours

COURSE OUTCOMES: students are able to understand,

- Requirements for Battery Systems in Electric -Vehicles and various Battery Modelling.
- SOC and SOE Estimation Method with model Parameters in Real-Time.
- State of Health Estimation and Power Estimation.
- Battery charging Algorithms and Battery Balancing methods.
- Various structure of Battery Management Systems.

TEXT BOOKS

1.Rui Xiong, Weixiang ShenAdvanced Battery Management Technologies for Electric Vehicles,Wiley 2018.

2.Xiong and Shen , Advanced Battery Management Technologies for Electric Vehicles 2019

3. Handbook On Battery Energy Storage System December 2018 Asian Development Bank Asian Development Bank. Isbn 978-92-9261-470-6 (print), 978-92-9261-471-3 (electronic) ublication Stock No. TCS189791-2 DOI: http://dx.doi.org/10.22617/ TCS189791-2

REFERENCE BOOKS

1. Mi and Masrur,Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, 2nd Edition, 2017.

2. Dincer, Hamut, and Javani, Thermal Management of Electric Vehicle Battery Systems 2017.

. 3. Robert A.Huggins, Advanced Batteries – Materials science aspects,Springer, 2009.

4. Wind-Diesel Systems by R. Hunter and G. Elliot, Cambridge University Press.

EE1624 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To impart knowledge on the following Topics

- To understand the concept, planning of DC power transmission and comparison with AC power transmission.
- To analyse HVDC converters.
- To study about the HVDC system control.
- To analyse harmonics and design of filters.
- To model and analysis the DC system under study state.

UNIT I INTRODUCTION **9**

DC Power transmission technology–Comparison of AC and DC transmission–Application of DC transmission–Description of DC transmission system–Planning for HVDC transmission–Modern trends in HVDC technology–DC breakers–Operating problems– HVDC transmission based on VSC –Types and applications of MTDC systems. Commercial HVDC links available in the world.

UNIT II ANALYSIS OF HVDC CONVERTERS **9**

Line commutated converter -Analysis of Graetz circuit with and without overlap -Pulse number– Choice of converter configuration – Converter bridge characteristics–Analysisofa 12 pulse converters– Analysis of VSC topologies and firing schemes

UNIT III CONVERTER AND HVDC SYSTEM CONTROL **9**

Principles of DC link control–Converter control characteristics–System control hierarchy– Firingangle control–Current and extinction angle control–Starting and stopping of DC link –Powercontrol –Higher level controllers –Control of VSC based HVDC link.

UNIT IV REACTIVE POWER AND HARMONICS CONTROL **9**

Reactive power requirements in steady state–Sources of reactive power–SVC and STATCOM– Generation of harmonics - characteristics and non-characteristic harmonics, troubles due to harmonics, harmonic filters–Design of AC and DC filters– Active filters

UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS **9**

Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis-Case study– Solution of AC/DC power flow-Simultaneous method- Sequential method

Total Periods: 45 hours

COURSE OUTCOMES:

- Basic principles and types of HVDC system are studied.
- Features of converters used in HVDC system are studied.
- Concepts and reactive power management, harmonics and power flow analysis are studied.

TEXTBOOKS

1.Padiyar,K.R.,"HVDCpowertransmissionsystem",NewAge International(P)Ltd.NewDelhi,SecondEdition,2014.

2. Edward Wilson Kimbark," Direct Current Transmission", Vol.I,Wiley inter science, New York,London, Sydney,1971.

REFERENCES

1. Kundur P.," Power System Stability and Control", McGraw-Hill,1993.

2. Colin Adamson and Hingorani NG," High Voltage Direct Current Power Transmission",Garraway Limited, London, 1960.

3. Arrillaga,J.,"HighVoltageDirectCurrentTransmission",PeterPregrinus,London,1983.

EE1625 POWER QUALITY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES: To impart knowledge about the following topics:

- Causes & Mitigation techniques of various PQ events.
- Various Active & Passive power filters.

UNIT I INTRODUCTION TO POWER QUALITY **9**

Terms and definitions & Sources – 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 fluctuations - Power frequency variations - International standards of power quality – Computer Business Equipment Manufacturers Associations (CBEMA) curve

UNIT II VOLTAGE SAG AND SWELL **9**

Estimating voltage sag performance - Thevenin's equivalent source - Analysis and calculation of various faulted condition - Estimation of the sag severity - Mitigation of voltage sag, Static transfer switches and fast transfer switches. - Capacitor switching – Lightning - Ferro resonance - Mitigation of voltage swell.

UNIT III 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 distortions - Harmonic indices - Inter harmonics – Resonance Harmonic distortion evaluation, IEEE and IEC standards.

UNIT IV PASSIVE POWER COMPENSATORS **9**

Principle of Operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators Simulation and Performance of Passive Power Filters- Limitations of Passive Filters Parallel Resonance of Passive Filters with the Supply System and Its Mitigation. Fundamentals of load compensation – voltage regulation & power factor correction.

UNIT V POWER QUALITY MONITORING & CUSTOM POWER DEVICES **9**

Monitoring considerations - Monitoring and diagnostic techniques for various power quality problems - Quality measurement equipment - Harmonic / spectrum analyzer - Flicker meters Disturbance analyzer - Applications of expert systems for power quality monitoring. Principle& Working of DSTATCOM – DSTATCOM in Voltage control mode, current control mode, DVR Structure – Rectifier supported DVR – DC Capacitor supported DVR -Unified power quality conditioner. Distributed generation and it's monitoring –Fluke meter.

Total Periods: 45 hours

COURSE OUTCOMES:

- Ability to understand various sources, causes and effects of power quality issues, electrical systems and their measures and mitigation.
- Ability to analyze the causes & Mitigation techniques of various PQ events.
- Ability to study about the various Active & Passive power filters.
- Ability to understand the concepts about Voltage and current distortions, harmonics.
- Ability to acquire knowledge on compensation techniques.
- Ability to acquire knowledge on power quality monitoring and custom power devices.

