VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE
(VJTI)
MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)

Curriculum
(Scheme of Instruction & Evaluation and Course contents)
(Revision 2014)

For
Third Year
of
Four Year Undergraduate Programmes Leading to
Bachelor of Technology (B Tech) Degree in Electrical Engineering

Implemented from the batch admitted in Academic Year 2014 - 15

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

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Curriculum

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Bachelor of Technology (B Tech)

In

103 - Electrical Engineering

B. Tech. Electrical Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

Electrical Engineering Graduates will have ability to

- Face technological challenges in the area of Electrical Engineering and ICT.
- Demonstrate expertise to articulate and use for problem solving, analysis design and evolution of electrical and electronics devices and systems.
- Develop leadership , team building and leadership skill**s.**

PROGRAM OUTCOMES (POS)

Engineering Graduates will be able to:

- **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

  Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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

PROGRAM SPECIFIC OUTCOMES (PSOS)

Electrical Engineering Graduates will be able to

- Critically understand the generation, transmission and distribution concepts of Electrical Power Systems and its control
- Gain in-depth knowledge to handle/control various electrical machines/drives used in industry.

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE
B TECH. ELECTRICAL ENGINEERING
Scheme of Instruction and Evaluation

SEMESTER V

Scheme of Instruction				Scheme of Evaluation				
S. No	**Course code**	**Course Title**	**L-T-P (Hours / week)**	**Credits**	**TA**	**IST**	**ESE**	**ESE hours**
1.	EE3001S	Mathematics for Electrical Engineers - III	3-1-0	4	10	30	60	3
2.	EE3002S	Electromagnetic Fields and Waves	3-1-0	4	10	30	60	3
3.	EE3003S	Power System Protection	3-1-0	4	10	30	60	3
4.	EE3004T	Power Electronics	3-0-0	3	10	30	60	3
	EE3004P	Power Electronics Lab	0-0-2	1	100 % CIE			-
5.	EE3005T	Control System	3-0-0	3	10	30	60	3
	EE3005P	Control System Lab	0-0-2	1	100 % CIE			-
6.	EE3006T	Analog and Digital Electronics	3-0-0	3	10	30	60	3
	EE3006P	Analog and Digital Electronics Lab	0-0-2	1	100 % CIE			-
7.	EE3007A	Intellectual Property Rights	3	3units	100%CIE			-
		Total	**30**	**24**				

SEMESTER VI

Scheme of Instruction				Scheme of Evaluation				
S. No	**Course code**	**Course Title--**	**L-T-P (Hours / week)**	**Credits**	**TA**	**IST**	**ESE**	**ESE hours**
1.	EE3011S	Advanced Control System	3-1-0	4	10	30	60	3
2.	EE3012S	Power System Analysis	3-1-0	4	10	30	60	3
3.	EE3013S	Electrical and Electronics Measurement and Instrumentation	3-1-0	4	10	30	60	3
4.	EE3014T	Microprocessor and Microcontroller	3-0-0	3	10	30	60	3
	EE3014P	Microprocessor and Microcontroller Lab	0-0-2	1	100 % CIE			-
5.	EE3015T	Communication System	3-0-0	3	10	30	60	3
6.	EE3015P	Communication System Lab	0-0-2	1	100%CIE			-
		Program Elective – I	3-0-0	3	10	30	60	-
		Program Elective – I Lab	0-0-2	1	100 % CIE			-
7	EE3016A	Electricity Act 2003	3	3 Units				
		Total	**30**	**24**				

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **IST**: In Semester Tests (comprise of average of two In semester tests), **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation

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SEMESTER VI

LIST OF ELECTIVES

S. No	Course code	Course Title
1.	EE3101T	Introduction to Renewable Energy
	EE3101P	Introduction to Renewable Energy Lab
2.	EE3102T	OOPs in Power System
	EE3102P	OOPs in Power System Lab
3	EE3103T	Industrial Automation
	EE3103P	Industrial Automation Lab

Programme Name	**Bachelor of Technology in Electrical Engineering**	**Semester - V**
Course Code	EE3001S	
Course Title	**Mathematics for Electrical Engineers - V**	

COURSE OUTCOMES

1. Student should be able to formulate probability distribution function and cumulative distribution function of various distributions, such as binomial distributions, Poisson distribution etc and use them to compute various moments.
2. Student should apply sampling theory and perform tests of significance for small and large samples.
3. Student should be able to solve curve fitting problem and do analysis of variance.
4. Student should be able to apply knowledge of reliability practices.

Course Contents

Review of Probability

Baye's theorem. Discrete and continuous random variables, Probability mass function and density function. Expected value. (Expectation) Moments and moments generating functions. Relation between Raw moments and Central moments.

Probability Distribution

Binomal, Poisson, Normal, Student's distribution, x^2 (Chisquare), F distribution.

Sampling Theory

Sampling distribution. Test of hypothesis. Level of significance. Critical region. One- tailed and two-tailed tests. Degree of freedom. Estimation of population parameters. Central limit theorem.

Large and Small samples:

1. Test of significance for large samples.
   i) Test of significance of the difference between sample proportion and population proportion.
   ii) Test of significance of the difference between the sample proportions.
   iii) Test of significance of the difference between sample mean and population means.
   iv) Test of significance of the difference between the means of two samples.

2. Test of significance for small samples :

a. Test of significance of the difference between sample mean and population mean.
b. Test of significance of the difference between means to two small samples drawn from the same normal population
c. Paired- t test.

C. F-test of significance of the difference between population variances.
D. Test of the Goodness of fit and independence of attribute. Contingency table. Yate's correction.

Fitting of Curves

Least square method, fitting of the straight line and parabolic curve. Bivariate frequency distribution. Co-relation, Co-variance. Karl Pearson's Coefficient and Spearman's Rank Co-relation coefficients, Regression coefficients and lines of regression.

Analysis of Variance

One way and two way classification

Statistical Quality Control and Control Charts.

Reliability

Text Books

1. S G Gupta, V K Kapur, Fundamentals of Mathematical Statistics, S Chand & Co.
2. T Veerrajan, Probability, Statistics and Random Processes, Tata McGraw Hill.
3. R P Hooda, Statistics for Business and Economics, Macmillan.
4. R. Billington, Reliability Evaluation of Power System, PHI.

Programme Name	**Bachelor of Technology in Electrical Engineering**	**Semester - V**
Course Code	EE3002S	
Course Title	**Electromagnetic Fields and Waves**	

COURSE OUTCOMES

1. Identify and make use of different coordinate systems for representation of vectors and perform interconversions between the systems.
2. Define and apply Coulomb's law, Gauss' law and Maxwell's equation to physical problems.
3. Describe electric fields in materials and write continuity equation, Poisson's and Laplace equation, and analyze solutions to boundary value problems.
4. Apply Ampere's law and Bio-Savart's law to physical problems.

