

COURSE OBJECTIVES

- To understand the basics of circuit theory and analysis of electric circuits.
- To apply the network elements and theorems for the analysis of complex circuits.
- To analyse the coupled circuits using the series & parallel resonance circuit terminologies.
- To compute the transient responses of RLC circuits.
- To understand the concepts of power measurements.

UNIT I BASICS OF CIRCUIT ELEMENTS AND ANALYSIS 15

Basics of circuit elements - Network reduction – voltage division – current division – Star – delta transformation - Ohm's Law – Kirchhoff's laws – DC and AC Circuits -Mesh current and node voltage method of analysis.

UNIT II NETWORK THEOREMS 15

Thevenin's Theorem- Norton's Theorem- Superposition theorem- Maximum power transfer theorem, Reciprocity theorem, Substitution theorem, Compensation theorem, Millman's theorem, Tellegen's theorem– Statement, illustration. Application to DC and AC circuits.

UNIT III RESONANCE AND COUPLED CIRCUITS 15

Series resonance, parallel resonance – Q factor – Bandwidth. Self-Inductance – Mutual Inductance – Coefficient of coupling – dot rule – ideal transformer effective inductance of coupled coils in series & in parallel – Analysis of magnetic circuits.

UNIT IV TRANSIENT CIRCUITS 15

Transient response of RL, RC and RLC circuits using Laplace transform for DC input and AC with sinusoidal input. Introduction to PSpice-Application to electrical circuits.

UNIT V POWER MEASUREMENTS 15

Power, Power Factor and Energy, Power measurement by 3 volt meter and 3 ammeter method - Solution of three phase balanced circuits & unbalanced circuits – Three phase power measurement using 2 wattmeter method

TOTAL: 75 PERIODS**COURSE OUTCOMES**

At the end of this course, the students will be able to

- understand the basic elements, laws and circuit solving methods.
- analyse the complex circuits using the network theorems.
- design the resonance circuit and calculate the inductance under coupled conditions.
- perform transient analysis of electrical circuits
- understand the concepts of power measurements.

TEXT BOOKS

1. Chakrabati A, Circuits Theory (Analysis and synthesis), Dhanpat Rai & Sons, 2004
2. Sudhakar, A. and Shyam Mohan S.P, Circuits and Networks, Analysis and Synthesis, Tata McGraw Hill Publishing Company Ltd., 2010.
3. Arumugam, M and Prem Kumar, K, Electric Circuit Theory, Khanna Publishers, 2013.

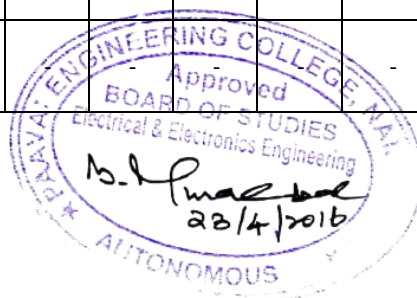
REFERENCES

1. William H. Hayt, Jack Kemmerly, Steven M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill, 2013.
2. Nahvi, M, Joseph Edminister and Uma Rao, K, Electric Circuits (Schaum's Series), Tata McGraw-Hill, 2010.
3. B.L. Theraja and A.K. Theraja, Electrical Technology, Volume 1, S. Chand Publications, 2008.
4. Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", Tata McGraw Hill, 2003.
5. Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., 1996.

WEB LINKS

1. http://www.allaboutcircuits.com/vol_1
2. <http://www.electronics-tutorials.ws/dccircuits>
3. <http://fourier.eng.hmc.edu/e84/lectures/ch2>

CO-PO MAPPING:														
Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
CO's	PO's												PSO's	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	-	-	3	1	2
CO2	3	3	3	3	-	-	-	-	-	-	-	3	1	2
CO3	3	3	3	3	-	-	-	-	-	-	-	3	1	2
CO4	3	3	3	3	-	-	-	-	-	-	-	3	1	2
CO5	3	3	3	3	-	-	-	-	-	-	-	3	1	2



COURSE OBJECTIVES

- To familiarise the students with VI characteristics of PN junction diode and special diodes.
- To acquaint the students with construction, theory and characteristics of BJT, FET and MOSFET and to analyze their VI characteristics.
- To impart knowledge on amplifier circuits and their performance and to obtain the frequency response
- To impart concepts on different classes of power amplifiers.
- To acquaint the students with the basics of negative feedback amplifiers and to apprise knowledge on oscillators

UNIT I PN JUNCTION DEVICES 9

PN junction diode –structure, operation and V-I characteristics, Diffusion and Transient Capacitance-Varactor Diode – Tunnel Diode.Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes- Zener diode, characteristics-Zener Reverse characteristics – Zener as regulator

UNIT II TRANSISTORS 9

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristor and IGBT -Structure and characteristics-Transistor as a switch-Use of a heat sink.

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

Differential amplifier – Common mode and Difference mode analysis – Single tuned amplifiers Transformer coupled class A, B, C and AB power amplifiers, complementary symmetry amplifiers, push pull amplifiers

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series, Shunt feedback – positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts, Crystal and UJT relaxation oscillator

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- understand the VI characteristics of PN junction diode and special diodes.
- describe the construction, theory and characteristics of BJT, FET and MOSFET and to analyze their VI characteristics.
- perform analysis of amplifiers and to obtain the frequency response
- explain the operation of multistage and power amplifiers.
- design feedback amplifiers and oscillators.

TEXT BOOKS

1. David.A.Bell, " Electronic Devices and Circuits ",Oxford University Press,2009
2. Millman and C.Halkias, "Electronic Devices and Circuits", Tata McGraw Hill., 2001
3. S.Salivahanan, "Electronic Devices and Circuits", Tata McGraw Hill, 2008.

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1. Donald A. Neaman, "Electronic Circuits" Tata McGraw Hill, 2006
2. Mathur.S.P., KulshreshthaD.C. &Chanda.P.R. "Electronic Devices – Applications and Integrated
3. Circuits",Umesh Publications.1999.
4. Allen Mottershed, "Electronic Devices & Circuits, An Introduction", Prentice Hall of India (P) Ltd, 2006.
5. Rashid, "Microelectronic circuits" Thomson Publication, 2011.P.RameshBabu , "Electronic Devices and Circuits", SciTech Publications Pvt Ltd, 2005

WEBLINKS

1. http://ecee.colorado.edu/~bart/book/book/chapter4/ch4_6.htm
2. <http://www.electronics-tutorials.ws/>
3. <http://hyperphysics.phy-astr.gsu.edu/hbase/electronic/feedn.html>
http://onlinevideolecture.com/?course_id=821

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B. S. Prasad
23/4/2016
AUTONOMOUS

COURSE OBJECTIVES

- To familiarize the basic functional elements of instrument and bridges
- To learn the use of different types of meters for measuring electrical quantities such as current, voltage, power, energy, power factor and frequency
- To learn the working principle and applications of CRO and other electronic measuring devices
- To familiarize the instrumentation equipment's such as Signal generators and analyzer.
- To introduce various types of transducers.

UNIT I BASIC MEASUREMENT CONCEPTS AND BRIDGES 9

Functional elements of an instrument – Static and dynamic characteristics –Standards and Calibration of measurements - Errors in measurement – Statistical evaluation of measurement data –Wheatstone bridge, Kelvin double bridge ,Maxwell's bridge, Anderson bridge ,Schering bridge, Wien bridge and Hay's Bridge.

UNIT II ELECTRICAL INSTRUMENTS 9

Principle and types of analog and digital voltmeters, ammeters, multimeters – Moving iron instruments – Moving coil instruments -Single and three phase wattmeters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III ELECTRONIC MEASUREMENTS 9

Cathode ray oscilloscopes – block schematic – applications – Analog and digital storage oscilloscope, sampling oscilloscope –Digital plotters and printers- Q Meters-Vector Meters – RF Voltage and Power Measurements – True RMS Meters.

UNIT IV TRANSDUCERS 9

Introduction of transducers – Classifications Selection of transducers – Resistive transducer – Potentiometer - Strain gauge –Inductive transducer - LVDT – Capacitive transducer - Piezo-electric transducers – Optical transducer - Encoders –Measurement of pressure and flow –Smart sensors.

UNIT V SIGNAL GENERATORS AND ANALYZERS 9

Function generators – pulse and square wave generators, RF signal generators – Sweep generators – Frequency synthesizer – wave analyzer – Harmonic distortion analyzer – spectrum analyzer - digital spectrum analyzer – Digital L,C,R Measurements and Digital RLC Meters.

TOTAL: 45 PERIODS

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

- understand the basic quantities in measurements using bridges.
- analyze various measuring techniques for both electrical and non-electrical quantities.
- provide a comparative study among the various types of oscilloscope.
- understand the basic fundamentals of signal generators and analyzer.
- understand the different types of transducers.

1. Albert D.Helfrick and William D.Cooper,” Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 2007.
2. Ernest O. Doebelin, “Measurement Systems- Application and Design”, TMH, 2007.
3. Sawhney A K, “A Course in Electrical and Electronic Measurement and Instrumentation”, DhanpatRai& Sons, 2012

1. S.Ramabhadran, “Electronic Measurements and Instruments”, Khanna Publishers, 2003.
2. Kalsi H.S, “Electronic Instrumentation”, McGraw Hill Education, 2010.
3. D. V. S. Moorthy, “Transducers and Instrumentation”, Prentice Hall of India, 2003.
4. J.B.Gupta, “A Course in electronic and Electrical Measurement”,S.K.Kataria& Sons,2003.
5. Martin Reissland, “Electrical Measurements”, New Age International (P)Ltd,2001

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B. I. Prasad
28/4/2016

COURSE OBJECTIVES

- To examine the electric force on stationary charged particles.
- To impart knowledge on the concepts of conductors, dielectrics and capacitance.
- To examine the magnetic force on steadily moving charged particles.
- To impart knowledge on the concepts of force between various elements and inductance.
- To impart knowledge on the concepts of field equations and electromagnetic waves.

UNIT I STATIC ELECTRIC FIELDS 9

Coulomb's law – Electric field intensity – Field due to different types of charges Electric flux density – Gauss law– Concept of divergence and curl – electric potential – Potential field due to different types of charges – Potential gradient – the dipole – field due to dipole – Energy density in electrostatic field.

UNIT II CONDUCTORS, DIELECTRICS AND CAPACITANCE 9

Current and current density – continuity of current – conductor properties– the nature of dielectric materials – boundary conditions– capacitance – different types of capacitances – capacitance of a two-wire line– Poisson's and Laplace's equations – Examples of solution of each one of them.

UNIT III STEADY MAGNETIC FIELDS 9

Biot- Savart Law – applications – Ampere’s circuital law – applications – curl of magnetic field intensity
- Magnetic flux and magnetic flux density – magnetic field intensity due to straight conductors - the scalar
and vector magnetic potentials – steady magnetic field laws – Magnetic boundary conditions.

UNIT IV FORCE TORQUE AND INDUCTANCE 9

Lorentz force equation – force between differential current elements – force and torque on a closed circuit
– the nature of magnetic materials – magnetization and permeability – inductance and mutual inductance –
inductance of solenoid and toroid.

UNIT V MAXWELLS EQUATIONS AND ELECTROMAGNETIC WAVES 9

Concept of displacement and conduction current – Modified Ampere’s Circuital law – Maxwell’s equations in point and integral forms – Comparison between Field Theory & Circuit Theory - Wave equations – Plane waves in free space – Polarization – Poynting Theorem and Poynting Vector and its significance – Energy in electromagnetic field.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- apply concepts and theories of electrostatics in field calculations for real world systems.

- analyze the concepts of electrostatic fields with capacitance
- determine the field due to moving charges.
- develop the boundary condition for different medium
- formulate the maxwell's equations and analyze the propagation of electromagnetic waves and their parameters in different media.

TEXT BOOKS

1. William H.Hayt, Jr., "Engineering Electromagnetics", Tata McGraw-Hill, 2011.
2. K.A.Gangadhar, "Field Theory", Khanna Publishers, 1997.
3. P.Dananjayan, "Engineering Electromagnetics", Lakhmi Publications, 2009.

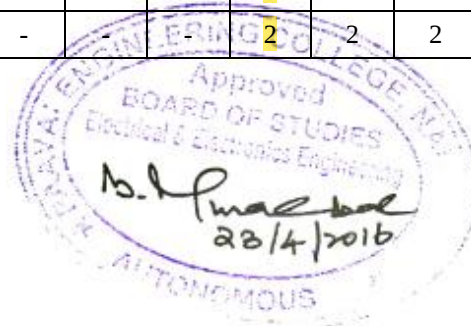
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1. Joseph A. Edminister, "Theory and Problems of electromagnetic", Schaum's outline series, 1999
2. David J.Griffiths, "Introduction to electrodynamics", Prentice Hall of India Private Limited, 1997.
3. Kraus and Fleish, "Electromagnetics with Applications", Tata McGraw Hill, 2005
4. Matthew N.O. Sadiku, "Principles of Electromagnetics", Oxford University Press, 2007.
5. Bhag Singh Guru, Hüseyin R. Hiziroglu, "Electromagnetic Field Theory Fundamentals", Cambridge University Press, 2004.