TEXT BOOKS:

- Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality' McGraw Hill, 3rd edition, 2012.
- Eswald.F.Fudis and M.A.S.Masoum, "Power Quality in Power System and Electrical Machines," Elseviar Academic Press, 2013.
- J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', Wiley, 2011.
- Bhim Singh, Ambrish Chandra, Kamal Al-Haddad," Power Quality Problems & Mitigation Techniques" Wiley, 2015.

REFERENCES:

- G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994). (For Chapter 1, 2, 3 and 5)
- M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions',(New York: IEEE Press, 2000). (For Chapters 1, 2, 3 and 5)
- G.J.Wakileh, "Power Systems Harmonics – Fundamentals, Analysis and Filter Design," Springer 2007.
- E.Aeha and M.Madrigal, "Power System Harmonics, Computer Modelling and Analysis, "Wiley India, 2012.
- R.S.Vedam, M.S.Sarma, "Power Quality – VAR Compensation in Power Systems," CRC Press 2013.
- C. Sankaran, 'Power Quality', CRC press, Taylor & Francis group, 2019.

PROFESSIONAL ELECTIVE-IV

EE1731 RESTRUCTURED POWER SYSTEM **L T P C**
3 0 0 3

COURSE OBJECTIVES

Students will be able to:

- Describe the behaviour of deregulated markets in power system.
- Describe the technical and non-technical issues in deregulated power industry.
- Identify the methods of Local Marginal prices calculation in transmission and the function of financial transmission rights.
- Analyze the energy and ancillary services management in deregulated power industry.
- Discriminate the restructuring framework US and Indian power sectors

UNIT I INTRODUCTION **9**

Reasons for restructuring - Understanding the restructuring process - objectives of deregulation of various power systems across the world - Consumer behavior - Supplier behavior - Market equilibrium - Short-run and Long-run costs - Various costs of production. The Philosophy of Market Models:Market models based on contractual arrangements - Market architecture - .

UNIT II TRANSMISSION CONGESTION MANAGEMENT **9**

Importance of congestion management in deregulated environment - Classification of congestion management methods - Calculation of ATC - Non-market methods - Market based methods – Nodal pricing - Inter-zonal Intra-zonal congestion management - Price area congestion management -Capacity alleviation method.

UNIT III LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS 9

Fundamentals of locational marginal pricing - Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation - ACOPF model for LMP calculation - Risk Hedging Functionality Of financial Transmission Rights - FTR issuance process - Treatment of revenue shortfall - Secondary trading of FTRs - Flow Gate rights - FTR and market power

UNIT IV ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK **9**

Types of ancillary services -Load-generation balancing related services - Voltage control and reactive power support services - Black start capability service - Mandatory provision of ancillary services - Markets for ancillary services - Co-optimization of energy and reserve services – International comparison. Pricing of transmission network: wheeling - principles of transmission pricing - transmission pricing methods - Marginal transmission pricing paradigm - Composite pricing paradigm -loss allocation methods.

UNIT V MARKET EVOLUTION **9**

US markets: PJM market - The Nordic power market - Reforms in Indian power sector: Framework of Indian power sector - Reform initiatives - availability based tariff (ABT) - The Electricity Act 2012 -Open Access issues - Power exchange

Total Periods: 45 hours

COURSE OUTCOMES:

Students will be able to:

- Describe the requirement for deregulation of the electricity market and the principles of market models in power systems.
- Analyze the methods of congestion management in deregulated power system
- Analyze the locational marginal pricing and financial transmission rights
- Analyze the ancillary services management
- Differentiate the framework of US and Indian power sectors

TEXT BOOKS:

1.Kankar Bhattacharya, Math H.J.Boolen, and JaapE. Daadler, "Operation of restructured power systems", Kluwer AcademicPub.,2012.

2. Paranjothi, S.R., "Modern Power Systems The Economics of Restructuring", New Age International Publishers, First Edition: 2017.

REFERENCES:

1.Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems: operation, trading and volatility" Marcel Dekker Pub.,2001.

2. Sally Hunt, "Making competition work In electricity",John Willey and SonsInc.2002.

3. Steven Stoft," Power System Economics: Designing Markets for Electricity",Wiley-IEEE Press, 2002.

4. A. Khaparde, A. R. Abhyankar, "Restructured Power Systems", NPTEL Course, https://nptel.ac.in/courses/108101005/.

EE1732 MICRO AND SMART GRID **L P T C**
3 0 0 3

COURSE OBJECTIVES:

To impart knowledge about the following topics:

- To analyze the impact of grid integration.
- To study concept of Microgrid and its configuration
- Smart Grid technologies, different smart meters and advanced metering infrastructure.
- The power quality management issues in Smart Grid.
- The high-performance computing for Smart Grid applications.

UNIT I BASICS OF A MICROGRID 9

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids

UNIT II CONTROL AND OPERATION OF MICROGRID 9

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

UNIT III 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 IV SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plugin Hybrid Electric Vehicles (PHEV).

UNIT V POWER QUALITY MANAGEMENT IN SMART GRID

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Total Periods: 45 hours

OUTCOMES:

- Analyse and Design the dc and ac micro grid
- Analyse power quality issues and control operation of micro grid
- Learners will develop more understanding on the concepts of Smart Grid and its present developments.
- Learners will study about different Smart Grid technologies.
- Learners will have knowledge on power quality management in Smart Grids.