Course Contents

Vector calculus, coordinate systems and transformations

Cartesian coordinates, Cylindrical coordinates, Spherical coordinates, Differential length, Area and volume, Line surface and volume integral, Del operator and gradient of scalar, Divergence of vector, Curl of vector.

Electrostatics

Coulomb's law and field intensity, Electric fields due to continuous charge distributions, Electric flux density, Gauss's law - Maxwell's equation, Applications of Gauss's law, Electric potential, Potential gradient, Relation between E and V Maxwell's equation, Electric dipole and flux lines, Equipotential contours, Energy density in electrostatic fields.

Electric fields in Material's space and Boundary value problems

Properties and materials, Convection and conduction current, Current density, Conductors, Polarization in dielectrics, Dielectric constant and strength, Continuity equation and boundary condition, Poisson's and Laplace equation, Uniqueness theorem, Resistance, capacitance and super-conductance, The Earth capacitor : an automatic electrostatic pilot.

Magnetostatics

Biot - Savart's law, Ampere's circuit law - Maxwell's equation, Applications of Ampere's law, Magnetic flux density - Maxwell's equation, Maxwell's equation for static fields, Magnetic scalar and vector potentials, Derivations of Biot-Savart's law and Ampere's Law.

Magnetic forces and materials

Forces due to magnetic fields, Magnetic torque and moment, Magnetic dipole, Magnetisation in materials, The solenoid, Classification of magnetic materials, Magnetic boundary conditions, Inductor and inductance, Magnetic energy and circuits, Forces on magnetic materials.

Time varying Maxwell's equations

Faraday's law, Transformer and motional electromotive forces, Displacement current, Inconsistency of Ampere's law, Maxwell's equation in time varying and harmonic form, Analogies between electric and magnetic fields

Electromagnetic wave propagation

Waves in general, Comparison and relation between permittivity & permeability, Propagation in lossy dielectric, Plane wave in lossless dielectrics, Plane waves in free space, Plane waves in good conductors, Power and Poynting vector, Reflection of plane wave at normal incidence.

Text Books

1. Matthew N. O. Sadiku, "Elements of Electromagnetics", second edition, 1985, Oxford university press.
2. Edward C. Jordan, Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", Second edition, Prentice-Hall.

Reference Books

1. William Hayt, "Engineering Electromagnetics", McGraw Hill, fourth edition, 1987
2. Edminister, "Schaum's series in Electromagnetics", McGraw Hill, third edition, 1986

Programme Name	Bachelor of Technology in Electrical Engineering	Semester - V
Course Code	EE3003S	
Course Title	**Power System Protection**	

COURSE OUTCOMES

1. Able to calculate S.C. MVA and fault current for different type of faults.
2. Able to explain working of different types of circuit breakers in power system.
3. Able to explain working of different types of protection principles employed for protection of power system.
4. Able to carry out relay coordination of IDMT and DT OC relays know how to choose between them.
5. Able to describe working principle of distance relays.
6. Able to write algorithm for O.C., distance and differential protection.

Course Contents

Fault Analysis

Types of Faults, Symmetrical Fault Calculations, Unsymmetrical Fault Calculations

Circuit Interrupting Devices

Sequence of operation and interlocking, Fuse, types, characteristics, Isolators, Circuit breaker: Arc phenomena and arc extinction, working principle of Oil circuit breakers, Air break, Air Blast, Sulphur Hexa Fluoride (SF_6) and vacuum circuit breakers, Auto-reclosure

Elements of Protection

Need of protective system, Protection System and Its Attributes: Sensitivity, Selectivity, Reliability and Dependability, Various Power System Elements That Need Protection, Protection zones: Backup protection zones, Protective Transformers, Neutral Earthing.

Over-Current Protection

Introduction, Instantaneous OC Relay, Definite Time Over-current Relay, Inverse Time Over-current Relay, Application of Definite Time OC Relays for Protection of a Distribution Feeder, Application of Inverse Definite Minimum Time Relay on a Distribution Feeder, Choice Between IDMT and DTOC Relays, Protection of a Three-phase Feeder, Directional Over-current Relay, Other Situations Where Directional OC Relays are necessary, Phasor Diagram for Voltage and Current for Forward and Reverse Fault (Single-phase System), Application of Directional Relay to a Three-phase Feeder, Directional OC Protection of a Three-phase Feeder, Directional Protection Under Non-fault Conditions (Reverse Power Relay), Relay Coordination

Differential Protection

Simple Differential Protection, Behaviour During Load, Behaviour During External Fault, Behaviour During Internal Fault, Simple Differential Protection, Double-end-fed: Behaviour: During Internal Fault, Zone of Protection of the Differential Relay, Actual Behaviour of a Simple Differential Scheme, Through Fault Stability and Stability Ratio, Equivalent Circuit of CT, Percentage Differential Relay, Earth Leakage Protection, Earth Leakage Protection for Single-phase Load, Earth Leakage Protection for Three-phase Loads.

Distance Protection of Transmission Lines

Drawbacks of Over-current Protection, Introduction to Distance Protection, Simple Impedance Relay, Reactance Relay and mho Relay: Performance of during Normal Load Flow, Effect of Arc Resistance on Reach, Directional Property, Performance during Power Swing, Distance Protection of a Three-phase Line, Phase Faults, Ground Faults, Complete Protection of a Three-phase Line

Protection of Generator, Busbar and Transformer

Generator Protection: Types of fault in alternators, Protection against stator faults, Balanced earth fault protection, stator inter turn protection, loss of excitation, loss of prime mover, Transformer protection: Types of Faults in Transformers, Percentage Differential Protection of Transformers, Inrush Phenomenon, Percentage Differential Relay with Harmonic Restraint, High Resistance Ground Faults in Transformers, High Resistance Ground Faults on the Delta Side, High Resistance Ground Faults on the Star Side, Inter-turn Faults in Transformers, Incipient Faults in Transformers, Buchholz Relay, Protection Against Over-fluxing, Busbar Protection: Introduction, Differential Protection of Busbars, Selection of CT Ratios for Busbar Protection

Numerical Relays

Introduction to Numerical relaying, DSP fundamentals like aliasing, sampling theorem, Discrete Fourier Transform and application to current and voltage, phasor estimation. Numerical relaying algorithms for over current, distance and differential protection with 1 Application to transmission system, transformer and bus

Text Books

1. Fundamentals of Power System Protection, Y.G. Paithankar, S.R. Bhide, PHI Learning, 2010.
2. Power System Protection, Ram B and Vishwakarma D. N., TMH, New Delhi (latest edition)
3. Switchgear protection and power System, S. Rao, Khanna Publication

Reference Books

1. Power System Protection and Switchgear, B. Ravindranath, M. Chander, New Age International (P) Ltd.

Programme Name	**Bachelor of Technology in Electrical Engineering)**	**Semester –V**
Course Code	EE3004T	
Course Title	**Power Electronics**	

COURSE OUTCOME

1. Able to describe the operation of various power electronic devices.
2. Able to desc
ribe the operation of various controlled converters.
3. Able to describe various phase controllers under different load conditions.
4. Able to describe the operation of various inverters, , choppers , cycloconverters, and power supplies (DC and AC).