WEB LINKS

1. <http://hyperphysics.phy-astr.gsu.edu/hbase/electric/elefie.html>
2. <http://mypages.iit.edu/~smile/guests/gsmxsec1.html>
3. http://www.feynmanlectures.caltech.edu/II_05.html

CO-PO MAPPING:														
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CO5	3	3	2	-	-	-	-	-	-	-	-	2	2	2



COURSE OBJECTIVES

- To review the control structures and data types with emphasis on structured data types and array processing.
- To understand fundamentals of programming such as variables, conditional and iterative execution, methods, and object-oriented concepts.
- To create Java programs that leverage the object-oriented features of the Java language, such as encapsulation, inheritance and polymorphism; use data types, arrays and other data collections.
- To explore the Java Abstract Programming Interface (API) and Java Collection Framework through programming assignments.
- To know about exception handling, compile, test and run Java programs

UNIT I OVERVIEW

9

Object oriented programming concepts - Introduction to C++ – classes – access specifiers – function and data members – default arguments – function overloading – friend functions – static members – pointers and objects – constant objects – nested classes.

UNIT II BASIC CHARACTERISTICS OF OOP

9

Constructors – default constructor – Parameterized constructors – Constructor with dynamic allocation – copy constructor – destructors – operator overloading – overloading through friend functions – overloading the assignment operator – type conversion.

UNIT III ADVANCED PROGRAMMING

9

Polymorphism – virtual functions- Function and class templates - Exception handling – Inheritance

UNIT IV JAVA INTRODUCTION

9

Data types, variables and arrays, operators, control statements, classes, objects, methods – Inheritance

UNIT V EXCEPTION HANDLING

9

Packages and Interfaces, Exception handling, Multithreaded programming, Strings, Input / Output

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- understand the concepts of objects and their significance in real world.
- investigate problem in terms of objects and entities.
- implement features of object oriented programming to solve real world problems.

- understand the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
- compile, test and run Java programs comprising more than one class, to address a particular software problem.

TEXT BOOKS

1. B. Trivedi, "Programming with ANSI C++", Oxford University Press, 2007.
2. H.M.Deitel, P.J.Deitel, "Java: how to program", Fifth edition, Prentice Hall of India private limited, 2003.

REFERENCES

1. Ira Pohl, "Object Oriented Programming using C++", Pearson Education, Second Edition Reprint 2004.
2. S. B. Lippman, Josee Lajoie, Barbara E. Moo, "C++ Primer", Fourth Edition, Pearson Education, 2005.
3. B. Stroustrup, "The C++ Programming language", Third edition, Pearson Education, 2004.
4. Herbert Schildt, "The Java 2: Complete Reference", Fourth edition, TMH, 2002.

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CO4	-	2	2	-	1	-	-	-	-	-	-	1	1	3
CO5	1	2	2	1	-	-	1	-	-	-	-	-	1	3



COURSE OBJECTIVES

- To conduct relevant experiments for determining the characteristics of various electronic devices.
- To understand design and test amplifiers and oscillators
- To understand design and test power supplies
- To know the caliber current transformer

LIST OF EXPERIMENTS

1. Characteristics of PN Junction diode
2. Half wave and Full wave rectifiers with and without filter
3. Characteristics of Bipolar Junction transistor - CE, CB, CC Configurations
4. Characteristics of JFET
5. Characteristics of UJT
6. Characteristics of Photo Diode & Photo Transistor
7. Design of RC phase shift oscillator.
8. AC bridges.
9. DC bridges.
10. Instrumentation amplifiers.
11. Design of RC coupled amplifier
12. Design of Multivibrators.
13. Measurement of iron loss.
14. A/D and D/A converters.
15. Calibration of current transformer.

TOTAL: 60 PERIODS**COURSE OUTCOMES**

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

- design and construct a power supply and analyze the ripple factor with filters.
- draw the characteristics of the electronic devices by conducting suitable experiments.
- draw the response characteristics of diode clippers and clampers by constructing them.
- caliber current transformer.

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CO4	3	3	3	2	2	-	-	-	-	-	3	-	3	3



COURSE OBJECTIVES

- To get a clear understanding of object-oriented concepts.
- To understand object oriented programming through C++.
- To know the concepts of polymorphism.
- To understand simple JAVA concepts.

LIST OF EXPERIMENTS**C++:****1. Program using functions**

- functions with default arguments
- implementation of call by value, address, reference

2. Simple classes for understanding objects, member functions & constructors

- classes with primitive data members,
- classes with arrays as data members
- classes with pointers as data members
- classes with constant data members
- classes with static member functions

3. Compile time polymorphism

- operator overloading
- function overloading

4. Run time polymorphism

- inheritance
- virtual functions
- virtual base classes
- templates

5. File handling

- sequential access
- random access

JAVA:**6. Simple java applications**

- for understanding references to an instant of a class
- handling strings in JAVA

7. Simple package creation

- developing user defined packages in java

8. Interfaces

- developing user defined interfaces

- use predefined interfaces

9. Threading

- creation of threading in java applications
- multi-threading

10. Exception handling mechanism in java

- handling predefined exceptions
- handling user defined exceptions

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

- gain the basic knowledge on Object Oriented concepts.
- develop applications using Object Oriented Programming Concepts.
- implement features of object oriented programming to solve real world problems.
- apply JAVA concepts

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CO4	1	2	3	2	1.5	3	1.5	-	2	2	1	2	-	3



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TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- describe the concepts of electromechanical energy conversion.
- discuss the characteristics and applications of DC generators.
- recognize the characteristics and speed control of DC motors.
- analyze the performance of transformers.
- estimate the efficiency of DC machines and transformers by conducting suitable tests

TEXT BOOKS

1. D.P. Kothari and I.J. Nagrath, “Electric Machines”, Tata McGraw Hill, 2002.
2. P.S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2003.
3. Theraja A.K & Theraja B.L, “ A Text book of Electrical Technology (Vol II)”, S Chand & Co-., 2008.

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1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, “Electric Machinery”, Tata McGraw Hill, 2003.
2. Smarajit Ghosh, “Electrical Machines”, Pearson Education, 2012.
3. Parkar Smith, N.N., “Problems in Electrical Engineering” CBS Publishers and Distributors, 1984.
4. J.B. Gupta, “Theory and Performance of Electrical Machines”, S.K.Kataria and Sons, 2002.
5. K. Murugesh Kumar, “Electric Machines”, Vikas publishing, 2002.

WEBLINKS

1. <http://www.newagepublishers.com/samplechapter/001374.pdf>
2. http://nptel.iitk.ac.in/courses/Webcourse-contents/IIT-MADRAS/Elec_Mach1/Transformers1.pdf

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CO5	3	3	3	3	-	-	-	-	-	-	3	-	3	3



COURSE OBJECTIVES

- To impart knowledge on the basics of transmission and distribution of power system.
- To develop expression for computation of fundamental parameters of lines.
- To categorize the lines into different classes and develop equivalent circuits for these classes.
- To analyze the voltage distribution in insulator strings and methods to improve the same.
- To impart knowledge for estimation of sag and tension.

UNIT I INTRODUCTION 9

General layout of power system - Standard voltages for transmission - Advantages of high voltage transmission. Feeders, distributors and service mains. Distribution- Requirements of power distribution - Radial & Ring main systems – Overhead versus Underground System - AC and DC distribution: Calculation for concentrated and uniform loading.

UNIT II TRANSMISSION LINE PARAMETERS 9

Line parameters: Calculation of Resistance, Inductance and Capacitance of single phase and three-phase overhead lines with Symmetrical and Unsymmetrical spacing for solid, stranded conductors and bundled conductors - Transposition of line conductors - Applications of self and mutual GMD - Skin and proximity effects- Interference with neighboring communication circuits.

UNIT III ANALYSIS OF TRANSMISSION LINE PERFORMANCE 9

Performance of power transmission lines- Short transmission lines - Medium transmission lines- End condenser, Nominal T and Nominal π model - Transmission efficiency and voltage regulation - Long transmission lines - ABCD constants of transmission lines, Ferranti effect.

UNIT IV INSULATORS AND CABLES 9

Insulators - Properties and types of insulators - potential distribution over a string of insulators - String efficiency - Methods of improving string efficiency. Underground Cables - Construction of LT and HT Cables - Insulation resistance, Capacitance and dielectric stress of a single core cable - Grading of cables – Capacitance of 3-core cables.

UNIT V OVERHEAD TRANSMISSION LINES AND SAG 9

Overhead Transmission Lines- Types of supporting structures and line conductors used. Sag calculation- Effect of wind and ice loading – Corona – Substation layout -Overhead transmission system in India.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- compute transmission line parameters such as resistance, inductance and capacitance of overhead transmission lines and underground cables.
- compute voltage drop and power loss in DC and AC radial, ring and interconnected distribution networks.
- categorize the different types of insulators and cables.
- evaluate the performance of overhead transmission lines based on their models.
- design insulator strings for high voltage overhead transmission lines.

TEXT BOOKS

1. Soni Gupta & Bhatnagar, "A Course in Electrical Power", Dhanpat Rai & Sons, 2001.
2. C. L. Wadhwa, "Electrical Power Systems", New Age International, 2009.
3. V.K. Mehta, Rohit Mehta, "Principles of Power Systems", S. Chand & Co., 2011.

REFERENCES

1. W.D. Stevenson, "Elements of Power System Analysis", TMH, 2009.
2. S. M. Singh, "Electric power generation Transmission & Distribution", PHI, 2009.
3. Dr. S. L. Uppal, "Electrical Power", Khanna Publications, 2003.
4. B. R. Gupta, "Power System Analysis and Design", S. Chand, 2003.
5. G. Ramamurthy, "Handbook of Electrical power Distribution", Universities Press, 2013.

WEB LINKS

1. http://en.wikipedia.org/wiki/Electric_power_transmission
2. <http://www.elc.com/transmission-and-distribution.html>

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CO2	3	2	-	3	-	-	-	-	-	-	-	3	3	3
CO3	3	2	3	3	3	2	-	1	-	-	-	3	3	3
CO4	3	-	3	3	-	-	-	-	-	-	1	3	3	3
CO5	-	3	-	3	-	-	-	-	-	-	-	3	3	3



COURSE OBJECTIVES

- To understand the methods of representation of systems and to obtain system transfer function models.
- To provide knowledge on time response of systems and steady state error analysis
- To acquaint basic knowledge in obtaining the open loop and closed-loop frequency responses of systems.
- To impart the concept of stability of control system and methods of stability analysis.
- To study the design of compensators for a control system.

UNIT I SYSTEMS AND THEIR REPRESENTATION 15

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

UNIT II TIME RESPONSE 15

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

UNIT III FREQUENCY RESPONSE 15

Frequency response – Bode plot – Polar plot – Constant M and N circles – Nichol's chart – Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications.

UNIT IV STABILITY OF CONTROL SYSTEM 15

Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

UNIT V COMPENSATOR DESIGN 15

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots and root locus. Introduction to MATLAB Simulink.

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- model a control system using differential equations and transfer functions.
- analyse the transient response of control systems in using time domain

- evaluate and analyse control systems using frequency domain methods
- check the stability of systems and the effect of pole zero addition
- design compensators for control systems.

TEXT BOOKS

1. M.N. Bandyopadhyay, “Control Engineering Theory and Practice”, Prentice Hall of India, 2003.
2. I.J. Nagrath & M. Gopal, “Control Systems Engineering”, New Age International Publishers, 2003.
3. Smarajit Ghosh, “Control System Engineering”, Pearson Education, 2012.

REFERENCES

1. B.C. Kuo, “Automatic Control Systems”, Prentice Hall of India Ltd., 1995.
2. M. Gopal, “Control Systems, Principles & Design”, Tata McGraw Hill, 2002.
3. K. Ogata, “Modern Control Engineering”, Pearson Education, 2003.
4. S.K. Bhattacharya, “Control System Engineering”, Pearson, 2013.
5. Arthur, G.O. Mutambara, “Design and Analysis of Control; Systems”, CRC Press, 2009.

WEB LINKS

1. <http://bookboon.com/en/control-engineering-problems-with-solutions-ebook>
2. <http://www.facstaff.bucknell.edu/mastascu/econtrolhtml/Intro/Intro1.html>

CO-PO MAPPING:														
Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO4	3	3	3	-	3	-	-	-	-	-	3	-	3	3
CO5	3	3	3	-	3	-	-	-	-	-	3	-	3	3



COURSE OBJECTIVES

- To study the IC fabrication procedure.
- To infer the characteristics and application of Op-amp ICs.
- To familiarize the concepts of waveform generation and converters.
- To impart the knowledge on basic applications of Special IC's.
- To interpret the internal functional blocks of applications ICs.

UNIT I FABRICATION OF ICS**9**

Integrated Circuit Technology, Moore's law, Steps in fabrication of IC-wafer preparation-epitaxial growth-lithography-diffusion, Fabrication of resistors, capacitors, diodes, BJT and FET.