TEXT BOOKS:

1. Stuart Borlase “Smart Grid: Infrastructure, Technology and Solutions”, CRC Press 2012.

2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: TechnologyandApplications”,Wiley2012.
3. Microgrids Architecture and control, N. D. Hatziargyriou, IEEE Press Series, John Wiley & Sons Inc, 2013, 1st Edition.
4. Microgrid Dynamics and Control, H. Bevrani, B. François, and T. Ise, John Wiley & Sons, 2017, 1st Edition

REFERENCES

1. Smart Grid Applications And Developments by Richard Balme Daphne Mah Peter Hills Victor O.K. Li, January 2020
2. Akihiko Yokoyama, James Momoh, Janaka Ekanayake, Jianzhong Wu, Kithsiri M. Liyanage “Smart Grid, An Indian Adaptation: Fundamentals, Design, Technology, Applications, Communication and Security” April 2021.
3. James Momohe “Smart Grid: Fundamentals of Design and Analysis,”, Wiley-IEEE Press , 2012.
4. Cooperative Synchronization in Distributed Microgrid Control, Bidram, V. Nasirian, A. Davoudi, F. L. Lewis, Springer, 2017, 1st Edition.

EE1733 ENERGY MANAGEMENT AND AUDITING **L P T C**
3 0 0 3

COURSE OBJECTIVES:

- To study the concepts behind economic analysis and load management
- To emphasize the energy management of various electrical equipment and metering
- To illustrate the concept of energy management technologies

UNIT I ENERGY SCENARIO **9** Basics of Energy and its various forms - Conventional and non-conventional sources - Energy policy - Energy conservation act 2001, Amedments (India) in 2010 - Need for energy management- Designing and starting an energy management program - Energy managers and energy auditors - Roles and responsibilities of energy managers - Energy labelling and energy standards.

UNIT II ENERGY COST AND LOAD MANAGEMENT **9**
Important concepts in an 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.

UNIT III ENERGY MANAGEMENT **9**
Demand side management (DSM)– DSM planning – DSM techniques – Load management as a DSM strategy – Energy conservation – Tariff options for DSM.

UNIT IV ENERGY AUDITING **9**
Definition – Energy audit methodology: audit preparation, execution and reporting – Financial analysis – Sensitivity analysis – Project financing options - Instruments for energy audit – Energy audit for generation, distribution and utilization systems – Economic analysis.

UNIT V ENERGY EFFICIENT TECHNOLOGIES **9**
Energy saving opportunities in electric motors - Power factor improvement benefit and techniques - Shunt capacitor, Synchronous Condenser and Phase Advancer - Energy conservation in industrial drives, electric furnaces, ovens and boilers - Lighting techniques: Natural, CFL, LED lighting sources and fittings.

Total Periods: 45 hours

COURSE OUTCOMES:

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

- Understand the present energy scenario and role of energy managers.
- Comprehend the Economic Models for cost and load management.
- Configure the Demand side energy management through its control techniques, strategy and planning.
- Understand the process of energy auditing.
- Implement energy conservation aspects in industries.

TEXT BOOKS:

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006.
2. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,.Logman Scientific & Technical, ISBN-0-582-03184 , 1990.
3. Amit K. Tyagi, “Handbook on Energy Audits and Management”, TERI, 2003.

REFERENCES

1. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, “Guide to Energy Management”, CRC press, Taylor & Francis group, Eighth Edition, 2016.
2. https://prsindia.org/files/bills_acts/bills_parliament/2010/The_Energy_Conservation_Amendment_Bill_2010.pdf
3. Anil Kumar, Om Prakash, Prashant Singh Chauhan “Energy Management: Conservation and Audits, CRC Press, 2020.
4. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, “Guide to Energy Management”, CRC press, Taylor & Francis group, Eighth Edition, 2016.
5. S.C. Bhatia and Sarvesh Devraj, “Energy Conservation”, Woodhead Publishing India Pvt. Ltd, 2016.

EE1734 MODELING OF ELECTRICAL MACHINES **L T P C**
3 0 0 3

OBJECTIVES:

- To master the various fundamentals, machine design, machine modeling of various types of electrical machines.
- 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 representation of Commutator machines, 3 phase synchronous machine with and without damper bars and 3 - phase induction machine, Kron's primitive Machine - voltage, current and Torque equations. DC Machine modeling: Mathematical model of separately excited D.C motor –Steady State analysis - Transient State analysis - Sudden application of Inertia Load - Transfer function of Separately excited D.C Motor - Mathematical model of D.C Series motor, Shunt motor - Linearization Techniques for small perturbations. Modeling of Brushless DC motor.

UNIT II REFERENCE FRAME THEORY **9**

Reference frame theory Real time model of a two phase induction machine-Transformation to obtain constant matrices - three phase to two phase transformation - Power equivalence. Dynamic modeling of three phase Induction Machine 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 - per unit model .

UNIT III SMALL SIGNAL MODELING OF INDUCTION MACHINE **9**

Small Signal Modeling of Three Phase Induction Machine Small signal equations of Induction machine – derivation - DQ flux linkage model derivation - control principle of Induction machine. Symmetrical and Unsymmetrical 2 phase Induction Machine Analysis of symmetrical 2 phase induction machine - voltage and torque equations for unsymmetrical 2 phase induction machine - voltage and torque equations in stationary reference frame variables for unsymmetrical 2 phase induction machine - analysis of steady state operation of unsymmetrical 2 phase induction machine - single phase induction motor - Cross field theory of single - phase induction machine.

UNIT IV MODELING OF SYNCHRONOUS MACHINE **9**

Synchronous machine inductances – voltage equations in the rotor's dq0 reference frame - electromagnetic torque - current in terms of flux linkages - simulation of three phase synchronous machine- modeling of PM Synchronous motor.

UNIT V DYNAMIC ANALYSIS OF SYNCHRONOUS MACHINE **9**

Dynamic performance of synchronous machine, three -phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria.

Total Periods: 45hours

COURSE OUTCOMES:

- To learn about the basic concepts of AC/DC machine modeling.
- To study about the dynamic modeling and phase transformation.

- To analyze various methodologies in small signal machine modeling.
- To understand the modeling of synchronous machine modeling.
- To learn the performance and dynamic modeling of synchronous machines.