Course Contents

Power Electronics Devices

Construction, characteristics, ratings of Diode, SCR, IGBT, Power MOSFET. Application of these switches in controlling power AC DC.

Controlled Rectifier

Principle of Phase-Controlled Converter Operation, Single Phase Full Converters, with RL load, Single Phase Dual Converters, Principle of Three-Phase Half- Wave Converters, Three Phase Full Converters, Three Phase Full Converters with RL load, Three Phase Dual Converter, Power Factor Improvements, Extinction Angle Control, Symmetric Angle Control, PWM control, Single-Phase Sinusoidal PWM, Three Phase PWM Rectifier, Single Phase Semi-Converters with RL load, Three Phase Semi-Converters with RL load **.**

AC Voltage Controllers

Introduction, Principle of On-Off Control, Principle of Phase Control, Single Phase Bidirectional Controllers with Resistive Loads, Single Phase Controllers with Inductive Loads, AC voltage Controller with PWM Control

Cycloconverters

Single Phase Cycloconverters, Three Phase Cycloconverters, Reduction of Output Harmonics

Inverters

Principle of Operation, Performance parameters, Typical Inverters: series Inverters, Self commutated Inverters. Bridge Inverters, Three Phase Inverters, Current Source Inverters, Static Frequency Conversion, Voltage Control of Inverters, Harmonic neutralization of Inverters, PWM Inverters, Simple Application of Inverters with Motor load, Introduction to Multilevel Inverter

Chopper

Principle of Chopper operation, Step-up Chopper, Step-down Chopper, Step-up/ Step-down Chopper, Switch mode regulators-Buck, Boost, Buck-Boost & Cuck Regulator,

Power Supplies

DC Power Supplies, Switched-Mode DC Power Supplies, Flyback Converter, Forward Converter, Push-Pull Converter, Half Bridge Converter, Full Bridge Converter, Resonant DC Power Supplies, Bidirectional Power Supplies, AC Power Supplies, Switched Mode AC Power Supplies, Resonant AC Power Supplies, Bidirectional AC Power Supplies

Text Books

1. Rashid M. H., "Power Electronics-Circuits, Devices and Application", PHI Publication, second edition, 2001
2. Mohan N., "Power Electronics- Converter Application and Design", Wiley Publication, third edition, 2002
3. Power Electronics, P. S. Bimbra.

Reference Books

1. Bose B.K. , "Modern Power Electronics and AC drives" , Pearson Education Asia

Programme Name	**Bachelor of Technology in Electrical Engineering**	**Semester –V**
Course Code		
Course Title	**Applied Power Electronics Laboratory**	

Course Contents

1. Single-Phase1Diode-Bridge Rectifiers
2. Three-Phase2 Diode-Bridge Rectifiers
3. Step-Down3 (Buck) DC-DC Converters
4. Step-Up4 (Boost) DC-DC Converter
5. Full-Bridge5 DC-DC Converters
6. Simulation6 of single phase Inverter with PWM control.
7. Parallel7 Inverter
8. Three8 Phase PWM Inverters
9. Average9 Model of Three-Phase PWM Inverter

Text Books

1. Rashid M. H., " Power Electronics-Circuits, Devices and Application", PHI Publication, second edition, 2001

Reference Books

1. Bose B.K., "Modern Power Electronics and AC Drives", Pearson Education Asia.

Programme Name	Bachelor of Technology in Electrical Engineering	Semester –V
Course Code	EE3005T	
Course Title	Control System	

COURSE OUTCOMES

1. Able to obtain transfer functions of different electrica and mechanical systems.
2. Able to write the state-space representation of systems and perform interconversion between state-space and transfer funtion representation.
3. Able to perform time-domain response analysis of first and second order systems, and also, perform Laplace transform solution of state equations.
4. Able to draw block-diagram and signal flow graph representation of systems.
5. Able to perform stability and root-locus analysis of control systems.
6. Able to obtain gain margin and phase margin via Nyquist diagrams.

Course Contents

Modeling in the Frequency domain

Laplace Transform review, The Transfer function, Electric network transfer function, Translational mechanical system transfer function, Rotational mechanical system transfer function, Electro-mechanical system transfer function, Electrical circuit analogs.

Modeling in the Time Domain

The general state-space representation, Applying the state-space representation, Converting the transfer function to state-space, Converting from state-space to transfer function.

Time Response

Poles, Zeros, & System response, First order system, Second order system :Introduction, The general second order system, Under damped second order system, System response with additional poles, System response with zeros, Laplace transform solution of state equations, Time domain solution of state equations.

Reduction of Multiple Systems

Block diagrams, Analysis and design of feedback system, Signal flow graphs, Mason's rule, Signal flow graphs of state equations.

Stability

Routh Hurwitz criterion, Routh Hurwitz criterion: special cases, Routh Hurwitz criterion: Additional examples, Stability in state space.

Steady State Error

Steady state error for unity feedback systems, Static error constants and system type, Steady state error specification, Steady state error for disturbances, Steady state error for non-unity feedback systems, Sensitivity, Steady state error for systems in state space.

Root Locus Techniques

Introduction, Root locus plots, Summary of general rules for constructing Root-Loci, Root locus analysis for control systems, Root loci for systems with transport lag.

Frequency Response Techniques

Asymptotic Approximations: Bode plots, Introduction to the Nyquist criterion, Sketching the Nyquist diagram, Stability via the Nyquist diagram, Gain margin and phase margin via the Nyquist diagram, Stability Gain margin and phase margin via the Bode-plots, Relation between closed loop transient and closed loop frequency response, Relation between closed loop and open loop frequency response, Relation between closed loop transient and open loop frequency response, Steady state error characteristic from frequency response

Text Books

1. Norman S. Nise ,"Control system engineering", 3rd edition, John Wiley and Sons, (Asia) Pvt. Ltd.2001

Reference Books

1. R. Bishop and R. Dorf," Modern Control system ", 8th edition (LPE), Addison Wesley, 1998

Programme Name	**Bachelor of Technology in Electrical Engineering**	**Semester - V**
Course Code	EE3005P	
Course Title	**Control System Lab**	