UNIT II OP-AMP CHARACTERISTICS AND APPLICATIONS**9**

Op-amp configurations, Ideal op-amp circuit analysis-DC and AC characteristics of ideal op-amp, - Inverting and Non-inverting amplifiers – summing amplifier - difference amplifier - voltage follower - Differentiator - Integrator – Nonlinear applications- clamper - clipper – sample and hold circuit, Log and Antilog Amplifier, Multiplier.

UNIT III WAVEFORM GENERATORS & CONVERTERS**9**

Sine wave generator- Weinbridge and phase shift oscillator, square wave, triangular wave, saw tooth wave generation, Schmitt trigger, and Window detector. Digital to analog converters- basic concepts, analog switches, types-weighted, R-2R ladder DAC. Analog to Digital converter- basic concepts, types-Flash, successive approximation and dual slope.

UNIT IV SPECIAL ICS**9**

IC555 Timer-Timer functional diagram, monostable and astable operation, Schmitt trigger and their applications.Phase Locked Loop-Operation of 565 PLL-Closed loop analysis of PLL-PLL applications, Voltage Controlled Oscillator.

UNIT V APPLICATION ICS**9**

Regulator IC's- LM78XX, 79XX Fixed voltage regulators, IC 723 General purpose register, LM 317, LM380 power amplifier, ICL 8038 function generator IC, isolation amplifiers, optocoupler, opto electronic ICs

TOTAL: 45 PERIODS**COURSE OUTCOMES**

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

- describe the IC fabrication procedure.

- examine the characteristics and application of op-amp.
- design waveform generation and Filters
- design circuits for application using special ICs.
- interpret the internal functional blocks and the applications of special ICs

TEXT BOOKS

1. David A.Bell, “Op-amp & Linear ICs”, Oxford, 2013.
2. Roy Choudry and Shail Jain, “Linear Integrated Circuits”, New Age, 2003
3. Gayakwad, R.A., “Op-amps & Linear Integrated Circuits”, Prentice Hall of India, 2003.

REFERENCES

1. Sergio Franco, “Design with operational amplifiers and Analog Integrated circuits”, Tata McGraw Hill, 2002
2. Millman, J. and Halkias, C.C., “Integrated Electronics-Analog and Digital System”, Tata McGraw Hill, 1995.
3. Floyd ,Buchla, “Fundamentals of Analog Circuits”, Pearson, 2013.
4. Salivahanan S &KanchanaBhaskaran V.S, “Linear Integrated Circuits”, TMH, 2008.
5. Robert F.Coughlin, Fredrick F.Driscoll, “Op-amp and Linear ICs”, Pearson Education, 2012.

WEB LINKS

1. en.wikipedia.org/wiki/Category:Linear_integrated_circuits
2. www.gobookee.org/linear-integrated-circuits-notes

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CO4	3	-	3	-	-	-	-	-	-	-	-	-	3	3
CO5	3	-	3	-	-	-	-	-	-	-	2	-	3	3



COURSE OBJECTIVES

- To study various number systems and to simplify the mathematical expressions using Boolean functions – simple problems.
- To study the implementation concepts of combinational circuits.
- To study the design of various synchronous and asynchronous circuits.
- To expose the students to various memory devices.
- To design digital circuits

UNIT I NUMBER SYSTEM & BOOLEAN ALGEBRA 15

Review of number system; types and conversion, codes. Boolean algebra: De-Morgan's theorem, switching functions and simplification using K-maps & Quine McCluskey method.

UNIT II COMBINATIONAL CIRCUITS 15

Design of Logic gates, NAND and NOR Implementations, Design of adder, subtractor, comparators, code converters, encoders, decoders, multiplexers and demultiplexers- Function realization using gates, multiplexers and demultiplexers

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 15

Flip flops - SR, D, JK and T; Analysis of synchronous sequential circuits; design of synchronous sequential circuits – Synchronous counters– Modulus counters, Up/Down counters, state diagram, state reduction, state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 15

Analysis of asynchronous sequential machines, Races & Hazards, state assignment techniques, asynchronous design problems, Asynchronous counters, Up/Down counters, Modulus counters.

UNIT V MEMORIES AND LOGIC FAMILIES 15

Memories: ROM, PROM, EPROM, EEPROM, PLA, PAL, FPGA - Digital logic families: RTL, TTL, ECL, CMOS.

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- device the number systems and simplify Boolean functions
- illustrate the various combinational circuits.
- design the synchronous and circuits.
- perform design and analysis of asynchronous circuits.

- develop digital circuits using basic IC's.

TEXT BOOKS

1. M. Morris Mano, "Digital Logic and Computer Design", Prentice Hall of India, 2002.
2. R.P.Jain, "Modern Digital Electronics", Tata Mc.Graw Hill, 2003
3. Thomas.L.Floyd, "Digital Fundamentals", Pearson Education, 2003.

REFERENCES

1. Charles H.Roth, "Fundamentals Logic Design", Jaico Publishing, 2002.
2. S.Arivazhagan, "Digital Logic Circuits", 2000
3. John F.Wakerly, "Digital Design Principles and Practice", Pearson Education, 2002.
4. John M.Yarbrough, "Digital Logic, Application & Design", Thomson, 2002.
5. Puri, "Digital Electronics:Circuits and Systems", Tata Mc.Graw Hill, 2000

WEB LINKS

1. en.wikipedia.org/wiki/Digital_electronics
2. <http://freevidelectures.com/Course/2319/Digital-Systems-Design/3>

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CO4	3	3	3	-	-	-	-	-	-	-	3	-	3	3
CO5	3	3	3	-	-	-	-	-	-	-	3	-	3	3



COURSE OBJECTIVES

- To understand about the fundamentals of modulation techniques.
- To know about the Transmitter and Receiver of different type of modulation.
- To gain knowledge on the different methods of pulse modulation techniques.
- To understand about the spread spectrum and multiple access techniques used in communication systems.
- To educate the basics of Satellite, Telecommunication and Optical communication.

UNIT I MODULATIONTECHNIQUES 9

Introduction to Modulation Techniques – Types – Need for Modulation_ Amplitude Modulation – Generation of AM waves (DSB-FC) - Suppressed carrier systems (DSB-SC) – Single side band modulation (SSB) – Vestigial side band modulation (VSB) - comparison of various AM systems. Introduction to Angle Modulation: Definitions for FM & PM – Narrow band FM – Wide band FM – FM Modulators – FM Demodulators- Comparison between AM & FM.

UNIT II TRANSMITTERS AND RECEIVERS 9

Demodulation of AM waves – Envelope Detectors – Synchronous Detectors - Pilot carrier method – AM Transmitters - Low level and High level transmitters – AM Receivers – TRF receiver, Super heterodyne receiver.

UNIT III PULSE MODULATION 9

Introduction to Pulse modulations – concepts of sampling and sampling theorems, PAM, PWM, PPM, PTM, quantization technique and coding: Delta Modulation, slope overload error. ADM - Inter Symbol Interference, Pulse Code Modulation, DPCM.

UNIT IV SPREAD SPECTRUM AND MA TECHNIQUES 9

Introduction to SS Techniques: Direct –sequence Spread Spectrum (DSSS) – Frequency Hopping Spread Spectrum (FHSS) –Time Hopping Spread Spectrum (THSS) – M
A Techniques: FDMA – TDMA – CDMA
– SDMA – OFDM.

UNIT V	COMMUNICATION SERVICES	9
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Tele Communication: GSM Architecture – 1st Gen, 2nd Gen and 3rd Gen Networks - Frequency Reuse – GPRS - EDGE. Satellite communication: Read – orbit – Satellite altitude – Transmission path – its loss – Satellite system. Fiber optical communication: Need – Principles of light transmission A 122 in a fiber – optical fiber communication system – **Light sources – Types & configuration of Optical Fiber.**

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- characterize and determine different methods of analog communication schemes.
- describe the Transmitter and Receiver of Modulation Techniques.
- characterize Pulse Modulation techniques and ISI methods.
- analyze different spread spectrum and multiple access techniques.
- describe the operation of Telecommunication, Satellite and Optical Communication Systems.

TEXT BOOKS

1. Simon Haykin, “Digital Communications”, John Wiley, 2006.
2. Theodore.S.Rappaport, “Wireless Communication”, Pearson Education, 2010
3. Singh.R.P.,Sapre.S.D, “Analog and DigitalCommunication Systems”, Tata McGraw Hill, 2010.

REFERENCES

1. Kennedy, “Electronics of Communication Systems”, Tata McGraw Hill, 2000.
2. Roddy D. And Coolen J, “Electronic communications”, Prentice Hall of India, 2000.
3. Anokh Singh, “Principles of communication Engineering”, S.Chand& Co. 2000.
4. Lathi B.P. “Modern digital and analog communication systems”, Oxford University Press, 2009.
5. Deshpande, N.D, “Communication Electronics”, Tata McGraw Hill, 2000.

WEB LINKS

1. www.wikipedia.org/wiki/Category:modulation
2. www.web.ee.ccu.edu.tw/.../class%20ppt/Multiple%20Access%20Techniques
3. <http://www.tech-faq.com/geostationary-satellite.html>
4. www.nptel.ac.in/courses/117102062 & [117101051](http://www.nptel.ac.in/courses/117101051)

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CO4	3	-	3	2	-	-	-	-	-	-	-	3	3	3
CO5	3	-	3	-	2	-	-	-	-	-	2	3	3	3



COURSE OBJECTIVE

- understand the performance of DC generators.
- know the characteristics of DC motors under loaded and unloaded conditions.
- know the performance of DC motors.
- study the speed control in DC shunt motor, Equivalent Circuit parameters and performance of Transformers.

LIST OF EXPERIMENTS

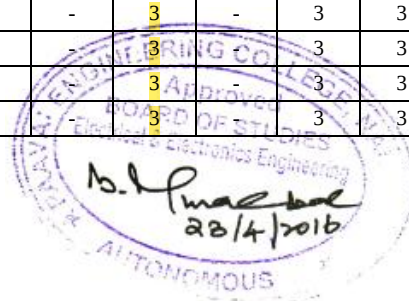
1. Load test on DC shunt motor and compound motor.
2. Load test on DC Series motor.
3. Speed Control of DC Shunt Motor and Swinburne's test.
4. Load test on DC shunt generator, DC compound generator.
5. Load test on single phase transformer.
6. Open circuit & Short circuit test on single phase transformer.
7. Open circuit characteristics of DC generator (Self and Separately Excited)
8. Hopkinson's test
9. Sumpner's test on 1-phase transformers
10. 3-phase transformer connections
11. Separation of no load losses in single phase transformer

TOTAL: 60 PERIODS**COURSE OUTCOMES**

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

- describe the performance of DC generators.
- summarize the characteristics of DC motors under loaded and unloaded conditions.
- predetermine the performance of DC motors.
- implement the speed control in DC shunt motor, Equivalent Circuit parameters and performance of Transformers.

CO-PO MAPPING:														
Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO4	3	3	3	3	3	-	-	-	-	-	3	-	3	3



COURSE OBJECTIVES

- To acquire programming skills in the analysis and design of control systems.
- To gain the knowledge for deriving transfer function of systems
- To analyse the stability of systems
- To test the performance of standard control equipments using analog simulation methods.

LIST OF EXPERIMENTS

1. Digital simulation of first and second order system.
2. Stability Analysis of Linear systems by Routh Hurwitz polynomial.
3. Stability Analysis of Linear systems by Root locus, Bode plot and Nyquist plot.
4. Design of Lag and lead compensator.
5. Design of P, PI, PD, PID controllers.
6. Transfer function of DC and AC servomotor.
7. Study of synchros.
8. Analog simulation of type 0 type 1 system.
9. Stepper motor control.
10. Transfer function of armature controlled and field controlled DC Motor.
11. Transfer function of DC generator.
12. AC and DC closed loop control system

TOTAL: 60 PERIODS**COURSE OUTCOMES**

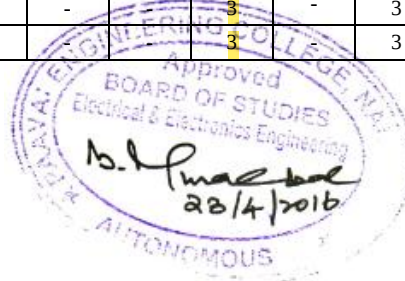
Upon the completion of the course, students will be able to

- basic knowledge on simulation of control system .
- design the feedback loop to achieve the desired output
- analyse the stability of systems.
- investigate servo motor speed and position control principles

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

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CO4	3	3	3	3	3	-	-	-	-	-	3	-	3	3



COURSE OBJECTIVES

- To familiarize with the operation of analog circuits using Op-amp
- To design of waveform generators.
- To understand the basic operations of Digital ICs
- To introduce the functions of counter, shift register and MUX-DEMUX circuits.