TEXT BOOKS:

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis& control", Pearson Publications, First edition,2015.
2. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive systems", IEEE Press, Third Edition -2013

REFERENCES:

1. P.S.Bimbra, "Generalized Theory of Electrical Machines" Khanna publications, Seventh edition -2021.
2.CheeMunOng –"Dynamic simulation of Electric machinery using MATLAB / Simulink", Prentice Hall of India Publications.
3. Online courses on Modeling of Electrical Machines -http://nptel.ac.in/courses/108106023/

EE1735 HIGH VOLTAGE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the following Topics
- Various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages, Corona and its effects — Bewley lattice diagram- Protection against over voltages.

UNIT II DIELECTRIC BREAKDOWN 9

Properties of Dielectric materials - 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- Applications of insulating materials in electrical equipments.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of High DC voltage: Rectifiers, voltage multipliers, vandigraff generator: generation of high impulse voltage: single and multistage Marx circuits – generation of high AC voltages: cascaded

transformers, resonant transformer and tesla coil- generation of switching surges — generation of impulse 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 highvoltage 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& testing of cabilitys.

Total Periods: 45 hours

COURSE OUTCOMES:

- Ability to understand Transients in power system.
- Ability to understand Generation and measurement of high voltage.
- Ability to understand High voltage testing.
- Ability to understand various types of over voltages in power system.
- Ability to measure over voltages.
- Ability to test power apparatus and insulation coordination

TEXT BOOKS:

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, FifthEdition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals',Newnes Elsevier , New Delhi, 2013.
3. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, 2018.

REFERENCES

1. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition,2011.
2. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, Roshday Radwan, High Voltage Engineering – Theory &Practice, Second Edition Marcel Dekker, Inc., 2010.
3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning PrivateLimited, New Delhi, Second Edition, 2013.

PROFESSIONAL ELECTIVE -IV

EE1741 BIOMEDICAL INSTRUMENTATION **L T P C**
3 0 0 3

UNIT I BIO POTENTIAL GENERATION AND ELECTRODES TYPES 9

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 ELECTRODECONFIGURATIONS 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.

UNIT III SIGNAL CONDITIONING CIRCUITS 9

Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering

UNIT IV MEASUREMENT OF NON-ELECTRICALPARAMETERS 10

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.

UNIT V BIO-CHEMICAL MEASUREMENT 8

Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

Total Periods: 45 hours

COURSE OUTCOMES

- To Learn the different bio potential and its propagation.
- To get Familiarize the different electrode placement for various physiological Recording
- Students will be able design bio amplifier for various physiological recording
- Students will understand various technique non electrical physiological measurements
- Understand the different biochemical measurements

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India,New Delhi, 2007.
2. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2014. (Units I, II & V)

REFERENCES:

1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.(Units II & IV)
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology",

EE1742 SOFT COMPUTING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To apply soft computing techniques to solve problems.

UNIT I I NTRODUCTION TO SOFT COMPUTING **9**

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

UNIT II ARTIFICIAL NEURAL NETWORKS **9**

Back propagation Neural Networks – Kohonen Neural Network -Learning Vector Quantization -Hamming Neural Network – Hopfield Neural Network- Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines – Spike Neuron Models.

UNIT III FUZZY SYSTEMS **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.

UNIT IV GENETIC ALGORITHMS **9**

Introduction, Building block hypothesis, 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 SYSTEMS **9**

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination – LR-Type Fuzzy Numbers – Fuzzy Neuron – Fuzzy BP Architecture – Learning in Fuzzy BP- Inference by Fuzzy BP – Fuzzy ArtMap: A Brief Introduction – Soft Computing Tools – GA in Fuzzy Logic Controller Design – Fuzzy Logic Controller

Total Periods: 45 hours

COURSE OUTCOMES:

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

- Apply suitable soft computing techniques for various applications.
- Integrate various soft computing techniques for complex problems.

TEXT BOOKS:

1. N.P.Padhy, S.P.Simon, “Soft Computing with MATLAB Programming”, Oxford University Press, 2015.

2. S.N.Sivanandam , S.N.Deepa, “Principles of Soft Computing”, Wiley India Pvt. Ltd., 2nd Edition, 2011.
3. S.Rajasekaran, G.A.Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications “, PHI Learning Pvt. Ltd., 2017.

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, ―Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2002.
2. Kwang H.Lee, ―First course on Fuzzy Theory and Applications, Springer, 2005.
3. George J. Klir and Bo Yuan, ―Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall, 1996.
4. James A. Freeman and David M. Skapura, ―Neural Networks Algorithms, Applications, and Programming Techniques, Addison Wesley, 2003.

EE1743 VLSI DESIGN **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits.
- Architectural choices and performance tradeoffs involved in designing and realizing thecircuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules,Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Nonideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logicaleffort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls.
Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmmit Trigger, Monostability Sequential Circuits, Astability Sequential Circuits.
Timing Issues : Timing Classification Of Digital System, Synchronous Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff.
Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core,

Memory Peripheral Circuitry.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures.

Design for Testability: *Ad Hoc* Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

Total Periods: 45 hours

COURSE OUTCOMES:

Upon completion of the course, students should ability to

- Realize the concepts of digital building blocks using MOS transistor.
- Design combinational MOS circuits and power strategies.
- Design and construct Sequential Circuits and Timing systems.
- Design arithmetic building blocks and memory subsystems.
- Apply and implement FPGA design flow and testing.

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris "CMOS VLSI Design: A Circuits and SystemsPerspective", 4th Edition, Pearson , 2017.(UNIT I,II,V)
2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits:ADesign perspective", Second Edition , Pearson , 2016.(UNIT III,IV)

REFERENCES

1. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim "CMOS Digital Integrated Circuits:Analysis& Design",4th edition McGraw Hill Education,2013
3. Wayne Wolf, "Modern VLSI Design: System On Chip", Pearson Education, 2007
4. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout andSimulation", Prentice Hall of India 2005.

EE1744 MICROCONTROLLER BASED SYSTEM DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES: To impart knowledge about the following topics:

- Architecture of PIC microcontroller
- Interrupts and timers
- Peripheral devices for data communication and transfer
- Functional blocks of ARM processor
- Architecture of ARM processors

UNIT I INTRODUCTION TO PIC MICROCONTROLLER 9

Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–IC16cxx–- Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Simple Operations.