1. Introduction to SCILAB programs

Part I : Introduction to Scilab

Part II : Matrix, Polynomials, Equations solving in Scilab

Part III : Plotting graphs, Loop conditions in Scilab

2. Time response analysis of second order systems

Part I : RLC Circuit

Part II : Mass Spring Damper Circuit

3. Effect of time response characteristics of horizontal, vertical and diagonal movement of poles of the systems.

4. To find the stability of the system.

5. Root locus of given circuit and its specifications

6. Frequency response analysis

Bode plot of given circuit and its specifications

Polar &Nyquist plot of the given circuit and its specifications

7. To model a DC Motor using state space model.

8. To analysis RLC series circuit using state space method.

9. To study and analyze the operation of a Proportional Controller.

10. To study and analyze the operation of Proportional-Integration (PI) Controller.

11. To study and analyze the operation of Proportional-Derivative (PD) Controller

12. To study and analyze the operation of Proportional-Integration-Derivative (PID) Controller.

Reference Book:

1. Norman S. Nise, Control system engineering, Third Edition, John Wiley and Sons, (Asia) Pvt. Ltd.2001

2. Katsuhiko Ogata, Modern Control Engineering, Fourth Edition, Prentice Hall,

Programme Name	**Bachelor of Technology in Electrical Engineering**	**Semester - V**
Course Code	EE3006T	
Course Title	**Analog and Digital Electronics**	

COURSE OUTCOMES

1. Able to identify and perform interconversions between different number systems.
2. Able to design basic combinational and sequential digital circuits and perform minimization of Boolean functions.
3. Able to describe the differential amplifier and opamdp circuit and identify different types of feedback in an amplifier.
4. Able to design different op-amp based circuits.

Course Contents

Number Systems and Binary Arithmetic

Decimal, Binary, Octal and Hexadecimal number system and conversion, binary weighted codes, 1's and 2's complement addition and subtraction in 1's and 2's complement system, binary multiplication and division

Boolean Algebra and Logic Gates

Basic theorems and properties of Boolean Algebra, Various logic Gates (NOT, AND, OR, NAND, NOR, XOR, XNOR) and their truth tables, SOP and POS forms of Boolean functions, Minimization of Boolean function using Karnaugh Map, design of logic circuit for given truth table

Combinational Logic

Code converters, Multiplexer, Multiplexers as function generators, De-multiplexer, Decoder, Encoder

Sequential Logic

Basic flip flops – SR, D, JK and T; flip flop applications – synchronous counters, shift registers

Operational Amplifier Basics

Differential amplifier; Ideal Op-Amp: characteristics, equivalent circuit, voltage transfer curve; open loop op-amp configurations; different types of negative feedback in op-amp – properties; virtual ground concept.

OP-Amp Based Circuits

Linear Applications: Inverting and non-inverting amplifier, voltage follower, summing amplifier, substractor, instrumentation amplifier, voltage to current and current to voltage converter, integrator, differentiator
Active Filters: First and second order low pass, high pass, band pass and band reject filters
Oscillators: Phase shift and Wein Bridge Oscillator
Non-linear applications: Comparator, Schmitt trigger

Timing Circuits

IC555 timer based astable, monostable and bistable multivibrator

Voltage Regulator Circuits

Series and shunt voltage regulators, breakdown protection, thermal shutdown, IC78XX and 79XX, adjustable voltage regulator ICLM317

Text books

1. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Fourth edition, PHI, 2013
2. M. Morris Mano, Digital Logic and Computer design, PHI, 2006
3. R. P. Jain, Modern Digital Electronics

Programme Name	**Bachelor of Technology in Electrical Engineering**	**Semester - V**
Course Code	EE3006P	
Course Title	**Analog and Digital Electronics Laboratory**	

List of Experiments

Digital Electronics

1. To design – a) half adder, b) full adder, c) half subtractor d) full subtractor using fundamental and universal logic gates.
2. To implement a 4:1 multiplexer using fundamental gates.
3. To implement a Boolean function using multiplexer IC 74151.
4. To design and implement a code converter (e.g. excess 3 to BCD).
5. To verify the truth table of - a) D flip flop using IC7474 b) JK flip flop using IC7473
6. To design a 3 bit binary synchronous counter for a given sequence.
7. To study shift registers (SISO, SIPO, PIPO, PISO) using universal shift register IC74194.

Analog Electronics

1. To study inverting and non-inverting configuration of OP-AMP using IC741.
2. To implement - a) summing amplifier and b) subtractor using IC741.
3. To implement - a) integrator and b) differentiator using IC741.
4. To design and implement different types of oscillators using op-amp.
5. To implement - a) astable multivibrator, b) monostable multivibrator and c) bi-stable multivibrator using IC555.
6. To study voltage regulation using IC LM317.

Programme Name	Bachelor of Technology in Electrical Engineering	Semester - V
Course Code	EE3007A	
Course Title	**Intellectual Property Rights**	

COURSE OUTCOMES

Students will be able to:

1. Describe legal aspects of patent infringement and trademarks.
2. Describe legal aspects of copyright and industrial dsignas and procedures for obtaining copyrights and registration of designs.
3. Describedifferent types of registration process of Industrial designs and trademarks.
4. Describe legal aspects in commercialization and transfer of Intellectual Property rights

Course Contents

Lab notebooks/Log books/Record books, methods of Invention disclosures, Patents application and its contents, writing of the Patent document

Patent Infringement

Literal Infringement, Doctrine of Equivalence and Doctrine of Colorable Variation, Legal Aspects(Act, Rules, Procedures)

Trademarks

The rationale of protection of trademark as (A) an aspect of commercial and (B) of consumer rights, Definition and concept of trademarks, Different kinds of marks(brand names, logos, signatures, symbols, well known marks, certification marks and service marks), Non Registrable trademarks.

Copyrights

Nature of Copyright, Works in which copyrights subsist, author &ownership of copyright, Rights conferred by copyright

Industrial Designs

What is a registrable design? What is not a design? Novelty & Originality Procedure for registration of Designs

Key Business Concerns in Commercializing Intellectual Property Rights

Competition and confidentiality issues, Antitrust laws, Assignment of Intellectual Property Rights, Technology Transfer Agreements, Intellectual Property Issues in the Sale of Business, Legal auditing of Intellectual Property

Text Books

1. Law Relating to Intellectual Property Rights (English) 2nd Edition, by V. K. Ahuja, Lexis Nexis
2. Intellectual Property Rights,by E. T. Lokganathan, Neha Publishers & Distributors
3. Intellectual Property Right In India, by V. K. Ahuja, LexisNexis
4. Handbook on Intellectual Property Rights in India, by Rajkumar S. Adukia
5. Law relating to patents, trademarks, copyright, desigs and geographical indications, B.L.Wadehra
6. Intellectual Property Rights, by S.B.Verma,Neha Publishers & Distributors