LIST OF EXPERIMENTS**LINEAR INTEGRATED CIRCUITS**

1. Inverting and non inverting amplifier
2. Summing amplifier and Difference amplifier
3. Integrator and Differentiator
4. Astable and monostable multivibrator using IC555
5. Waveform generators using IC741

DIGITAL CIRCUITS

1. Verification of logic gates
2. Boolean function implementation
3. Adder and Subtractor
4. Code Converters
5. Multiplexer and de-multiplexer
6. Encoder and Decoder
7. Synchronous counter

TOTAL: 60 PERIODS**COURSE OUTCOMES**

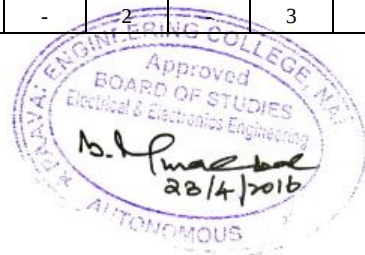
Upon the completion of the course, students will be able to

- describe the operation of amplifiers using BJT and FET.
- examine different waveforms of variable frequency.
- design multiplexers, data converters and counters.
- Implement functions of counter, shift register and MUX-DEMUX circuits.

CO-PO MAPPING:

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CO4	3	3	3	-	-	-	-	-	-	-	2	-	3	3



OBJECTIVES:

- To model the power system under steady state operating condition.
- To apply numerical methods to solve the power flow problem.
- To model and analyze the system under faulted conditions.
- To model and analyze the transient behaviour of power system when it is subjected to a fault.

UNIT I INTRODUCTION

9

Need for system planning and operational studies – basic components of a power system.-Introduction to restructuring - Single line diagram – per phase and per unit analysis – Generator - transformer – transmission line and load representation for different power system studies.- Primitive network - construction of Y-bus using inspection and singular transformation methods – z-bus.

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 - development of power flow model in complex variables form - iterative solution using Gauss-Seidel method - Q-limit check for voltage controlled buses – power flow model in polar form - iterative solution using Newton-Raphson method .

UNIT III FAULT ANALYSIS – BALANCED FAULTS

9

Importance of short circuit analysis - assumptions in fault analysis - analysis using Thevenin's theorem - Z-bus building algorithm - fault analysis using Z-bus – computations of short circuit capacity, post fault voltage and currents.

UNIT IV FAULT ANALYSIS – UNBALANCED FAULTS

9

Introduction to symmetrical components – sequence impedances – sequence circuits of synchronous machine, transformer and transmission lines - sequence networks analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem and Z-bus matrix.

UNIT V STABILITY ANALYSIS

9

Importance of stability analysis in power system planning and operation - classification of power system stability - angle and voltage stability – Single Machine Infinite Bus (SMIB) system: Development of swing equation - equal area criterion - determination of critical clearing angle and time – solution of swing equation by modified Euler method and Runge-Kutta fourth order method.

TOTAL : 45 PERIODS**OUTCOMES:**

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition, 2011.
2. John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', Tata McGraw-Hill, Sixth reprint, 2010.
3. P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan, 'Electrical Power Systems- Analysis, Security and Deregulation', PHI Learning Private Limited, New Delhi, 2012.

REFERENCES:

1. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

2. Kundur P., 'Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
3. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
4. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, ' Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
5. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2012.
6. C.A.Gross, "Power System Analysis," Wiley India, 2011.

EE6502

MICROPROCESSORS AND MICROCONTROLLERS

L T P C
3 0 0 3

OBJECTIVES:

- To study the Architecture of uP8085 & uC 8051
- To study the addressing modes & instruction set of 8085 & 8051.
- To introduce the need & use of Interrupt structure 8085 & 8051.
- To develop skill in simple applications development with programming 8085 & 8051
- To introduce commonly used peripheral / interfacing

UNIT I 8085 PROCESSOR

9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– **Timing Diagram – Interrupts.**

UNIT II PROGRAMMING OF 8085 PROCESSOR

9

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

UNIT III 8051 MICRO CONTROLLER

9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – **I/O ports and data transfer concepts– Timing Diagram** – Interrupts-Comparison to Programming concepts with 8085.

UNIT IV PERIPHERAL INTERFACING

9

Study on need, Architecture, configuration and interfacing, with ICs: **8255 , 8259 , 8254,8237,8251, 8279 , - A/D and D/A converters &Interfacing with 8085& 8051.**

UNIT V MICRO CONTROLLER PROGRAMMING & APPLICATIONS

9

Data Transfer, Manipulation, Control Algorithms& I/O instructions – Simple programming exercises- key board and display interface – Closed loop control of servo motor- stepper motor control – Washing Machine Control.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyse, linear and digital electronic circuits.
- To understand and apply computing platform and software for engineering problems.

TEXT BOOKS:

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi , 2007.
2. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.

REFERENCES:

1. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.
2. N.Senthil Kumar, M.Saravanan, S.Jeevananthan, 'Microprocessors and Microcontrollers', Oxford,2013.
3. Valder – Perez, "Microcontroller – Fundamentals and Applications with Pic," Yeesdee Publishers, Tayler & Francis, 2013.

ME6701

POWER PLANT ENGINEERING

L T P C
3 0 0 3

OBJECTIVES:

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

UNIT I COAL BASED THERMAL POWER PLANTS 10

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 10

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS 7

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : *Boiling Water Reactor* (BWR), *Pressurized Water Reactor* (PWR), *CANada Deuterium-Uranium reactor* (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY 10

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, *Solar Photo Voltaic* (SPV), *Solar Thermal*, *Geo Thermal*, *Biogas* and *Fuel Cell* power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 8

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, *relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.*

OUTCOMES:

- Upon completion of this course, the Students can able to understand different types of power plant, and its functions and their flow lines and issues related to them.
- Analyse and solve energy and economic related issues in power sectors.

TEXT BOOK:

1. P.K. Nag, Power Plant Engineering, Tata McGraw – Hill Publishing Company Ltd., Third Edition, 2008.

REFERENCES:

1. M.M. El-Wakil, Power Plant Technology, Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Black & Veatch, Springer, Power Plant Engineering, 1996.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, Standard Handbook of Power Plant Engineering, Second Edition, McGraw – Hill, 1998.
4. Godfrey Boyle, Renewable energy, Open University, Oxford University Press in association with the Open University, 2004.

EE6503**POWER ELECTRONICS****L T P C
3 0 0 3****OBJECTIVES:**

- To get an overview of different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations.

UNIT I POWERSEMI-CONDUCTOR DEVICES**9**

Study of switching devices, Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT-Static and Dynamic characteristics - Triggering and commutation circuit for SCR- Design of Driver and snubber circuit.

UNIT II PHASE-CONTROLLED CONVERTERS**9**

2-pulse, 3-pulse and 6-pulse converters– performance parameters –Effect of source inductance— Gate Circuit Schemes for Phase Control–Dual converters.

UNIT III DC TO DC CONVERTER**9**

Step-down and step-up chopper-control strategy–Forced commutated chopper–Voltage commutated, Current commutated, Load commutated, Switched mode regulators- Buck, boost, buck- boost converter, Introduction to Resonant Converters.

UNIT IV INVERTERS

9

Single phase and three phase voltage source inverters(both 120° mode and 180° mode)–Voltage & harmonic control–PWM techniques: Sinusoidal PWM, modified sinusoidal PWM - multiple PWM – Introduction to space vector modulation –Current source inverter.

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.

TOTAL:45 PERIODS

OUTCOMES:

- Ability to understand and analyse, linear and digital electronic circuits.

TEXT BOOKS:

1. M.H.Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, PHI Third Edition, New Delhi, 2004.
2. P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition, 2003.
3. L. Umanand, " Power Electronics Essentials and Applications", Wiley, 2010.

REFERENCES:

1. Joseph Vithayathil, ' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.
2. Ashfaq Ahmed Power Electronics for Technology Pearson Education, Indian reprint, 2003.
3. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2004 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. Daniel.W.Hart, "Power Electronics", Indian Edition, Mc Graw Hill, 3rd Print, 2013.
6. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, 2013.

EE6504

ELECTRICAL MACHINES – II

L T P C
3 1 0 4

OBJECTIVES:

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

UNIT I SYNCHRONOUS GENERATOR

9

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

UNIT II SYNCHRONOUS MOTOR

9

Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed-Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

UNIT III THREE PHASE INDUCTION MOTOR

9

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

9

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

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES

9

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor- Servo motors- Stepper motors - introduction to magnetic levitation systems.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- Ability to model and analyze electrical apparatus and their application to power system

TEXT BOOKS:

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D.Umans, 'Electric Machinery', Tata Mc Graw Hill publishing Company Ltd, 2003.
2. D.P. Kothari and I.J. Nagrath, 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2002.
3. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.

REFERENCES:

1. M.N.Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009.
2. Charles A. Gross, "Electric /Machines, "CRC Press, 2010.
3. K. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, 2002.
4. Syed A. Nasar, Electric Machines and Power Systems: Volume I, Mcgraw -Hill College; International ed Edition, January 1995.
5. Alexander S. Langsdorf, Theory of Alternating-Current Machinery, Tata McGraw Hill Publications, 2001.

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 and study the effect of state feedback

UNIT I SYSTEMS AND THEIR REPRESENTATION**9**

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

UNIT II TIME RESPONSE**9**

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**9**

Frequency response – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications- Effect of Lag, lead and lag-lead compensation on frequency response- Analysis.

UNIT IV STABILITY AND COMPENSATOR DESIGN**9**

Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria – Lag, lead and lag-lead networks – Lag/Lead compensator design using bode plots.

UNIT V STATE VARIABLE ANALYSIS**9**

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 – Effect of state feedback.

TOTAL (L:45+T:15): 60 PERIODS**OUTCOMES:**

- Ability to understand and apply basic science, circuit theory, theory control theory
Signal processing and apply them to electrical engineering problems.

TEXT BOOKS:

1. M. Gopal, 'Control Systems, Principles and Design', 4th Edition, Tata McGraw Hill, New Delhi, 2012
2. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.
3. Dhanesh. N. Manik, Control System, Cengage Learning, 2012.

REFERENCES:

1. Arthur, G.O.Mutambara, Design and Analysis of Control; Systems, CRC Press, 2009.
2. Richard C. Dorf and Robert H. Bishop, " Modern Control Systems", Pearson Prentice Hall, 2012.
3. Benjamin C. Kuo, Automatic Control systems, 7th Edition, PHI, 2010.
4. K. Ogata, 'Modern Control Engineering', 5th edition, PHI, 2012.

5. S.N.Sivanandam, S.N.Deepa, Control System Engineering using Mat Lab, 2nd Edition, Vikas Publishing, 2012.
6. S.Palani, Anoop. K.Jairath, Automatic Control Systems including Mat Lab, Vijay Nicole/ Mcgraw Hill Education, 2013.

EE6511

CONTROL AND INSTRUMENTATION LABORATORY

LT P C

0 0 3 2

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

INSTRUMENTATION:

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

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory

control theory and apply them to electrical engineering problems.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CONTROLSYSTEMS:

1. PID kit – 1 No.
DSO – 1 No.
CRO Probe – 2 nos
2. Personal computers
3. DC motor – 1 No.
Generator – 1 No. Rheostats – 2 nos
Ammeters Voltmeters
Connecting wires (3/20)
4. CRO 30MHz – 1 No.
2MHz Function Generator – 1No.
5. Position Control Systems Kit (with manual) – 1 No., Tacho Generator Coupling set
6. AC Synchro transmitter& receiver – 1No.
Digital multi meters

INSTRUMENTATION:

7. R, L, C Bridge kit (with manual)
8. a) Electric heater – 1No.
Thermometer – 1No. Thermistor (silicon type) RTD nickel type – 1No.

b) 30 psi Pressure chamber (complete set) – 1No. Current generator (0 – 20mA)
Air foot pump – 1 No. (with necessary connecting tubes)

c) LVDT 20mm core length movable type – 1No. CRO 30MHz – 1No.

d) Optical sensor – 1 No. Light source

e) Strain Gauge Kit with Handy lever beam – 1No.
100gm weights – 10 nos

f) Flow measurement Trainer kit – 1 No.
(1/2 HP Motor, Water tank, Digital Milliammeter, complete set)
9. Single phase Auto transformer – 1No.
Watt hour meter (energy meter) – 1No. Ammeter
Voltmeter Rheostat Stop watch
Connecting wires (3/20)
10. IC Transistor kit – 1No.

OBJECTIVES:

To enable learners to,

- Develop their communicative competence in English with specific reference to speaking and listening
- Enhance their ability to communicate effectively in interviews.
- Strengthen their prospects of success in competitive examinations.

UNIT I LISTENING AND SPEAKING SKILLS 12

Conversational skills (formal and informal)- group discussion- making effective presentations using computers, listening/watching interviews conversations, documentaries. **Listening to lectures, discussions from TV/ Radio/ Podcast.**

UNIT II READING AND WRITING SKILLS 12

Reading different genres of texts ranging from newspapers to creative writing. Writing job applications- cover letter- resume- emails- letters- memos- reports. Writing abstracts- summaries- interpreting visual texts.

UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS 12

International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) - **Civil Service(Language related)- Verbal Ability.**

UNIT IV INTERVIEW SKILLS 12

Different types of Interview format- answering questions- offering information- **mock interviews-body language(paralinguistic features)- articulation of sounds- intonation.**

UNIT V SOFT SKILLS 12

Motivation- emotional intelligence-Multiple intelligences- **emotional intelligence-** managing changes-time management-stress management-leadership traits-team work- career planning - intercultural communication- creative and critical thinking

TOTAL: 60 PERIODS

Teaching Methods:

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for gaining proficiency and better participation in the class.