UNIT II INTERRUPTS AND TIMER 9

PIC micro controller Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine Timers-Timer Programming– Front panel I/O-Soft Keys– State machines andkey switches– Display of Constant and Variability strings.

UNIT III PERIPHERALS AND INTERFACING 9

I^2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM—Analog to Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization -
LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.

UNIT IV INTRODUCTION TO ARM PROCESSOR 9

Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy – ARM Assembly Language Programming–Simple Examples–Architectural Support forOperating systems.

UNIT V ARM ORGANIZATION 9

2-Stage Pipeline ARM Organization– 5-Stage Pipeline ARM Organization–ARM Instruction Execution- ARM Implementation– ARM Instruction Set– ARM coprocessor interface– Architectural support for High Level Languages – Embedded ARM Applications.

Total Periods: 45 hours

COURSE OUTCOMES:

- Ability to understand and apply computing platform and software for engineeringproblems.
- Ability to understand the concepts of Architecture of PIC microcontroller
- Ability to acquire knowledge on Interrupts and timers.
- Ability to understand the importance of Peripheral devices for data communication.
- Ability to understand the basics of sensor interfacing
- Ability to acquire knowledge in Architecture of ARM processors

TEXT BOOKS:

1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation, 2018.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade ComputerPublication, 2000.

REFERENCES

1. Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey ,Prentice Hall ofIndia, 2021.

EE1745 SENSORS AND TRANSDUCERS **L T P C**
3 0 0 3

COURSE OBJECTIVES:
- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT I INTRODUCTION 9
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 9
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 9
Strain Gauge, Load Cell, Magnetic Sensors –types, principle, requirement and advantages- Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V DAQ SYSTEMS AND SENSOR'S APPLICATIONS 9
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging – Applications - Automobile, Aerospace, Home appliances, Manufacturing, Medical diagnostic sensors, Environmental monitoring - Introduction to IOT sensors.

Total Periods: 45 hours

COURSE OUTCOMES:
The students will be able to
- Expertise in various calibration techniques and signal types for sensors.
- Understand the concepts of various motion, proximity and ranging sensors.
- Acquire knowledge in force, magnetic and heading sensors.
- Study the basic principles of various optical, pressure and temperature sensors.
- Implement the DAQ systems with different sensors for real time applications.
- Understand the concepts of IOT sensor with applications.

TEXT BOOKS:
1. Ernest O Doebelin, "Measurement Systems – Applications and Design", 7th edition, Tata McGraw-Hill, 2019.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control",

12th edition, Dhanpat Rai & Co, New Delhi, 2017.

REFERENCES:

1. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2017.
2. Authors(s) : Ambika Nagaraj Introduction to Sensors in IoT and Cloud Computing Applications.Bentham Book 2021.
3. Ian Sinclair, “Sensor and Transducers”, Elsevier India Pvt Ltd, 5th Edtion, 2015.
4. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.

PROFESSIONAL ELECTIVE –V

EE1851 BIG DATA ANALYTICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand big data.
- To learn and use NoSQL big data management.
- To learn mapreduce analytics using Hadoop and related tools.
- To work with map reduce applications
- To understand the usage of Hadoop related tools for Big Data Analytics

UNIT I UNDERSTANDING BIG DATA 9

Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop –open source technologies – cloud and big data – mobile business intelligence – Crowd sourcinganalytics – inter and trans firewall analytics

UNIT II NOSQL DATA MANAGEMENT 9

Introduction to NoSQL – aggregate data models – key-value and document data models –relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra clients.
Casestudy : Modelling of power system database using No SQL database.

UNIT III MAP REDUCE APPLICATIONS 9

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN –job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats.

UNIT IV BASICS OF HADOOP 9

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes –design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow –Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures -Cassandra – Hadoop integration

UNIT V HADOOP RELATED TOOLS 9

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Pig – Grunt – pig data

model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

Total Periods: 45 hours

TEXT BOOKS:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. Sadalage, Pramod J. “NoSQL distilled”, 2013

REFERENCES:

1. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
4. Alan Gates, "Programming Pig", O'Reilley, 2011.
5.Casestudy of No SQL data base: https://ieeexplore.ieee.org/document/8249453

EE1852 SMART SYSTEM AUTOMATION

L	T	P	C
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COURSE OBJECTIVES:

- To introduce the **smart** system technologies and its role in real time applications
- To teach the architecture and requirements of Home Automation.
- To provide an insight into smart appliances and energy management concepts.
- To familiarize the design and needs of smart wearable devices
- To teach the basics of robotics and its role for automation.

UNIT I INTRODUCTION **9**

Overview of a smart system - Hardware and software selection - Smart sensors and Actuators – Communication protocols used for smart systems.

UNIT II HOME AUTOMATION **9**

Home Automation – System Architecture - Essential Components- Design Considerations: Control Unit, Sensing Requirements, Communication, Data Security.

UNIT III SMART APPLIANCES AND ENERGY MANAGEMENT **9**

Significance of smart appliances for energy management -Smart Meters: Significance, Architecture & Energy Measurement Technique – Security Considerations.

UNIT IV SMART WEARABLE DEVICES **9**

Body Area Networks - Sensors– communication protocol for Wearable devices- Application of Smart Wearable in Healthcare & Activity Monitoring.

UNIT V EMBEDDED SYSTEMS AND ROBOTICS **9**

Fundamental concepts in Robotics- Robots and Controllers components - Embedded processor based: pick and place robot- Mobile Robot Design- UAV.

Total Periods: 45 hours

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

- Understand the concepts of smart system design and its present developments.
- Illustrate different embedded open-source and cost-effective techniques for developing solution for real time applications.
- Acquire knowledge on different platforms and Infrastructure for Smart system design.
- Infer about smart appliances and energy management concepts.
- Improve Employability and entrepreneurship capacity due to knowledge upgradation on embedded system technologies.