Reference Books

1. Law of trademarks in India, by Aswanikumar Bansal
2. The law of trademarks, copyright, patents and design, by G.V.G Krishnamurthy
3. The management of Intellectual property, by SatyawratPonkse
4. Manual of patent office practice and procedure, by Office of the controller general of patents, designs and trade(CGPDTM)
5. Trade marks agents, by Office of the controller general of patents, designs and trade(CGPDTM)
6. WIPO guide to using patent information, by WIPO
7. Intellectual Property (IP) audit, by WIPO
8. Journal of Intellectual Property Rights 2007 and 2009
9. IPR & Technology bulletin(www.psa.co.za)
10. A manual on Intellectual Property Rights 2007,by BITS Pilani
11. dca(http://www.bits-pilani.ac.in/uploads/Patent_ManualOct_25th_07.pdf)

Programme Name	Bachelor of Technology in Electrical Engineering	Semester – VI
Course Code	EE3005T	
Course Title	**Control System**	

COURSE OUTCOMES

1. Able to specify analysis and design objectives and outline control system design.
2. Able to improve transient and steady-state response.
3. Able to design compensator via frequency response.
4. Able to design controller via state space.
5. Analyze a control system in Z-domain.
6. Differentiate between linear and nonlinear systems and apply linearization techniques.

Course Contents

Introduction to Design

Analysis & Design Objectives, An Outline of Control System Design.

Design with Root Locus Techniques

Transient Response Design via Gain Adjustment, Improving Steady State Error via Cascade Compensation, Improving Transient Response via Cascade Compensation, Improving Steady Sate and Transient Response.

Design with Frequency Response

Transient Response via Gain Adjustment, Lag Compensation, Lead Compensation, Lag-Lead Compensation.

Design via State Space

Controller Design, Controllability, Alternative Approaches to Controller Design, Observer Design, Observability, Alternative Approaches to Observer Design, Steady-State Error Design via Integral Control.

Digital Control System

Introduction, The Z-Transform, Transfer Function, Block Diagram Reduction, Stability, Steady-State Errors.

Introduction to Non Linear System

Definition of nonlinear systems**,** Difference between linear and nonlinear. Systems, Characteristics of nonlinear systems**,** Common physical nonlinearities. Linearization Techniques: Linearization by small signal. Analysis (Taylor series expansion), linearization by nonlinear feedback, and Conditional stability analysis using root locus.

Text Books:

1. Norman Nise, “Control System Engineering”, Fourth Edition. Wiley International Edition.
2. K. Ogata, “Modern Control Engineering” Fourth Edition, Prentice Hall, 2010.
3. M. Gopal, "Modern Control System Theory", Wiley Eastern Ltd., New Delhi.

Reference Books:

1. J. Wilkie, M. Johnson & R. Katebi, Control Engineering: An introductory course, 1st edition, Palgrave.

Programme Name	Bachelor of Technology in Electrical Engineering	Semester - VI
Course Code	EE3012S	
Course Title	**Power System Analysis**	

COURSE OUTCOMES

1. Able to models generators, transformers and transmission systems.
2. Able to develop a power flow model in complex and polar variable form and solve equations for power flow.
3. Able to solve the economicdispatch problem for a power system and without generator limits and losses.
4. Students should be able to model and design load frequency control loop and voltage control loop.
5. Demonstrate ability to explain the basic concept of stability , its importance in interconnected power system and describe different methods to keep system stable for both small and large disturbances.

Course Contents

Basics and Fundamentals

Basic components of a power system. Generator models, transformer model, transmission system model- load representation. Methods for formation of Y-Bus matrix.

Power Flow Analysis

Importance of power flow analysis in planning and operation of power systems. Statement of power flow problem- classification of buses into P-Q buses, P-V (voltage controlled) buses and slack bus. Development of Power flow model in complex variables form and polar variables form. Iterative solution using Gauss-Seidel method including Q-limit check for voltage controlled buses– algorithm and flow chart. Iterative solution using Newton-Raphson (N-R) method (polar form) including Q-limit check and bus switching for voltage-controlled buses– Jacobian matrix elements–algorithm and flow chart. Development of Fast Decoupled Power Flow (FDPF) model and iterative solution–algorithm and flowchart; Comparison of the three methods. Control of Voltage Profile.

Economic Dispatch

Economic dispatch, neglecting generator limits and line losses, Economic dispatch with generator limits, Economic dispatch with line losses.

Automatic Generation and Voltage Control

Load Frequency control (Single area case), Load Frequency Control and Economic Dispatch Control, Two area LFC, Optimal LFC (Two Area), Automatic Voltage Control, LFC with Generation Rate Constraints , speed governor dead- band and its effect on AGC.

Power System Stability

Importance of stability analysis in power system planning and operation - classification of power system stability- angle and voltage stability– simple treatment of angle stability into small-signal and large-signal (transient) stability Single Machine Infinite Bus (SMIB) system: Development of swing equation- equal area criterion- determination of critical clearing angle and time by using modified Euler method. Factors affecting steady state and transient stability and methods of improvement.

Text Books

1. Kothari & Nagrath, “Modern Power System Analysis”, Tata Mc. Graw Hill.
2. Grainger and Stevenson “Power System Analysis”
3. Hadi Sadat, “Power System Analysis”, Tata McGraw Hill.

Reference Books

1. J. D. Glover, M. S. Sharma & T. J. Overbye, “Power System Analysis and Design” , Cengage Learning, 2012.

Programme Name	**Bachelor of Technology in Electrical Engineering**	**Semester – VI**
Course Code	EE3013S	
Course Title	**Electrical and Electronics Measurement and Instrumentation**	

COURSE OUTCOMES

The student will be able to;

1. Diffrentiate between accuracy and precision and perform error analysis.
2. Describe different types of transducers.
3. Decribe different techniques of impedance measurement.
4. Describe operation of and design different kinds of oscillators.
5. Decribe the operation of different signal recording devices and wave analyzers.

Course Contents

Measurement Errors and Standards

Definitions Accuracy and Precision, Significant Figures, Types of Error, Statistical Analysis, Probability of Errors, Limiting Errors, Time and Frequency Standards, Electrical Standards

Transducers and Measurement of Current and Voltage

Classification of transducers: resistive, capacitive and inductive – piezoelectric transducer – strain gauges – LVDT – thermoelectric – piezoelectric. Hall Effect sensors. Transducers for measurement of displacement – temperature – pressure – velocity. CT and PT construction working Ratio and phase angle errors, accuracy class, selection of sensors. Parameter calculation techniques, ADC/ DAC techniques, sampling techniques, quantization techniques, scaling of data, transducer signal conditioning and digital interfacing with computing device.

Measurement of Resistance and Impedance

Low Resistance: Kelvin's double bridge method - Medium Resistance: Voltmeter Ammeter method, Megger – Direct deflection method – Megohm bridge method – Principle of Electronic Megger. Earth resistance measurement. Measurement of Self Inductance. Measurement of Mutual Inductance. Measurement of frequency.