Lab Infrastructure:

S. No.	Description of Equipment (minimum configuration)	Qty Required
1	Server	1 No.
	• PIV System	
	• 1 GB RAM / 40 GB HDD	
	• OS: Win 2000 server	
	• Audio card with headphones	
	• JRE 1.3	
2	Client Systems	60 Nos.
	• PIII or above	
	• 256 or 512 MB RAM / 40 GB HDD	
	• OS: Win 2000	
	• Audio card with headphones	
	• JRE 1.3	
3	Handicam	1 No.
4	Television 46"	1 No.
5	Collar mike	1 No.
6	Cordless mike	1 No.
7	Audio Mixer	1 No.
8	DVD recorder/player	1 No.
9	LCD Projector with MP3/CD/DVD provision for Audio/video facility	1 No.

Evaluation:

Internal: 20 marks

Record maintenance: Students should write a report on a regular basis on the activities conducted, focusing on the details such as the description of the activity, ideas emerged, learning outcomes and so on. At the end of the semester records can be evaluated out of 20 marks.

External: 80 marks

Online Test	- 35 marks
Interview	- 15 marks
Presentation	- 15 marks
Group Discussion	- 15 marks

Note on Internal and External Evaluation:

1. Interview – mock interview can be conducted on one-on-one basis.
2. Speaking – example for role play:
 - a. Marketing engineer convincing a customer to buy his product.
 - b. Telephonic conversation- fixing an official appointment / placing an order / enquiring and so on.
3. Presentation – should be extempore on simple topics.
4. Discussion – topics of different kinds; general topics, and case studies.

OUTCOMES:

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

- Take international examination such as IELTS and TOEFL
- Make presentations and Participate in Group Discussions.
- Successfully answer questions in interviews.

REFERENCES:

1. **Business English Certificate Materials**, Cambridge University Press.

2. **Graded Examinations in Spoken English and Spoken English for Work** downloadable materials from Trinity College, London.
3. **International English Language Testing System** Practice Tests, Cambridge University Press.
4. Interactive Multimedia Programs on **Managing Time and Stress**.
5. **Personality Development** (CD-ROM), Times Multimedia, Mumbai.
6. Robert M Sherfield and et al. **"Developing Soft Skills"** 4th edition, New Delhi: Pearson Education, 2009.

Web Sources:

<http://www.slideshare.net/rohitjsh/presentation-on-group-discussion>

http://www.washington.edu/doit/TeamN/present_tips.html

<http://www.oxforddictionaries.com/words/writing-job-applications>

<http://www.kent.ac.uk/careers/cv/coveringletters.htm>

http://www.mindtools.com/pages/article/newCDV_34.htm

EE6512

ELECTRICAL MACHINES LABORATORY - II

**LT P C
0 0 3 2**

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 test on three-phase induction motor(Determination of equivalent circuit parameters).
8. Separation of No-load losses of three-phase induction motor.
9. Load test on single-phase induction motor.
10. No load and blocked rotor test on single-phase induction motor.
11. Study of Induction motor Starters

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to model and analyze electrical apparatus and their application to power system

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Synchronous Induction motor 3HP – 1 No.
2. DC Shunt Motor Coupled With Three phase Alternator – 4 nos
3. DC Shunt Motor Coupled With Three phase Slip ring Induction motor – 1 No.

4. Three Phase Induction Motor with Loading Arrangement – 2 nos
5. Single Phase Induction Motor with Loading Arrangement – 2 nos
6. Tachometer -Digital/Analog – 8 nos
7. BLDC Motor – 1 No.
8. Single Phase Auto Transformer – 2 nos
9. Three Phase Auto Transformer – 3 nos
10. Single Phase Resistive Loading Bank – 2 nos
11. Three Phase Resistive Loading Bank – 2 nos
12. Capacitor Bank – 1 No.
13. SPST switch – 2 nos

EC6651

COMMUNICATION ENGINEERING

**L T P C
3 0 0 3**

OBJECTIVES:

- To introduce different methods of analog communication and their significance
- To introduce Digital Communication methods for high bit rate transmission
- To introduce the concepts of source and line coding techniques for enhancing rating of transmission of minimizing the errors in transmission.
- To introduce MAC used in communication systems for enhancing the number of users.
- To introduce various media for digital communication

UNIT I ANALOG COMMUNICATION

9

AM – Frequency spectrum – vector representation – power relations – generation of AM – DSB, DSB/SC, SSB, VSB AM Transmitter & Receiver; FM and PM – frequency spectrum – power relations : NBFM & WBFM, Generation of FM and DM, Amstrong method & Reactance modulations : FM & PM frequency.

UNIT II DIGITAL COMMUNICATION

9

Pulse modulations – concepts of sampling and sampling theormes, PAM, PWM, PPM, PTM, quantization and coding : DCM, DM, slope overload error. ADM, DPCM, OOK systems – ASK, FSK, PSK, BSK, QPSK, QAM, MSK, GMSK, applications of Data communication.

UNIT III SOURCE CODES, LINE CODES & ERROR CONTROL (Qualitative only)

9

Primary communication – entropy, properties, BSC, BEC, source coding : Shaum, Fao, Huffman coding : noiseless coding theorem, BW – SNR trade off codes: NRZ, RZ, AMI, HDBP, ABQ, MBnBcodes : Efficiency of transmissions, error control codes and applications: convolutions & block codes.

UNIT IV MULTIPLE ACCESS TECHNIQUES

9

SS&MA techniques : FDMA, TDMA, CDMA, SDMA application in wire and wireless communication : Advantages (merits) :

UNIT V SATELLITE, OPTICAL FIBER – POWERLINE, SCADA**9**

Orbits : types of satellites : frequency used link establishment, MA techniques used in satellite communication, earth station; aperture actuators used in satellite – Intelsat and Insat: fibers – types: sources, detectors used, digital filters, optical link: power line carrier communications: SCADA

TOTAL : 45 PERIODS**OUTCOMES:**

- Ability to understand and analyse, linear and digital electronic circuits.

TEXT BOOKS:

1. Taub & Schilling “Principles of Communication Systems” Tata McGraw Hill 2007.
2. J.Das “Principles of Digital Communication” New Age International, 1986.

REFERENCES:

1. Kennedy and Davis “Electronic Communication Systems” Tata McGraw hill, 4th Edition, 1993.
2. Sklar “Digital Communication Fundamentals and Applications” Pearson Education, 2001.
3. Bary le, Memuschmidt, Digital Communication, Kluwer Publication, 2004.
4. B.P.Lathi “Modern Digital and Analog Communication Systems” Oxford University Press, 1998.

EE6601**SOLID STATE DRIVES****L T P C****3 0 0 3****OBJECTIVES:**

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

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 – 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 and discontinuous conduction– Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive.

UNIT III INDUCTION MOTOR DRIVES**9**

Stator voltage control–energy efficient drive–v/f control–constant airgap flux–field weakening mode – voltage / current fed inverter – closed loop control.

UNIT IV SYNCHRONOUS MOTOR DRIVES**9**

V/f control and self control of synchronous motor: Margin angle control and power factor control –

permanent magnet synchronous motor.

UNIT V DESIGN OF CONTROLLERS FOR DRIVES

9

Transfer function for DC motor / load and converter – closed loop control with Current and speed feedback–armature voltage control and field weakening mode – Design of controllers; current controller and speed controller- converter selection and characteristics.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.

TEXT BOOKS:

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992.
2. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.
3. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice Hall of India, 2001.

REFERENCES:

1. John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier 2012.
2. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press(Taylor and Francis Group), 2013.
3. S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 1993.
4. S. Sivanagaraju, M. Balasubba Reddy, A. Mallikarjuna Prasad "Power semiconductor drives" PHI, 5th printing, 2013.
5. N.K.De., P.K.SEN"Electric drives" PHI, 2012.
6. Vedam Subramanyam, "Thyristor Control of Electric Drives", Tata McGraw Hill, 2007.

EE6602

EMBEDDED SYSTEMS

L T P C
3 0 0 3

OBJECTIVES:

- To introduce the Building Blocks of Embedded System
- To Educate in Various Embedded Development Strategies
- To Introduce Bus Communication in processors, Input/output interfacing.
- To impart knowledge in Various processor scheduling algorithms.
- To introduce Basics of Real time operating system and example tutorials to discuss on one real-time operating system tool

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS

9

Introduction to Embedded Systems – The build process for 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.

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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 INTRODUCTION**9**

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

UNIT II REAL POWER - FREQUENCY CONTROL**9**

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

UNIT III REACTIVE POWER–VOLTAGE CONTROL**9**

Generation and absorption of reactive power - basics of reactive power control - excitation systems – modeling - static and dynamic analysis - stability compensation - methods of voltage control: tap-changing transformer, SVC (TCR + TSC) and STATCOM – secondary voltage control.

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH**9**

Formulation of economic dispatch problem – I/O cost characterization – incremental cost curve - co-ordination equations without and with loss (No derivation of loss coefficients) - solution by direct method and λ -iteration method - statement of unit commitment problem – priority-list method - forward dynamic programming.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS**9**

Need for computer control of power systems - concept of energy control centre - functions - system monitoring - data acquisition and control - system hardware configuration – SCADA and EMS functions - network topology - state estimation – WLSE - Contingency Analysis - state transition diagram showing various state transitions and control strategies.

TOTAL : 45 PERIODS**OUTCOMES:**

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2003.
3. Abhijit Chakrabarti, Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

REFERENCES:

1. Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition, 2011.
2. Kundur P., 'Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
4. N.V.Ramana, "Power System Operation and Control," Pearson, 2011.
5. C.A.Gross, "Power System Analysis," Wiley India, 2011.

EE6604

DESIGN OF ELECTRICAL MACHINES

LT P C
3 1 0 4

OBJECTIVES:

- To study mmf calculation and thermal rating of various types of electrical machines.
- To design armature and field systems for D.C. machines.
- To design core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines.
- To design stator and rotor of synchronous machines and study their thermal behaviour.

UNIT I INTRODUCTION

9

Major considerations in Electrical Machine Design - Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings - Thermal considerations - Heat flow – Temperature rise and Insulating Materials - **Rating of machines – Standard specifications.**

UNIT II DC MACHINES

9

Output Equations – Main Dimensions – Choice of Specific Electric and Magnetic Loading - Magnetic Circuits Calculations - **Carter's Coefficient - Net length of Iron –Real & Apparent flux densities** – Selection of number of poles – Design of Armature – Design of commutator and brushes – performance prediction using design values.

UNIT III TRANSFORMERS

9

Output Equations – Main Dimensions - kVA output for single and three phase transformers – Window space factor – Design of core and winding – Overall dimensions – Operating characteristics – No load current – Temperature rise in Transformers – Design of Tank - Methods of cooling of Transformers.

UNIT IV INDUCTION MOTORS

9

Output equation of Induction motor – Main dimensions – Choice of Average flux density – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – **Design of wound rotor – Magnetic leakage calculations** – Leakage reactance of polyphase machines- Magnetizing current - Short circuit current – Operating characteristics- Losses and Efficiency.

UNIT V SYNCHRONOUS MACHINES

9

Output equations – choice of Electrical and Magnetic Loading – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – 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 – Rotor design.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- Ability to model and analyze electrical apparatus and their application to power system

TEXT BOOKS:

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 1984.
2. M.V.Deshpande "Design and Testing of Electrical Machine Design" Wheeler Publications, 2010.

REFERENCES:

1. A.Shanmuga Sundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.
2. R.K.Agarwal "Principles of Electrical Machine Design" Esskay Publications, Delhi, 2002.
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.

EE6611

POWER ELECTRONICS AND DRIVES LABORATORY

LT P C

0 0 3 2

OBJECTIVES:

To provide hands on experience with power electronic converter design and testing

LIST OF EXPERIMENTS:

1. Gate Pulse Generation using R, RC and UJT.
2. Characteristics of SCR and Triac
3. Characteristics of MOSFET and IGBT
4. AC to DC half controlled converter
5. AC to DC fully controlled Converter
6. Step down and step up MOSFET based choppers
7. IGBT based single phase PWM inverter
8. IGBT based three phase PWM inverter
9. AC Voltage controller
10. Switched mode power converter.
11. Simulation of PE circuits (1 Φ & 3 Φ semiconverter, 1 Φ & 3 Φ full converter, dc-dc converters, ac voltage controllers).

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and analyse, linear and digital electronic circuits.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Device characteristics (for SCR, MOSFET, TRIAC and IGBT kit with builtin / discrete power supply and meters) - 2 each

2. SinglephaseSCRbasedhalfcontrolledconverterandfullycontrolledconverteralong with built-in/separate/firing circuit/module and meter – 2 each
3. MOSFET based step up and step down choppers(Built in/ Discrete) – 1 each
4. IGBT based single phase PWM inverter module/Discrete Component – 2
5. IGBT based three phase PWM inverter module/Discrete Component – 2
6. Switched mode power converter module/Discrete Component – 2
7. SCR & TRIAC based 1 phase AC controller along with lamp or rheostat load - 2
8. Cyclo converter kit with firing module –
9. Dual regulated Dc power supply with common ground
10. Cathode ray Oscilloscope –10
11. Isolation Transformer – 5
12. Single phase Auto transformer –3
13. Components (Inductance, Capacitance) 3 set for each
14. Multimeter – 5
15. LCR meter – 3
16. Rheostats of various ranges – 2 sets of 10 value
17. Work tables – 10
18. DC and AC meters of required ranges – 20
19. Component data sheets to be provided

EE6612

MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

**LT P C
0 0 3 2**

OBJECTIVES:

To provide training on programming of microprocessors and microcontrollers and understand the interface requirements.