TEXTBOOKS:

1. Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan, Embedded Systems for Smart Appliances and Energy Management, Springer 2013, 1st Edition.
2. KazemSohraby, Daniel Minoli and TaiebZnati, Wireless Sensor Networks Technology, Protocols, and Applications, John Wiley & Sons, 2007, 1st Edition.
3. NilanjanDey, Amartya Mukherjee, Embedded Systems and Robotics with Open-Source Tools, CRC press, 2016, 1st Edition.

REFERENCES:

1. Thomas Bräunl, Embedded Robotics, Springer, 2003.
2. Raj Kamal, Embedded Systems - Architecture, Programming and Design, McGraw- Hill, 2008
3. Karim Yaghmour, Embedded Android, O'Reilly, 2013.
4. Steven Goodwin, Smart Home Automation with Linux and Raspberry Pi, Apress , 2013
5. C.K. Toh, AdHoc mobile wireless networks, Prentice Hall, Inc, 2002.
6. Anna Ha´c, Wireless Sensor Network Designs, John Wiley & Sons Ltd, 2003.
7. J. J. Craig, “Introduction to Robotics Mechanics and Control”, Pearson Education.
8. Y. Koren, “Robotics for Engineers”, McGraw-Hill.
9. Robert Faludi, Wireless Sensor Networks, O’Reilly, 2011.

EE1853 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

L	T	P	C
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COURSE OBJECTIVES:

The objective of this course is to enable the students to

- Understand the basic concepts of intelligent agents.
- Develop general-purpose problem solving agents, logical reasoning agents, and agents that reason under uncertainty.
- Employ AI techniques to solve some of today's real world problems.

UNIT I - INTELLIGENT AGENTS **9**

Introduction to AI – Agents and Environments – Concept of rationality – Nature of environments – Structure of agents - Problem solving agents – search algorithms –uninformed search strategies.

UNIT II - PROBLEM SOLVING **9**

Heuristic search strategies – heuristic functions - Local search and optimization problems –local search in continuous space –search with non - deterministic actions – search in partially observable environments – online search agents and unknown environments.

UNIT III - GAME PLAYING AND CSP **9**

Game theory – optimal decisions in games –alpha-beta search –monte-carlo tree search –stochastic games – partially observable games - Constraint satisfaction problems – constraint propagation –backtracking search for CSP –local search for CSP –structure of CSP.

UNIT IV LOGICAL AGENTS **9**

Knowledge-based agents –propositional logic –propositional theorem proving –propositional model checking –agents based on propositional logic

First-order logic –syntax and semantics –knowledge representation and engineering –inferences in first-order logic –forward chaining –backward chaining –resolution

UNIT V KNOWLEDGE REPRESENTATION AND PLANNING **9**

Ontological engineering –categories and objects –events –mental objects and modal logic –reasoning systems for categories –reasoning with default information

Classical planning –algorithms for classical planning –heuristics for planning –hierarchical planning –non-deterministic domains –time, schedule, and resources –analysis.

Total Periods: 45 hours

COURSE OUTCOMES:

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

- Explain autonomous agents that make effective decisions in fully informed, partially observable, and adversarial settings
- Choose appropriate algorithms for solving given AI problems
- Design and implement logical reasoning agents

- Design and implement agents that can reason under uncertainty

TEXT BOOK:

1. Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Fourth Edition, Pearson Education, 2020.

REFERENCES:

1. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013 (http://nptel.ac.in/)
5. Artificial Intelligence by Example: Develop machine intelligence from scratch using real artificial intelligence use cases -by Dennis Rothman, 2018

EE1854 MACHINE LEARNING

L	T	P	C
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COURSE OBJECTIVES:

- To understand the basics of Machine Learning (ML)
- To understand the methods of Machine Learning
- To know about the implementation aspects of machine learning
- To understand the concepts of Data Analytics and Machine Learning
- To understand and implement use cases of ML

UNIT I MACHINE LEARNING BASICS **9**

Introduction to Machine Learning (ML) - Essential concepts of ML – Types of learning – Machine learning methods based on Time – Dimensionality – Linearity and Non linearity – Early trends in Machine learning – Data Understanding Representation and visualization.

UNIT II MACHINE LEARNING METHODS **9**

Linear methods – Regression -Classification –Perceptron and Neural networks – Decision trees – Support vector machines – Probabilistic models —Unsupervised learning – Featurization.

UNIT III MACHINE LEARNING IN PRACTICE **9**

Ranking – Recommendation System - Designing and Tuning model pipelines- Performance measurement – Azure Machine Learning – Open-source Machine Learning libraries – Amazon’s Machine Learning Tool Kit: Sagemaker

UNIT IV MACHINE LEARNING AND DATA ANALYTICS **9**

Machine Learning for Predictive Data Analytics – Data to Insights to Decisions – Data Exploration – Information based Learning – Similarity based learning

UNIT V APPLICATIONS OF MACHINE LEARNING 9

Probability based learning – Error based learning – Evaluation – The art of Machine learning to Predictive Data Analytics.
Image Recognition – Speech Recognition – Email spam and Malware Filtering – Online fraud detection – Medical Diagnosis.

Total Periods: 45 hours

COURSE OUTCOMES:

- Understand the basics of ML
- Explain various ZMachine Learning methods
- Demonstrate various ML techniques using standard packages.
- Explore knowledge on Machine learning and Data Analytics
- Apply ML to various real time examples

TEXT BOOKS:

1. Ameet V Joshi, Machine Learning and Artificial Intelligence, Springer Publications, 2020
2. John D. Kelleher, Brain Mac Namee, Aoife D' Arcy, Fundamentals of Machine learning for Predictive Data Analytics, Algorithms, Worked Examples and case studies, MIT press,2015

REFERENCES:

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer Publications, 2011
2. Stuart Jonathan Russell, Peter Norvig, John Canny, Artificial Intelligence: A Modern Approach, Prentice Hall, 2020
3. Machine Learning Dummies, John Paul Muller, Luca Massaron, Wiley Publications, 2021 .