Oscilloscopes and Signal Generators

CRO – General purpose and advanced type – Sampling and storage scopes – Signal and function generators – Noise generators – Pulse and square wave generator –Sweep generator – Pattern generator.

Recording devices and wave analyzers

Signal recorders – X-Y recorder – Magnetic tape recorders – Digital recording and data loggers – Basic wave analyzer – Frequency selective and heterodyne spectrum analyzer – Fundamental type harmonic distortion analyzers – Distortion factor meter – Q meter – Distortion analyzers.

Text Books

1. Sawhney A.K, "A Course in Electrical and Electronics Measurements and Instrumentation", 18th Edition, Dhanpat Rai & Company Private Limited, 2007.
2. Golding. E. W, and Widdis F.C, "Electrical Measurements and Measuring" Instruments", 5th Edition, A. H. Wheeler & Company, 2003.

Reference Books

1. Kalsi. H. S, "Electronic Instrumentation", 2nd Edition, Tata McGraw Hill Company, 2004.
2. Copper. W. D and Hlefrick A. D, "Modern Electronic Instrumentation and Measurement Techique", 5th Edition, Prentice Hall of India, 2002. EI1008

Programme Name	Bachelor of Technology in Electrical Engineering	Semester – VI
Course Code	EE3014T	
Course Title	Microprocessor and Microcontrollers	

COURSE OUTCOMES

1. Ability to differentiate between micro processors and microcontrollers and demonstrate awareness opf different types of architectures.
2. Ability to describe in detail the architecture of the 8051 microcontroller in detail and demonstrate ability of programming in its assembly language.
3. Ability to describe in detail the architecture of the AVR, ARM 7 and PIC microcontrollers.

Course Contents

Introduction to Microcontrollers and Microprocessor

Types of Architectures: Von Neumann Architecture, Harvard Architecture. RISC and CISC, Comparison between microprocessor and microcontroller. Interrupts, Peripheral devices, Types of communication in processors, timers/counters.

Microcontroller 8051

8051 architecture, Features, and pin configurations, CPU timing and machine cycle, Memory organization, Counters and timers, Interrupts, Serial data input and output.

8051 Assembly Language Programming

Serial communication using RS232: Pulse width modulation and DC motor interfacing, electromagnetic relay, stepper motor interfacing, switch interfacing, SCR firing circuit (with electrical isolation); Parallel input/output interfacing: 7-segment LED display interfacing, 8-bit parallel DAC interfacing, 8-bit parallel ADC interfacing, temperature (resistive, diode based) sensor, optical (photodiode/ phototransistor, LDR) sensors interfacing, 16x2 generic alphanumeric LCD interfacing

AVR Processors

8 bit processor and 32 bit processor. Architecture, internal memory organizations, applications. Programming of AVR

ARM 7 Processors

Features, architecture, Processor operating states, memory formats, data types, operating modes, registers. The program status registers, exceptions, interrupt latencies, and pipelined architecture advantage

PIC Controller

PIC 18 Block diagram PIC 18 microprocontroller, PIC microcontroller program memory and data (File) memory organization, Special Function Register (SFR), General purpose Register (GPR), CPU registers, WREG register, Status register, BSR register, Instruction register, Program counter and program ROM, Stack pointer and Stack RAM, PIC 18 internal architecture (ALU, EEPROM, RAM, I/O port, Timer, CCP, DAC), Pipelining.

Text books

1. M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, "The 8051 Microcontroller & Embedded systems", Pearson Publications, Second Edition, 2006.
2. C. Kenneth, J. Ayala and D. V. Gadre, "The 8051 Microcontroller & Embedded system using assembly &C++ ", Cengage Learning, Edition, 2010.
3. David Seal, "ARM Architecture", Reference Manual (2nd Edition).
4. Mazidi Muhmmad A., "PIC Microcontroller and Embedded systems", Pearson Education.

Programme Name	Bachelor of Technology in Electrical Engineering	Semester – VI
Course Code	EE3014P	
Course Title	Microprocessor and Microcontroller Laboratory	

List of Experiments

8051 Programming

1. Arithmetic and logical operations
2. Serial Communication
3. Timer and counter Programming
4. Pulse width modulation
5. DC motor interfacing
6. Stepper motor interfacing
7. Switch interfacing
8. SCR firing circuit (with electrical isolation)
9. Parallel input/output interfacing: 7-segment LED display interfacing
10. 8- bit parallel DAC interfacing, 8-bit parallel ADC interfacing
11. Temperature (resistive, diode based) sensor, optical (photodiode/ phototransistor, LDR) sensors interfacing

AVR Programming

1. Arithmetic and logical operations
2. Serial Communication
3. Timer and counter Programming
4. Pulse width modulation
5. DC motor interfacing
6. Stepper motor interfacing
7. Switch interfacing
8. SCR firing circuit (with electrical isolation)
9. Parallel input/output interfacing: 7-segment LED display interfacing
10. 8- bit parallel DAC interfacing, 8-bit parallel ADC interfacing
11. Temperature (resistive, diode based) sensor, optical (photodiode/ phototransistor, LDR) sensors interfacing

Programme Name	Bachelor of Technology in Electrical Engineering	Semester – VI
Course Code	EE3015T	
Course Title	Communication System	

COURSE OUTCOMES

1. Demonstrate understanding of basic elements of a communication system and ability to describe different measures of noise.
2. Describe analog modulation and demodulation systems.
3. State the sampling theorem and demonstrate understanding of varipus digital modulation techniques.
4. Demonstrate understanding of computer and wireless communication systems.

Course Contents

Introduction

Introduction: Elements of a communication system, Modulation and demodulation, Noise in Communication systems, Signal-to-Noise ratio, Noise factor and Noise Figure, Equivalent Noise Temperature

Analog communication system

Amplitude Modulation: DSB Full carrier AM, Principles, Modulator circuits, Transmitters. Different types of AM, Suppressed – carrier AM, SSB, ISB – Principles, transmitters.
Angle Modulation: Frequency modulation, Phase modulation, Effect of noise, FM modulators, Transmitters. Radio receivers: Receiver : Receiver characteristics, TRF and Super heterodyne receivers, AM detectors, FM detectors, Receiver circuits.

Digital communication

Sampling Theorem for Low-pass and Band–pass signals, Proof with spectrum, Aliasing. Sampling Techniques – principle, generation, demodulation, spectrum.
Quantization, Quantization error, Non-uniform quantizing, Encoding. PCM, DPCM – transmission system, bandwidth. ASK, PSK, FSK and QPSK system

Advanced communication system

Computer Communication system-Network, Protocols and standards, line configuration, Topology, Transmission modes, categories of networks, Internetworks, Transmission media, the OSI model, TCP/IP, DTE – DCE interface.
Wireless communication system- Introduction, cellular structures & planning, Frequency reuse, propagation Problems, Base station antennas, Mobile unit antenna Type of mobile

systems, Handoffs, Analog cellular Radio Digital Cellular radio, Digital Narrow band TDMA, CDMA technology.