LIST OF EXPERIMENTS:

1. Simple arithmetic operations: addition / subtraction / multiplication / division.
2. Programming with control instructions:
 - (i) Ascending / Descending order, Maximum / Minimum of numbers
 - (ii) Programs using Rotate instructions
 - (iii) Hex / ASCII / BCD code conversions.
3. Interface Experiments: with 8085
 - (i) A/D Interfacing. & D/A Interfacing.
4. Traffic light controller.
5. I/O Port / Serial communication
6. Programming Practices with Simulators/Emulators/open source

7. Read a key ,interface display
8. Demonstration of basic instructions with 8051 Micro controller execution, including:
 - (i) Conditional jumps, looping
 - (ii) Calling subroutines.
- 9.. Programming I/O Port 8051
 - (i) study on interface with A/D & D/A
 - (ii) study on interface with DC & AC motor .
10. Mini project development with processors.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and analyse, linear and digital electronic circuits.
- To understand and apply computing platform and software for engineering problems.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl.No.	Description of Equipment	Quantity required
1.	8085 Microprocessor Trainer with Power Supply	15
2.	8051 Micro Controller Trainer Kit with power supply	15
3.	8255 Interface board	5
4.	8251 Interface board	5
5.	8259 Interface board	5
6.	8279 Keyboard / Display Interface board	5
7.	8254 timer counter	5
8.	ADC and DAC card	5
9.	AC & DC motor with Controller	5
10.	Traffic Light Control System	5

EE6613

PRESENTATION SKILLS AND 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 over head 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 : 30 PERIODS

OUTCOMES:

- Ability to review, prepare and present technological developments
- Ability to face the placement interviews

EE6701

HIGH VOLTAGE ENGINEERING

L T P C
3 0 0 3

OBJECTIVES:

- To understand the 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 overvoltages, Corona and its effects – Reflection and Refraction of Travelling waves- Protection against overvoltages.

UNIT II DIELECTRIC BREAKDOWN

9

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS

9

Generation of High DC, AC, impulse voltages and currents - Triggering and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS

9

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION

9

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second

Edition Elsevier , New Delhi, 2005.

3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.

REFERENCES:

1. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
2. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Third Edition, 2010.

EE6702

PROTECTION AND SWITCHGEAR

L T P C
3 0 0 3

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 ELECTROMAGNETIC 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.

UNIT III APPARATUS PROTECTION

9

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, busbars and transmission line.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION

9

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

UNIT V CIRCUIT BREAKERS

9

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF6 and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

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', Dhanpat Rai & Co.,1998.

REFERENCES:

1. Badri Ram ,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. Ravindra P.Singh, ' Switchgear and Power System Protection', PHI Learning Private Ltd., New Delhi, 2009.
5. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,'Protection and Switchgear' Oxford University Press, 2011.

EE6703**SPECIAL ELECTRICAL MACHINES****LT P C
3 0 0 3****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.

UNIT I 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 II 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 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.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to model and analyze electrical apparatus and their application to power system

TEXT BOOKS:

1. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
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, 1984.

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.
4. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

MG6851

PRINCIPLES OF MANAGEMENT

**LT P C
3 0 0 3**

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: 45 PERIODS

OUTCOMES:

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

TEXT BOOKS:

1. Stephen P. Robbins & Mary Coulter, “ Management”, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, Pearson Education, 6th Edition, 2004.

REFERENCES:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, “ Management”, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich “Essentials of Management” Tata McGraw Hill,1998.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999.

OBJECTIVES:

To provide better understanding of power system analysis through digital simulation

LIST OF EXPERIMENTS:

1. Computation of Parameters and Modelling of Transmission Lines
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
3. Load Flow Analysis - I : Solution of load flow and related problems using Gauss-Seidel Method
4. Load Flow Analysis - II: Solution of load flow and related problems using Newton Raphson.
5. Fault Analysis
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
7. Transient Stability Analysis of Multi machine Power Systems
8. Electromagnetic Transients in Power Systems
9. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
10. Economic Dispatch in Power Systems.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

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

OBJECTIVES:

To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercise.

METHOD OF EVALUATION:

The students will be assessed 100% internally through weekly test with objective type questions on all the subject related topics

TOTAL : 30 PERIODS

OUTCOMES:

- Ability to review, prepare and present technological developments

OBJECTIVES:

- To analyze the various concepts behind renewable energy resources.
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To introduce knowledge on Solar Radiation and Solar Energy Collectors
- To introduce concepts of Wind Energy and its utilization

UNIT I ELECTRIC DRIVES AND TRACTION**9**

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - traction motors - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT II ILLUMINATION**9**

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.

UNIT III HEATING AND WELDING**9**

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding.

UNIT IV SOLAR RADIATION AND SOLAR ENERGY COLLECTORS**9**

Introduction - solar constant - solar radiation at the Earth's surface - solar radiation geometry – estimation of average solar radiation - physical principles of the conversion of solar radiation into heat – flat-plate collectors - transmissivity of cover system - energy balance equation and collector efficiency - concentrating collector - advantages and disadvantages of concentrating collectors - performance analysis of a cylindrical - parabolic concentrating collector – Feedin Invertors.

UNIT V WIND ENERGY**9**

Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind Turbines - analysis of aerodynamic forces acting on the blade - performances of wind.

TOTAL : 45 PERIODS**OUTCOMES:**

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to handle the engineering aspects of electrical energy generation and utilization.

TEXT BOOKS:

1. N.V. Suryanarayana, "Utilisation of Electric Power", Wiley Eastern Limited, New Age International Limited, 1993.
2. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons, 2000.
3. G.D.Rai, "Non-Conventional Energy Sources", Khanna Publications Ltd., New Delhi, 1997.

REFERENCES:

1. R.K.Rajput, Utilisation of Electric Power, Laxmi publications Private Limited., 2007.

2. H.Partab, Art and Science of Utilisation of Electrical Energy”, Dhanpat Rai and Co., New Delhi, 2004.
3. C.L.Wadhwa, “Generation, Distribution and Utilisation of Electrical Energy”, New Age International Pvt.Ltd., 2003.
4. S. Sivanagaraju, M. Balasubba Reddy, D. Srilatha,’ Generation and Utilization of Electrical Energy’, Pearson Education, 2010.
5. Donalds L. Steeby,’ Alternative Energy Sources and Systems’, Cengage Learning, 2012.

EE6811

PROJECT WORK

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: 180 PERIODS

OUTCOMES:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

OBJECTIVES :

- To study about the concepts of windows programming models, MFC applications, drawing with the GDI, getting inputs from Mouse and the Keyboard.
- To study the concepts of Menu basics, menu magic and classic controls of the windows programming using VC++.
- To study the concept of Document/View Architecture with single & multiple document interface, toolbars, status bars and File I/O Serialization.
- To study about the integrated development programming event driven programming, variables, constants, procedures and basic ActiveX controls in visual basic.
- To understand the database and the database management system, visual data manager, data bound controls and ADO controls in VB.

UNIT I FUNDAMENTALS OF WINDOWS AND MFC**9**

Messages - Windows programming - SDK style - Hungarian notation and windows data types - SDK programming in perspective. **The benefits of C++ and MFC - MFC design philosophy – Document / View architecture** - MFC class hierarchy - AFX functions. Application object - Frame window object - Message map. Drawing the lines – Curves – Ellipse – Polygons and other shapes. GDI pens – Brushes - GDI fonts - Deleting GDI objects and deselecting GDI objects. Getting input from the mouse: Client & Non-client - Area mouse messages - Mouse wheel - Cursor. Getting input from the keyboard: Input focus - Keystroke messages - Virtual key codes - Character & dead key messages.

UNIT II RESOURCES AND CONTROLS**9**

Creating a menu – Loading and displaying a menu – Responding to menu commands – Command ranges - Updating the items in menu, **update ranges – Keyboard accelerators. Creating menus programmatically - Modifying menus programmatically - The system menu** - Owner draw menus – Cascading menus - Context menus. The C button class – C list box class – C static class - The font view application – C edit class – C combo box class – C scrollbar class. Modal dialog boxes – Modeless dialog boxes.

UNIT III DOCUMENT / VIEW ARCHITECTURE**9**

The in existence function revisited – Document object – View object – Frame window object – Dynamic object creation. SDI document template - Command routing. Synchronizing multiple views of a document – **Mid squares application – Supporting multiple document types – Alternatives to MDI. Splitter Windows: Dynamic splitter window** – Static splitter windows. Creating & initializing a toolbar - Controlling the toolbar's visibility – Creating & initializing a status bar - Creating custom status bar panes – Status bar support in appwizard. Opening, closing and creating the files - Reading & Writing – C file derivatives – Serialization basics - Writing serializable classes.

UNIT IV FUNDAMENTALS OF VISUAL BASIC**9**

Menu bar – Tool bar – Project explorer – Toolbox – Properties window – Form designer – Form layout – Intermediate window. Designing the user interface: Aligning the controls – Running the application – Visual development and event driven programming.

Variables: Declaration – Types – Converting variable types – User defined data types - Lifetime of a variable. Constants - Arrays – Types of arrays. Procedures: Subroutines – Functions – Calling procedures. Text box controls – List box & Combo box controls – Scroll bar and slider controls – File controls.

UNIT V DATABASE PROGRAMMING WITH VB**9**

Record sets – Data control – Data control properties, methods. Visual data manager: Specifying indices with the visual data manager – Entering data with the visual data manager. Data bound list control – Data bound combo box – Data bound grid control. Mapping databases: Database object – Table def object, Query def object. Programming the active database objects – ADO object model – Establishing a connection - Executing SQL statements – Cursor types and locking mechanism – Manipulating the record set object – Simple record editing and updating.

TOTAL = 45 PERIODS**OUTCOMES:**

- To understand and apply computing platform and software for engineering problems.

TEXT BOOKS:

1. Jeff Prosise, 'Programming Windows With MFC', Second Edition, WP Publishers & Distributors (P) Ltd, Reprinted, 2002.
2. Evangelos Petroutsos, 'Mastering Visual Basic 6.0', BPB Publications, 2002.

REFERENCES:

1. Herbert Schildt, 'MFC Programming From the Ground Up', Second Edition, Tata McGraw Hill, reprinted, 2002.
2. John Paul Muller, 'Visual C++ 6 From the Ground Up Second Edition', Tata McGraw Hill, Reprinted, 2002.
3. Curtis Smith & Micheal Amundsen, 'Teach Yourself Database Programming with Visual Basic 6 in 21 days', Techmedia Pub, 1999.

IC6601**ADVANCED CONTROL SYSTEM**

L	T	P	C
3	0	0	3

OBJECTIVES :

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

UNIT I STATE VARIABLE DESIGN**9**

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control.

UNIT II PHASE PLANE ANALYSIS**9**

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III DESCRIBING FUNCTION ANALYSIS**9**

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

UNIT IV OPTIMAL CONTROL**9**

Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti's equation – Application examples.

UNIT V OPTIMAL ESTIMATION**9**

Optimal estimation – Kalman Bucy Filter-Solution by duality principle-Discrete systems- Kalman Filter- Application examples..

TOTAL : 45 PERIODS**OUTCOMES:**

- Ability to apply advanced control theory to practical engineering problems.

TEXT BOOKS :

1. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.
2. G. J. Thaler, "Automatic Control Systems", Jaico Publishing House, 1993.
3. M.Gopal, Modern Control System Theory, New Age International Publishers, 2002.

REFERENCES:

1. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
2. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.
3. K. Ogata, 'Modern Control Engineering', 4th edition, PHI, New Delhi, 2002.
4. T. Glad and L. Ljung,, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002.
5. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.

EE6002**POWER SYSTEM TRANSIENTS****L T P C
3 0 0 3****OBJECTIVES:**

- To study the generation of switching transients and their control using circuit – theoretical concept.
- To study the mechanism of lighting strokes and the production of lighting surges.
- To study the propagation, reflection and refraction of travelling waves.
- To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT I INTRODUCTION AND SURVEY**9**

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT II SWITCHING TRANSIENTS**9**

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient

voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - ferro resonance.

UNIT III LIGHTNING TRANSIENTS

9

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS

9

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewley's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM

9

The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - over voltage induced by faults -switching surges on integrated system Qualitative application of EMTP for transient computation.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2nd Edition, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

REFERENCES:

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
3. Y.Hase, Handbook of Power System Engineering," Wiley India, 2012.
4. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley, 2012.

OBJECTIVES:

- To introduce the basic concepts of linear programming
- To educate on the advancements in Linear programming techniques
- To introduce non-linear programming techniques
- To introduce the interior point methods of solving problems
- To introduce the dynamic programming method

UNIT I LINEAR PROGRAMMING**9**

Introduction - formulation of linear programming model-Graphical solution-solving LPP using simplex algorithm – Revised Simplex Method.