EE1855 FIBER OPTICS AND LASER INSTRUMENTATION

L	T	P	C
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UNIT I OPTICAL FIBRES AND THEIR PROPERTIES 9

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, –Principles of light propagation through a fibre: Total internal reflection, Acceptance angle (θa),Critical angle, Numerical aperture and Skew mode, –Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers,– fibre characteristics: Mechanical characteristics and Transmission characteristics, – Absorption losses – Scattering losses– Dispersion – Connectors and splicers – Fibre termination – Optical sources: Light Emitting Diode(LED), – Optical detectors: PIN Diode.

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9

Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacement sensor (Extrinsic Sensor) –Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) –Interferometric method of measurement of length –Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Mono chromaticity, Coherence, Divergence and Directionality and Brightness –Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers; – Gas lasers-Helium Neon laser and CO2 laser, solid lasers- Ruby rod laser and Nd-YAG laser, liquid lasers and semiconductor lasers- PN diode laser.

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric Effect , Types of LIDAR, Construction, Working, and Applications – Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting –Laser trimming of material: Process Of Laser Trimming, Types Of Trim, Construction, Working, Advantages – Material Removal and vaporization: Process Of Material Removal

UNIT V HOLOGRAM AND MEDICAL APPLICATIONS 9

Holography: Basic Holographic components, Working principle and Condition Of Hologram Recording Reconstructing and viewing the holographic image –Holography vs photography, Holography for non-destructive testing.

Medical applications of lasers: laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser insturments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynecology and oncology.

Total Periods: 45 hours

COURSE OUTCOMES :

- Understand the principle, transmission, dispersion and attenuation characteristics of optical fibers
- Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications.
- Understand laser theory and laser generation system.
- Students will gain ability to apply laser theory for the selection of lasers for a specific Industrial application.
- Apply laser theory for obtaining hologram and to apply for specific medical application.

TEXT BOOKS:

1. J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India, January 2010
2. Eric Udd, William B., and Spill man, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists ", John Wiley & Sons, 2011.

REFERENCES:

1. G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1 July 2017
2. M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, January 2012.
3. John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.

PROFESSIONAL ELECTIVE –VI

EE1861	**INTELLECTUAL PROPERTY RIGHTS**	**L**	**T**	**P**	**C**
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COURSE OBJECTIVES:

• To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION **9**

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs **9**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS **9**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW **9**

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs **9**

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

Total Periods: 45 hours

COURSE OUTCOMES

- Ability to manage Intellectual Property portfolio to enhance the value of the firm

TEXTBOOKS

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCES

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

EE1862 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

L	T	P	C
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COURSE OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services.
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems.
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification.
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics.
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT **9**

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation.

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal.

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

Total Periods: 45 hours

COURSE OUTCOMES:

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

- Define, formulate and analyze a problem.
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context.
- Work independently as well as in teams .
- Manage a project from start to finish.

TEXTBOOKS:

1.Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.

2.John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

EE 1863 TOTAL QUALITY MANAGEMENT IN ELECTRICAL INDUSTRY

L	T	P	C
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COURSE OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of productand service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention

UNIT II TQM PRINCIPLES **9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY MANAGEMENT SYSTEM **9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation— Internal Audits Registration- -ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001 Requirements of ISO 14001— Benefits of EMS. CASE STUDY: THE CASE OF AN ELECTRICITY DISTRIBUTION COMPANY.

Total Periods: 45 hours

COURSE OUTCOMES:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

EE 1864 PRINCIPLES OF MANAGEMENT

L	T	P	C
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COURSE OBJECTIVES:

- 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

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers

and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

Total Periods: 45 hours

COURSE OUTCOMES:

- Understand the fundamental of management and managerial roles.
- Understand the planning and planning process.
- Understand the fundamental of organizing functions in functions of management
- Understand the directing functions of management an communication strategies.
- Understand the controlling and budgeting techniques.
- Understand the application of management theories

TEXT BOOKS:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.

REFERENCE BOOKS:

1. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India)Pvt. Ltd., 10th Edition,2009.

EE 1865 INDUSTRIAL MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the functions of Management and various theories of Management.
- To understand the various types organizational structures.
- To understand the objectives of operations management.
- To understand the objectives and steps of method in work study and statistical Quality Control theory.
- To understand the various methods of job evaluation.

UNIT I INTRODUCTION TO MANAGEMENT 9

Entrepreneurship and organization – Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management.

UNIT II DESIGNING ORGANIZATIONAL STRUCTURES 9

Departmentalization and Decentralization, Types of Organization structures – Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

UNIT III OPERATIONS MANAGEMENT 9

Objectives- product design process- Process selection-Types of production system(Job, batch and Mass Production),Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts- Design of product layout- Line balancing(RPW method) Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram

UNIT IV WORK STUDY 9

Introduction —definition —objectives -steps in work study—Method study—definition,objectives—steps of method study. Work Measurement — purpose — types of study — stop watch methods — steps — key rating — allowances — standard time calculations — work sampling. Statistical Quality Control: variables-attributes, Shewart control charts for variables- chart, R chart, – Attributes- Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves.

UNIT V JOB EVALUATION 9

Methods of job evaluation — simple routing objective systems — classification method factor comparison method, point method, benefits of job evaluation and limitations. Project Management (PERT/CPM): Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

Total Periods: 45 hours

COURSE OUTCOMES:

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

- Gain knowledge of the functions of management and theory of management.
- Define and designing various organizational structures.
- Gain knowledge of the product design process, production system and design of product Layout.
- Gain knowledge of steps in work study, work measurement and statistical quality control.
- Gain knowledge of benefits of various methods job evaluation and Project Management.

TEXT BOOKS

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers.
2. Industrial Engineering and Management Science/T.R. Banga and S.C. Sarma /Khanna Publishers.