Optical fiber communication- Type of fibers, optical source, detectors, Basic principle of optical communication system

Text Books

1. Tomasi W, Advanced Electronics Communication Systems, PHI, 4th Ed., 1998.
2. Forouzan, Data Communication and Networking, Tata McGraw Hill, third edition
3. Theodre S Rappaport : Wireless Communication – Pearson Education, second edition

Reference Books

1. Taub & Schlling, Principles of Communication Systems, McGraw Hill, 2nd Ed., 1987
2. William Stallings, Data and computer communication –Pearson Education, sixth edition
3. Haykin S. Communication Systems, John Wiley & sons, 3rd Ed.,1995

Programme Name	**Bachelor of Technology in Electrical Engineering**	**Semester – VI**
Course Code	EE3015P	
Course Title	**Communication System Laboratory**	

Course Contents

List of Experiments

1. Generation and demodulation of AM
2. Generation and demodulation of FM
3. Generation of DSB suppressed carrier signals
4. Generation of SSB signals
5. Test the characteristics of radio receivr.
6. Sampling theorem
7. Encoding and decoding PCM
8. Encoding and decoding DPCM
9. Generation and demodulation of ASK
10. Generation and demodulation of BFSK
11. Generation and demodulation of BPSK.
12. Transmission and reception of optical communication.

Text Books

1. Tomasi W., Advanced Electronics Communication Systems, PHI, 4th Ed., 1998.
2. Theodre S Rappaport : Wireless Communication – Pearson Education, second edition
3. Taub&Schlling, Principles of Communication Systems, McGraw Hill, 2nd Ed., 1987

Programme Name	**Bachelor of Technology in Electrical Engineering**	**Semester – VI**
Course Code	EE3101T	
Course Title	**Introduction to Renewable Energy**	

COURSE OUTCOMES

1. Summarize the different sources of renewable energy and the energy scenario in India.
2. Outline factors affecting availability of solar radiation and the various technologies for harnessing solar energy, and demonstrate understanding of system design for solar PV.
3. Explain generation of biomass, wind and geothermal energy and factors affecting it.
4. Demonstrate awareness of impact of renewable sources in electrical system design and smart grid.

Course Contents

Basics of energy

Energy and Power, Estimation of energy bills, Conventional energy source, Limited fossil fuels, Quality of fuel, Environmental impact of fossil fuels, Solar energy as an alternative, Other energy alternatives, Nuclear energy, Tidal and geothermal energy, Worldwide energy production, Energy Scenario of India, Current energy situation, Indian Energy Conservation Act 2001.

System design for solar PV

Power plant consisting of solar cell technology, DC power conversion, DC AC power conversion and connectivity to the grid using on line and off line inverters. Understanding of grid codes.

Solar cell technology

Solar Spectrum, Extraterrestrial radiation, Radiation on the earth surface, Global, diffuse solar radiation, Solar radiation at a given location, Daily radiation pattern, Annual variation in solar radiation, Optimal tilt for solar equipment, Monthly averaged global radiation at optimal tilt, Flat plate collectors, heat transfer processes, short term and long term collector performance, solar concentrators-design, analysis and performance evaluation. Si Wafer based solar cell technology: Development of commercial Si solar cells, high efficiency Si solar cells and other types of solar cell technologies. Thin Film Solar Cell Technologies: advantages, materials, common features, types of thin film cell technologies.

Biomass energy

Sources of biomass-different species, conversion of biomass into fuels-energy through fermentation, pyrolysis, gasification and combustion-Aerobic and anaerobic bio-conversion, properties of biomass, biogas plants-types of plants, design and operation, properties and characteristics of biogas.

Wind energy

Power plant consisting of wind power technology, power conversion, AC power conversion and connectivity to the grid using on line and off line inverters. Understanding of grid codes. Wind flow, Motion of wind, Vertical wind speed variation, Distribution of wind speeds, Power in the wind, Conversion of wind power, Site selection considerations, Wind turbines.

Geothermal energy

Availability, system development and limitations, ocean thermal energy conversion.

Integration of renewable and financial estimates

Impact of renewable energy sources in electrical system design, concept of green building, grid connected and stand alone renewable energy systems, challenges in grid integration of renewable sources of energy, introduction to smart grid, costing and payback period.

Text books

1. Renewable Energy Systems, Kaltschmitt, M.; Themelis, N.J.; Bronicki, L.Y.; Söder, L.; Vega, L.A. (Eds.) 3 volumes, 2013, XXVI, 1898 p.
2. Introduction to Renewable Energy, Vaughn Nelson, West Texas A&M University, Canyon, USA Published: April 25, 2011 by CRC Press - 408 Pages

Reference Books

1. S. P. Sukhatme, “Solar Energy - Principles of Thermal Collection and Storage”, Second Edition, Tata McGraw-Hil, New Delhi, 1996
2. Y. Goswami, F. Kreith and J. F. Kreider, “Principles of Solar Engineering”, Taylor and Francis, Philadelphia, 2000
3. B H khan “Non conventional energy sources” Tata Mc-Graw Hills Publication

Programme Name	**Bachelor of Technology in Electrical Engineering**	**Semester – VI**
Course Code	EE3101P	
Course Title	**Introduction to Renewable Energy Lab**	

List of Experiments

1. Design the equivalent circuit of a PV cell.
2. Design boost converter used in DC AC conversion.
3. Design inverter for solar power plant.
4. Design a PV power plant interconnected to grid.
5. Design a hybrid renewable energy system connected to grid.

Case study:

1. Indian Energy Conservation Act 2001.
2. Worldwide energy production.
3. Energy scenario of India and current situation.

Text Books

1. S. P. Sukhatme, "Solar Energy - Principles of Thermal Collection and Storage", Second Edition, Tata McGraw-Hil, New Delhi, 1996
2. B H khan "Non conventional energy sources" Tata Mc-Graw Hills Publication.
   Renewable Energy Systems, Kaltschmitt, M.; Themelis, N.J.; Bronicki, L.Y.; Söder, L.; Vega, L.A. (Eds.) 3 volumes, 2013, XXVI, 1898 p.
3. Introduction to Renewable Energy, Vaughn Nelson, West Texas A&M University, Canyon, USA Published: April 25, 2011 by CRC Press - 408 Pages

Programme Name	**Bachelor of Technology in Electrical Engineering**	**Semester – VI**
Course Code	EE3102T	
Course Title	**OOPs in Power System (Theory) Elective**	

COURSE OUTCOMES

- Able to perform object oriented programming to develop solutions to problems involving usage of control structures, modularity, I/O etc.
- Demonstrate ability to use object oriented programming to develop solutions to problems involving use of classes, data abstraction, encapsulation, function and operator overloading, inheritance and polymorphism.
- Perform object-oriented implementation of distribution system analysis.