UNIT II ADVANCES IN LPP**9**

Dualit theory- Dual simplex method - Sensitivity analysis--Transportation problems– Assignment problems-Traveling sales man problem -Data Envelopment Analysis.

UNIT III NON LINEAR PROGRAMMING**9**

Classification of Non Linear programming – Lagrange multiplier method – Karush – Kuhn Tucker conditions–Reduced gradient algorithms–Quadratic programming method – Penalty and Barrier method.

UNIT IV INTERIOR POINT METHODS**9**

Karmarkar's algorithm–Projection Scaling method–Dual affine algorithm–Primal affine algorithm Barrier algorithm.

UNIT V DYNAMIC PROGRAMMING**9**

Formulation of Multi stage decision problem–Characteristics–Concept of sub-optimization and the principle of optimality–Formulation of Dynamic programming–Backward and Forward recursion–Computational procedure–Conversion of final value problem in to Initial value problem.

TOTAL: 45 PERIODS**OUTCOMES:**

- To understand ethical issues, environmental impact and acquire management skills.

TEXT BOOKS:

1. Hillier and Lieberman "Introduction to Operations Research", TMH, 2000.
2. R.Panneerselvam, "Operations Research", PHI, 2006
3. Hamdy ATaha, "Operations Research –An Introduction", Prentice Hall India, 2003.

REFERENCES:

1. Philips, Ravindran and Solberg, "Operations Research", John Wiley, 2002.
2. Ronald L.Rardin, "Optimization in Operation Research" Pearson Education Pvt. Ltd. New Delhi, 2005.

OBJECTIVES:

- To expose the basic concepts of optical fibers and their industrial applications.
- To provide adequate knowledge about Industrial application of optical fibres.
- To provide basic concepts of lasers.
- To provide knowledge about Industrial application of lasers
- To provide knowledge about Industrial application of Holography and Medical applications of Lasers.

UNIT I OPTICAL FIBRES AND THEIR PROPERTIES**9**

Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicers – Fibre termination – Optical sources – Optical detectors.

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBRES**9**

Fibre optic sensors – Fibre optic instrumentation system – Different types of modulators – 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 – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

UNIT IV INDUSTRIAL APPLICATION OF LASERS**9**

Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Removal and vaporization.

UNIT V HOLOGRAM AND MEDICAL APPLICATIONS**9**

Holography – Basic principle - Methods – Holographic interferometry and application, Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser and tissue interactive – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL : 45 PERIODS**OUTCOMES:**

- Ability to understand and analyze Instrumentation systems and their applications to various industries.

TEXT BOOKS:

1. R.P.Khare, Fiber Optics and Optoelectronics, Oxford university press, 2008.
2. J. Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2001.

REFERENCES:

1. Asu Ram Jha, Fiber Optic Technology Applications to commercial, Industrial, Military and Space Optical systems, PHI learning Private limited, 2009.
2. M. Arumugam, Optical Fibre Communication and Sensors, Anuradha Agencies, 2002.
3. John F. Read, Industrial Applications of Lasers, Academic Press, 1978.

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues - Basic mechanics of spinal column and limbs -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO₂, pO₂, finger-tip oxymeter - ESR, GSR measurements.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems - Analysis of digital images.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation.

TOTAL: 45 PERIODS**OUTCOMES:**

- Ability to understand and analyze Instrumentation systems and their applications to various industries.

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi, 2007.
2. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.

3. Khandpur R.S, Handbook of Biomedical Instrumentation, , Tata McGraw-Hill, New Delhi, 2nd Edition, 2003.

REFERENCES:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

EE6004

FLEXIBLE AC TRANSMISSION SYSTEMS

L T P C
3 0 0 3

OBJECTIVES:

- To introduce the reactive power control techniques
- To educate on static VAR compensators and their applications
- To provide knowledge on Thyristor controlled series capacitors
- To educate on STATCOM devices
- To provide knowledge on FACTS controllers

UNIT I INTRODUCTION

9

Reactive power control in electrical power transmission lines -Uncompensated transmission line - series compensation – Basic concepts of Static Var Compensator (SVC) – Thyristor Controlled Series capacitor (TCSC) – Unified power flow controller (UPFC).

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) AND APPLICATIONS

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 coordination using genetic algorithms.

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. R.Mohan Mathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc, 2002.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi- 110 006, 2011.
3. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Limited, Publishers, New Delhi, 2008.

REFERENCES:

1. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.
2. V.K.Sood,HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2004 , Kluwer Academic Publishers, 2004.
3. Xiao – Ping Zang, Christian Rehtanz and Bikash Pal, "Flexible AC Transmission System: Modelling and Control" Springer, 2012.

EE6005**POWER QUALITY****L T P C
3 0 0 3****OBJECTIVES:**

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

UNIT I INTRODUCTION TO POWER QUALITY**9**

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

UNIT II VOLTAGE SAGS AND INTERRUPTIONS**9**

Sources of sags and interruptions - estimating voltage sag performance. Thevenin's equivalent source - analysis and calculation of various faulted condition. Voltage sag due to induction motor starting. Estimation of the sag severity - mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches.

UNIT III OVERVOLTAGES**9**

Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding - line

arresters - protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD and EMTP.

UNIT IV HARMONICS

9

Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion - voltage and current distortion - harmonic indices - inter harmonics – resonance. Harmonic distortion evaluation - **devices for controlling harmonic distortion** - passive and active filters. IEEE and IEC standards.

UNIT V POWER QUALITY MONITORING

9

Monitoring considerations - monitoring and diagnostic techniques for various power quality problems - modeling of power quality (harmonics and voltage sag) problems by mathematical simulation tools - power line disturbance analyzer – quality measurement equipment - harmonic / spectrum analyzer - flicker meters - disturbance analyzer. **Applications of expert systems for power quality monitoring.**

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Roger. C. Dugan, Mark. F. McGranaghan, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality' McGraw Hill, 2003. (For Chapters 1, 2, 3, 4 and 5).
2. **Eswald.F.Fudis and M.A.S.Masoum**, "Power Quality in Power System and Electrical Machines," Elsevier Academic Press, 2013.
3. J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', Wiley, 2011.

REFERENCES:

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994). (For Chapter 1, 2, 3 and 5)
2. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999). (For Chapters 1, 2, 3 and 5)
3. G.J.Wakileh, "Power Systems Harmonics – Fundamentals, Analysis and Filter Design," Springer 2007.
4. E.Aeha and M.Madrigal, "Power System Harmonics, Computer Modelling and Analysis, " Wiley India, 2012.
5. R.S.Vedam, M.S.Sarma, "Power Quality – VAR Compensation in Power Systems," CRC Press 2013.
6. C. Sankaran, 'Power Quality', CRC press, Taylor & Francis group, 2002.

OBJECTIVES:

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks
- To provide adequate knowledge about fuzzy and neuro-fuzzy systems
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- To provide adequate knowledge of genetic algorithms and its application to economic dispatch and unit commitment problems.

UNIT I ARCHITECTURES – ANN**9**

Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm- Back propagation network.

UNIT II NEURAL NETWORKS FOR CONTROL**9**

Feedback networks – Discrete time Hopfield networks – Transient response of continuous time system – Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum.

UNIT III FUZZY SYSTEMS**9**

Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules - Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system.

UNIT IV APPLICATION OF FUZZY LOGIC SYSTEMS**9**

Fuzzy logic control: Home heating system - liquid level control - aircraft landing- inverted pendulum – fuzzy PID control, Fuzzy based motor control.

UNIT V GENETIC ALGORITHMS**9**

Introduction-Gradient Search – Non-gradient search – Genetic Algorithms: binary and real representation schemes, selection methods, crossover and mutation operators for binary and real coding - constraint handling methods – applications to economic dispatch and unit commitment problems.

TOTAL: 45 PERIODS**OUTCOMES:**

- Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.
- To understand and apply computing platform and software for engineering problems.

TEXT BOOKS:

1. Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, 1992.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 1997.
3. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013.

REFERENCES:

1. Simon Haykin, 'Neural Networks', Pearson Education, 2003.
2. John Yen & Reza Langari, 'Fuzzy Logic – Intelligence Control & Information', Pearson Education, New Delhi, 2003.

3. M.Gen and R.Cheng, Genetic algorithms and Optimization, Wiley Series in Engineering Design and Automation, 2000.
4. Hagan, Demuth, Beale, " Neural Network Design", Cengage Learning, 2012.
5. N.P.Padhy, " Artificial Intelligence and Intelligent Systems", Oxford, 2013.
6. William S.Levine, "Control System Advanced Methods," The Control Handbook CRC Press, 2011.

GE6081

FUNDAMENTALS OF NANOSCIENCE

L T P C
3 0 0 3

OBJECTIVES:

To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION

8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms- **multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).**

UNIT II GENERAL METHODS OF PREPARATION

9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, **MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.**

UNIT III NANOMATERIALS

12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal **oxides-ZnO, TiO₂, MgO, ZrO₂, NiO, nanoalumina, CaO, AgTiO₂, Ferrites,** Nanoclays- functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES

9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- **AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.**

UNIT V APPLICATIONS

7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechnology: nanoprobe in medical diagnostics and biotechnology, Nano medicines, Targeted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- **Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products** - In Photostat, printing, solar cell, battery.

TOTAL : 45 PERIODS

OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS :

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

IC6002**SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL****LT P C****3 0 0 3****OBJECTIVES:**

- To introduce Non parametric methods
- To impart knowledge on parameter estimation methods
- To impart knowledge on Recursive identification methods
- To impart knowledge on Adaptive control schemes
- To introduce stability, Robustness and Applications of adaptive control method

UNIT I NON PARAMETRIC METHODS**9**

Non parametric methods: **Transient analysis–frequency analysis**–Correlation analysis–Spectral analysis.

UNIT II PARAMETER ESTIMATION METHODS**9**

Least square estimation – best linear unbiased estimation under linear constraints – updating the parameter estimates for linear regression models–prediction error methods: description of prediction methods – **optimal prediction – relation between prediction error methods and other identification methods** – theoretical analysis - Instrumental variable methods: Description of instrumental variable methods – Input signal design for identification.

UNIT III RECURSIVE IDENTIFICATION METHODS**9**

The recursive least square method – the recursive instrumental variable methods- the recursive prediction error methods – **Maximum likelihood. Identification of systems operating in closed loop: Identifiability considerations** – direct identification – indirect identification.

UNIT IV ADAPTIVE CONTROL SCHEMES**9**

Introduction – **Types of adaptive control–Gain scheduling controller–Model reference adaptive control schemes–Self tuning controller–MRAC** and STC: Approaches–The Gradient approach – Lyapunov functions – Passivity theory – pole placement method – Minimum variance control – Predictive control.

UNIT V ISSUES INADAPTIVE CONTROL AND APPLICATIONS**9**

Stability – Convergence – Robustness –Applications of adaptive control.

TOTAL: 45 PERIODS**OUTCOMES:**

- Ability to apply advanced control theory to practical engineering problems.

TEXT BOOKS:

1. Soder Storm T and Peter Stoica, System Identification, Prentice Hall International, 1989.
2. Astrom, K.J. and Wittenmark, B., "Adaptive Control", Pearson Education, 2nd Edition, 2001.
3. Sastry, S. and Bodson, M., "Adaptive Control– Stability, Convergence and Robustness", Prentice Hall inc., New Jersey, 1989.

REFERENCES:

1. Ljung L, System Identification: Theory for the user, Prentice Hall, Engle wood Cliffs, 1987.
2. Bela.G.Liptak., "Process Control and Optimization", Instrument Engineers' Handbook., volume 2, CRC press and ISA, 2005.
3. William S. Levine, "Control Systems Advanced Methods, the Control Handbook, CRC Press, 2011.

EE6007

MICRO ELECTRO MECHANICAL SYSTEMS

LT P C
3 0 0 3

OBJECTIVES:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT I INTRODUCTION

9

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - **Silicon based MEMS processes** – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I

9

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – **Comb drive devices – Micro Grippers – Micro Motors** - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – **Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.**

UNIT III SENSORS AND ACTUATORS-II

9

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to **Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators** – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING

9

Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching – **Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants** – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistrication methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS**9**

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL : 45 PERIODS**OUTCOMES:**

- Ability to understand the operation of micro devices, micro systems and their applications.
- Ability to design the micro devices, micro systems using the MEMS fabrication process.

TEXT BOOKS:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. Nadim Maluf, "An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

EE6008**MICROCONTROLLER BASED SYSTEM DESIGN****L T P C****3 0 0 3****OBJECTIVES:**

- To introduce the architecture of PIC microcontroller
- To educate on use of interrupts and timers
- To educate on the peripheral devices for data communication and transfer
- To introduce the functional blocks of ARM processor
- To educate on the architecture of ARM processors

UNIT I INTRODUCTION TO PIC MICROCONTROLLER**9**

Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–PIC16cxx– 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 and key switches– Display of Constant and Variable strings.