REFERENCE BOOKS

1. Motion and Time Study by Ralph M Barnes! John Willey & Sons Work Study by lLO.
2. Human factors in Engineering & Design/Ernest J McCormick /TMH.
3. Production & Operation Management /Paneer Selvam/PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Hand Book/Maynard.
6. Industrial Engineering Management I Ravi Shankar/ Galgotia

OPEN ELECTIVES OFFERED BY EEE DEPARTMENT

OEE501 Basics of Biomedical Instrumentation **L T P C**
3 0 0 3

OBJECTIVES:

- To study about the different bio potential and its propagation
- To understand the different types of electrodes and its placement for various recording
- To study the design of bio amplifier for various physiological recording
- To learn the different measurement techniques for non-physiological parameters.
- To familiarize the different biochemical measurements.

UNIT I BIO POTENTIAL GENERATION AND ELECTRODES TYPES 9

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 ELECTRODECONFIGURATIONS 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.

UNIT III SIGNAL CONDITIONING CIRCUITS 9
Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering

UNIT IV MEASUREMENT OF NON-ELECTRICALPARAMETERS 9
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.

UNIT V BIO-CHEMICAL MEASUREMENT 9

Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

Total Periods: 45 hours

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
2. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004. (Units I, II & V)

REFERENCES:

1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.(Units II & IV)
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

OEE502 SENSORS AND TRANSDUCERS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

• To understand the concepts of measurement technology.
• To learn the various sensors used to measure various physical parameters.
• To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT I INTRODUCTION **9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS **9**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V DAQ SYSTEMS AND SENSOR'S APPLICATIONS **9**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - Applications - Automobile, Aerospace, Home appliances, Manufacturing, Medical diagnostic sensors, Environmental monitoring.

TOTAL : 45 PERIODS

OUTCOMES:

The students will be able to

CO1. Expertise in various calibration techniques and signal types for sensors.
CO2. Understand the concepts of various motion, proximity and ranging sensors.
CO3.Aquire knowledge in force, magnetic and heading sensors.
CO4. Study the basic principles of various optical, pressure and temperature sensors.
CO5. Implement the DAQ systems with different sensors for real time applications

TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", 7th edition, Tata McGraw-Hill, 2019.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, DhanpatRai& Co, New Delhi, 2017.

REFERENCES:

1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2017.
2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 2009.
3.Ian Sinclair, "Sensor and Transducers", Elsevier India Pvt Ltd, 5th Edtion, 2015
4. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 20

OEE701 RENEWABLE ENERGY SOURCES L T P C
3 0 0 3

OBJECTIVES:

- To get exposure on solar radiation and its environmental impact to power
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

UNIT I PRINCIPLES OF SOLAR RADIATION 10

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II SOLAR ENERGY COLLECTION 8

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT III SOLAR ENERGY STORAGE AND APPLICATIONS 7

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT IV WIND ENERGY **10**

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

UNIT V GEOTHERMAL ENERGY **9**

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.
DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC.

Total Periods: 45 hours

OUTCOMES:

- Understanding the physics of solar radiation.
- Ability to classify the solar energy collectors and methodologies of storing solar energy.
- Knowledge in applying solar energy in a useful way.
- Knowledge in wind energy and biomass with its economic aspects.
- Knowledge in capturing and applying other forms of energy sources like wind, biogas and geothermal energies.

TEXT BOOKS:

1. Rai G.D. , “Non-Conventional Energy Sources”, Khanna Publishers, 2011
2. Twidell & Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011

REFERENCES:

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007
2. Ramesh R & Kumar K.U , “Renewable Energy Technologies”,Narosa Publishing House, 2004
3. Mittal K M, “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi, 2003
4. Kothari D.P, Singhal ., K.C., “Renewable energy sources and emerging technologies”, P.H.I, New Delhi, 2010

OEE702 ELECTRIC VEHICLES L T P C
3 0 0 3

OBJECTIVE:

- To introduce the history and challenges in electric vehicles.
- To impart the knowledge on different configurations of electric Vehicles.
- To learn the energy storage technologies used in electric vehicles.
- To study and familiarize the electric vehicles drive technologies.
- To impart the knowledge on charging and battery management system in EV.

UNIT I INTRODUCTION 9

Basics of vehicle mechanisms -Historical background of electric vehicle – Benefits of Electric Vehicles , Overview of the different types of Electric vehicles, Power/Energy supply requirements - challenges in EVs.

UNIT-II CONFIGURATIONS OF ELECTRIC VEHICLE 9

Different configurations of electric vehicles - Performance of Electric Vehicles -Different Configurations of full hybrid vehicles - Configuration of Fuel cell electric vehicle - Converted EVs.

UNIT-III ENERGY STORAGE SYSTEM 9

Requirements of Storage systems in Electric Vehicles - Battery parameters, Types of Batteries, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Supercapacitors - comparison of different energy storage technologies

UNIT IV ELECTRIC VEHICLES DRIVE TECHNOLOGY 9

Comparison of speed torque characteristics of IC engine and Electric motor – Requirements of EV motor compared to industrial motor – Types of Electric motors: DC motor, Induction motor, Switched reluctance motor, Brushless DC motor and Permanent Magnet Synchronous motor.

UNIT V BATTERY MANAGEMENT SYSTEM 9

Need for Battery management system- Classification - Responsibilities Of An Electric Vehicle Battery Management System – Battery charging optimization - Construction & Working of Battery Management System- Automotive Battery Management System -Charging schemes for EV: Normal charging, opportunity charging and fast charging – Need for Charging algorithms.

Total Periods: 45 hours

OUTCOMES:

The students will be able to

- Understand the need and types of electric vehicles.
- Understand the configurations of different Electric Vehicles.
- Understand the energy storage technology used for electric vehicles
- Understand the different drive technologies used in electric vehicles
- Understand the battery management system and battery charging.

TEXT BOOKS:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, Second edition, 2011.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, Third edition 2018.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, Second edition 2012.

REFERENCES:

1. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
2. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2001
3. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles and Applications With Practical Perspectives, Wiley Publication, 2011.
2. NPTEL lecture on “Electric vehicles - Part 1”