UNIT III PERIPHERALS AND INTERFACING**9**

I²C 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

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

UNIT V ARM ORGANIZATION 9

3-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: 45 PERIODS

OUTCOMES:

- To understand and apply computing platform and software for engineering problems.
- To understand ethical issues, environmental impact and acquire management skills.

TEXT BOOKS:

1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, 2000.

REFERENCE:

1. Mazidi, M.A., "PIC Microcontroller" Rollin Mckinlay, Danny causey Printice Hall of India, 2007.

**EE6009 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS LT P C
3 0 0 3**

OBJECTIVES:

- To Provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To develop maximum power point tracking algorithms.

UNIT I INTRODUCTION 9

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

9

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS

9

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS

9

TOTAL : 45 PERIODS

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to handle the engineering aspects of electrical energy generation and utilization.

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi,2009.

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.
2. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
3. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.
5. Andrzej M. Trzynadlowski, ‘Introduction to Modern Power Electronics’, Second edition, wiley India Pvt. Ltd. 2012.

LTPC
3003

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

9

99

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 – Analysis of a 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 – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.		
UNIT IV	REACTIVE POWER AND HARMONICS CONTROL	9
Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM – Generation of harmonics – 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.		

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Padiyar, K. R., "HVDC power transmission system", New Age International (P) Ltd., New Delhi, Second Edition, 2010.
2. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd., New Delhi, 1990.

REFERENCES:

1. Kundur P., "Power System Stability and Control", McGraw-Hill, 1993.
2. Colin Adamson and Hingorani N G, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.
3. Arrillaga, J., "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983.
4. S. Kamakshaiah, V. Kamaraju, 'HVDC Transmission', Tata McGraw Hill Education Private Limited, 2011.

EE6011

POWER SYSTEM DYNAMICS

L T P C
3 0 0 3

OBJECTIVES:

- To introduce the basics of dynamics and stability problems
- To educate on modeling of synchronous machines
- To educate on the excitation system and speed-governing controllers.
- To study small signal stability of a single-machine infinite bus system with excitation system and power system stabilizer.
- To educate on the transient stability simulation of multi machine power system.

UNIT I INTRODUCTION 9

Basics of system dynamics – numerical techniques – introduction to software packages to study the responses. Concept and importance of power system stability in the operation and design - distinction between transient and dynamic stability - complexity of stability problem in large system – necessity for reduced models - stability of interconnected systems.

UNIT II SYNCHRONOUS MACHINE MODELLING 9

Synchronous machine - flux linkage equations - Park's transformation - per unit conversion - normalizing the equations - equivalent circuit - current space model - flux linkage state space model. Sub-transient and transient inductances - time constants. Simplified models (one axis and constant flux linkage) - steady state equations and phasor diagrams.

UNIT III MACHINE CONTROLLERS 9

Exciter and voltage regulators - function and types of excitation systems - typical excitation system configuration - block diagram and state space representation of IEEE type 1 excitation system - saturation function - stabilizing circuit. Function of speed governing systems - block diagram and state space representation of IEEE mechanical hydraulic governor and electrical hydraulic governors for hydro turbines and steam turbines.

UNIT IV TRANSIENT STABILITY 9

State equation for multi machine system with one axis model and simulation – modelling of multi machine power system with one axis machine model including excitation system and speed governing system and simulation using R-K method of fourth order (Gill's technique) for transient stability analysis - power system stabilizer. For all simulations, the algorithm and flow chart have to be discussed.

UNIT V DYNAMIC STABILITY 9

System response to small disturbances - linear model of the unregulated synchronous machine and its modes of oscillation - regulated synchronous machine - distribution of power impact - linearization of the load equation for the one machine problem – simplified linear model - effect of excitation on dynamic stability - approximate system representation - supplementary stabilizing signals - dynamic performance measure - small signal performance measures.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. P.M. Anderson and A.A.Fouad, 'Power System Control and Stability', Galgotia Publications, New Delhi, 2003.
2. P. Kundur, 'Power System Stability and Control', McGraw Hill Inc., USA, 1994.
3. R.Ramanujam, "Power System Dynamics – Analysis and Simulation", PHI, 2009.

REFERENCES:

1. M.A.Pai and W.Sauer, 'Power System Dynamics and Stability', Pearson Education Asia, India, 2002.
2. James A.Momoh, Mohamed. E. El-Hawary. " Electric Systems, Dynamics and Stability with Artificial Intelligence applications", Marcel Dekker, USA First Edition, 2000.
3. C.A.Gross, "Power System Analysis," Wiley India, 2011.
4. B.M.Weedy, B.J.Lory, N.Jenkins, J.B.Ekanayake and G.Strbac," Electric Power Systems", Wiley India, 2013.
5. K.Umarao, "Computer Techniques and Models in Power System," I.K. International, 2007.

OBJECTIVES:

- To introduce the functional elements of Robotics
- To impart knowledge on the direct and inverse kinematics
- To introduce the manipulator differential motion and control
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

UNIT I BASIC CONCEPTS

9

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.

UNIT II DIRECT AND INVERSE KINEMATICS

9

Mathematical representation of Robots - Position and orientation - Homogeneous transformation-Variou joints- Representation using the Denavit Hattenberg parameters -Degrees of freedom-Direct kinematics-Inverse kinematics-PUMA560 & SCARA robots- Solvability - Solution methods-Closed form solution.

UNIT III MANIPULATOR DIFFERENTIAL MOTION AND STATICS

9

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance.

UNIT IV PATH PLANNING

9

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.

UNIT V DYNAMICS AND CONTROL

9

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model -Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.

TOTAL: 45 PERIODS**OUTCOMES:**

- Ability to understand and analyze Instrumentation systems and their applications to various industries.

TEXT BOOKS:

1. R.K.Mittal and I.J.Nagrath, Robotics and Control,Tata McGraw Hill,New Delhi,4th Reprint, 2005.
2. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. M.P.Groover, M.Weiss,R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

REFERENCES:

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. K. K.Appu Kuttan, Robotics, I K International, 2007.
3. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
4. R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.

5. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
6. S.Ghoshal, “ Embedded Systems & Robotics” – Projects using the 8051 Microcontroller”, Cengage Learning, 2009.

GE6083

DISASTER MANAGEMENT

**L T P C
3 0 0 3**

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS

9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR)

9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj

Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Process and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT

9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA

9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS

9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man

Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

TEXTBOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

GE6075

PROFESSIONAL ETHICS IN ENGINEERING

**LT P C
3 0 0 3**

OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES

10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS

9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION

9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS

9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk -

Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – **Employee Rights – Intellectual Property Rights (IPR) – Discrimination**.

UNIT V GLOBAL ISSUES

8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – **Moral Leadership – Code of Conduct – Corporate Social Responsibility**.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

Web sources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

GE6757

TOTAL QUALITY MANAGEMENT

L T P C
3 0 0 3

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 product and service quality - **Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM** - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES

9

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, **Team and Teamwork, Quality circles 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

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - **TPM - Concepts, improvement needs - Performance measures.**

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors.

TOTAL: 45 PERIODS

OUTCOMES:

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

TEXT BOOK:

1. Dale H. Besterfield, et al., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint, 2006.

REFERENCES:

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

EC6002

ADVANCED DIGITAL SIGNAL PROCESSING

L T P C

3 0 0 3

OBJECTIVES:

- To bring out the concepts related to stationary and non-stationary random signals
- To emphasize the importance of true estimation of power spectral density
- To introduce the design of linear and adaptive systems for filtering and linear prediction
- To introduce the concept of wavelet transforms in the context of image processing

UNIT I DISCRETE-TIME RANDOM SIGNALS 9

Discrete random process – Ensemble averages, Stationary and ergodic processes, Autocorrelation and Autocovariance properties and matrices, White noise, Power Spectral Density, Spectral Factorization, Innovations Representation and Process, Filtering random processes, ARMA, AR and MA processes.

UNIT II	SPECTRUM ESTIMATION	9
Bias and Consistency, Periodogram, Modified periodogram, Blackman-Tukey method, Welch method, Parametric methods of spectral estimation, Levinson-Durbin recursion.		
UNIT III	LINEAR ESTIMATION AND PREDICTION	9
Forward and Backward linear prediction, Filtering - FIR Wiener filter- Filtering and linear prediction, non-causal and causal IIR Wiener filters, Discrete Kalman filter.		
UNIT IV	ADAPTIVE FILTERS	9
Principles of adaptive filter – FIR adaptive filter – Newton's Steepest descent algorithm – LMS algorithm – Adaptive noise cancellation, Adaptive equalizer, Adaptive echo cancellers.		
UNIT V	WAVELET TRANSFORM	9
Multiresolution analysis, Continuous and discrete wavelet transform, Short Time Fourier Transform, Application of wavelet transform, Cepstrum and Homomorphic filtering.		
		TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the parametric methods for power spectrum estimation.
- Discuss adaptive filtering techniques using LMS algorithm and the applications of adaptive filtering.
- Analyze the wavelet transforms.

TEXT BOOKS:

1. Monson H, Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, Indian Reprint, 2007.
2. John G.Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson, Fourth, 2007.
3. Dwight F. Mix, "Random Signal Processing", Prentice Hall, 1995.

REFERENCE:

1. Sophocles J. Orfanidis, "Optimum Signal Processing, An Introduction", McGraw Hill, 1990.

EE6012

COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS

**LT P C
3 0 0 3**

OBJECTIVES:

- To introduce the importance of computer aided design method.
- To provide basic electromagnetic field equations and the problem formulation for CAD applications.
- To get familiarized with Finite Element Method as applicable for Electrical Engineering.
- To introduce the organization of a typical CAD package.
- To introduce Finite Element Method for the design of different Electrical apparatus.

UNIT I	INTRODUCTION	9
Conventional design procedures – Limitations – Need for field analysis based design – Review of Basic principles of energy conversion – Development of Torque/Force.		

UNIT II	MATHEMATICAL FORMULATION OF FIELD PROBLEMS	9
Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector /Scalar potential – Stored energy in Electric and Magnetic fields – Capacitance - Inductance- Laplace and Poisson's Equations – Energy functional.		
UNIT III	PHILOSOPHY OF FEM	9
Mathematical models – Differential/Integral equations – Finite Difference method – Finite element method – Energy minimization – Variational method- 2D field problems – Discretisation – Shape functions – Stiffness matrix – Solution techniques.		
UNIT IV	CAD PACKAGES	9
Elements of a CAD System –Pre-processing – Modelling – Meshing – Material properties- Boundary Conditions – Setting up solution – Post processing.		
UNIT V	DESIGN APPLICATIONS	9
Voltage Stress in Insulators – Capacitance calculation - Design of Solenoid Actuator – Inductance and force calculation – Torque calculation in Switched Reluctance Motor.		
		TOTAL : 45 PERIODS

OUTCOMES:

- Ability to model and analyze electrical apparatus and their application to power system.

TEXT BOOKS:

1. S.J Salon, 'Finite Element Analysis of Electrical Machines', Springer, YesDEE publishers, Indian reprint, 2007.
2. Nicola Bianchi, 'Electrical Machine Analysis using Finite Elements', CRC Taylor & Francis, 2005.

REFERENCES:

1. Joao Pedro, A. Bastos and Nelson Sadowski, 'Electromagnetic Modeling by Finite Element Methods', Marcell Dekker Inc., 2003.
2. P.P.Silvester and Ferrari, 'Finite Elements for Electrical Engineers', Cambridge University Press, 1983.
3. D.A.Lowther and P.P Silvester, 'Computer Aided Design in Magnetics', Springer Verlag, New York, 1986.
4. S.R.H.Hoole, 'Computer Aided Analysis and Design of Electromagnetic Devices', Elsevier, New York, 1989.
5. User Manuals of MAGNET, MAXWELL & ANSYS Softwares.

EC6601

VLSI DESIGN

L T P C

3 0 0 3

OBJECTIVES:

- In this course, the MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit is studied.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed.
- The main focus in this course is on the transistor circuit level design and realization for digital operation and the issues involved as well as the topics covered are quite distinct from those encountered in courses on CMOS Analog IC design.

UNIT I	MOS TRANSISTOR PRINCIPLE	9
NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling, Scaling principles and fundamental limits, CMOS inverter scaling, propagation delays, Stick diagram, Layout diagrams		
UNIT II	COMBINATIONAL LOGIC CIRCUITS	9
Examples of Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Low power design principles		
UNIT III	SEQUENTIAL LOGIC CIRCUITS	9
Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory architecture and memory control circuits, Low power memory circuits, Synchronous and Asynchronous design		
UNIT IV	DESIGNING ARITHMETIC BUILDING BLOCKS	9
Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, accumulators, Multipliers, dividers, Barrel shifters, speed and area tradeoff		
UNIT V	IMPLEMENTATION STRATEGIES	9
Full custom and Semi custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.		
		TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students should

- Explain the basic CMOS circuits and the CMOS process technology.
- Discuss the techniques of chip design using programmable devices.
- Model the digital system using Hardware Description Language.

TEXTBOOKS:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2003.
2. M.J. Smith, "Application Specific Integrated Circuits", Addison Wesley, 1997

REFERENCES:

1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addison Wesley 1993
2. R.Jacob Baker, Harry W.Li., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005
3. A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007.