Course Contents

Basic Concepts

C++ Standard library, Basics of a typical C++ environment, Header files and Namespace library files, Major pillars of OOP, Access specifiers, Overloading and Overriding methods, Abstract classes, Reusability

Classes and Data Abstraction

Program organization in C++, Accessing members of structures, Class scope, Accessing class members, Controlling access function and utility functions, Initializing class objects: Constructors, Default arguments with constructors, destructors, Classes : Constant object and Constant member , Object as member of classes, Friend function and friend classes, This pointer, Dynamic memory allocation, Static class members, Container classes and integrators, Proxy classes, Function overloading

Operator Overloading

Fundamentals of operator overloading, Restrictions on operators overloading, Operator functions as class members vs. Friend functions, Overloading of unary and binary operators

Inheritance

Base classes and derived classes, Protected members, Casting base-class pointers to derived-class Pointers, Using member functions, Overriding base-class members in a derived class, Different possible combination of inheritance, Using constructors and destructors in derived classes, Implicit derived–class object to base-class object conversion, Composition Vs. Inheritance

Virtual Functions

Virtual functions, Abstract base classes and concrete classes, Polymorphism, New classes and dynamic binding, Virtual destructors, Polymorphism, Dynamic binding

Object-Oriented Modeling of Distribution System

Introduction, Modeling of balanced distribution system, Modeling of radial distribution system, Modeling of weakly meshed distribution system, Modeling of distribution system with dispersed generation, Modeling of unbalanced distribution system, Single-phase load modeling, Three-phase load modeling, Single-phase and three-phase shunt modeling, Three-phase bus modeling, Three-phase feeder modeling, Three-phase voltage regulator modeling, Two-phase components modeling, Unbalanced distribution system modeling, Object-oriented implementation of distribution system analysis, Balanced load flow analysis, Unbalanced three-phase load flow analysis, Short circuit analysis of unbalanced distribution system

Text Books

1. H. M. Deitel and P. J. Deitel, "C++ How to Program", 1998, Prentice Hall.
2. Robert Lafore, "Object Oriented Programming in Turbo C++", 1994, the WAITE Group Press.

Reference Books

1. Bjarne Stroustrup, "The C++ Programming Language", 2nd edition , Wesley,1997.
2. Herbert Schildt, "The Complete Reference in C++", 2002, TMH.
3. Horstmann, "Computing Concepts with C++ Essentials", 2003, John Wiley.

Programme Name	Bachelor of Technology in Electrical Engineering	Semester – VI
Course Code	EE3102P	
Course Title	OOPs in Power System Lab	

List of Experiments

1. Write a program in C++ to exchange the content of two variables using call by reference
2. Write a program to implement an Account Class with member functions to Compute Interest, Show Balance, Withdraw and Deposit amount from the Account.
3. Write a C ++ program to implement a class for complex numbers with add and multiply as member functions. Overload ++ operator to increment a complex number.
4. Write a program in C++ to demonstrate unary operator over complex number class.
5. Write a program in C++ to search the 2^{nd} smallest element in an array

6. Create the equivalent of a four function calculator. The program should request the user to enter a number, an operator, and another number. It should then carry out the specified arithmetical operation: adding, subtracting, multiplying, or dividing the two numbers. (It should use a switch statement to select the operation). Finally it should display the result. When it finishes the calculation, the program should ask if the user wants to do another calculation. The response can be 'Y' or 'N'. Some sample interaction with the program might look like this.
   i. Enter first number, operator, second number: 10/ 3
   ii. Answer = 3.333333
   iii. Do another (Y/ N)? Y
   iv. Enter first number, operator, second number 12 + 100
   v. Answer = 112
   vi. Do another (Y/ N)? N

7. Create a class rational which represents a numerical value by two double values- NUMERATOR & DENOMINATOR. Include the following public member Functions:
   i. Constructor with no arguments (default)
   ii. Constructor with two arguments.
   iii. void reduce( ) that reduces the rational number by eliminating the highest common factor between the numerator and denominator.
   iv. Overload + operator to add two rational number.
   v. Overload >> operator to enable input through cin.
   vi. Overload << operator to enable output through cout.
   vii. Write a main ( ) to test all the functions in the class.

8. A point on the two dimensional plane can be represented by two numbers: an X coordinate and a Y coordinate. For example, (4, 5) represents a point 4 units to the right of the origin along the X axis and 5 units up the Y axis. The sum of two points can be defined as a new point whose X coordinate is the sum of the X coordinates of the points and whose Y coordinate is the sum of their Y coordinates.

i. Write a program that uses a structure called point to model a point. Define three points, and have the user input values to two of them. Than set the third point equal to the sum of the other two, and display the value of the new point. Interaction with the program might look like this:

ii. Enter coordinates for P1: 3 4
iii. Enter coordinates for P2: 5 7
iv. Coordinates of P1 + P2 are: 8, 11

9. Write a function called reversit( ) that reverses a string (an array of char). Use a for loop that swaps the first and last characters, then the second and next to last characters and so on. The string should be passed to reversit( ) as an argument. Write a program to exercise reversit( ). The program should get a string from the user, call reversit( ), and print out the result. Use an input method that allows embedded blanks. Test the program with Napoleon's famous phrase, "Able was I ere I saw Elba)"

10. Make a class Employee with a name and salary. Make a class Manager inherit from Employee. Add an instance variable, named department, of type string. Supply a method to String that prints the manager's name, department and salary. Make a class Executive inherit from Manager. Supply a method to String that prints the string "Executive" followed by the information stored in the Manager super class object. Supply a test program that tests these classes and methods.

Programme Name	Bachelor of Technology in Electrical Engineering	Semester – VI
Course Code	EE3103T	
Course Title	Industrial Automation Elective	

COURSE OUTCOMES

1. Explain Fundamentals of Process Control and classify Process Control Systems.
2. Explain Industrial Control System with reference to Process Control and Drives Control.
3. Able to draw P & I and block diagram representation of process.
4. Explain the design methodology and performance objectives.
5. Perform a case study in industrial automation.

Introduction

Overview of Industrial Automation Systems in typical Industries.

Elements Industrial Automation

Five tier concept (Sensors to Boardroom) Field Devices (Instruments, IEDs, Lab Equipment etc, Smart & Conventional) Controllers (PLC, DCS, RTU, DDCs) SCADA/HMI & Database, IT Infrastructure (Servers, Work Stations, Engineering Stations, Gateways, FEP, Communication Networks etc.) Higher level applications (MIS/MES/Optimization / ERP etc) "Protocols: 7 layer model, TCP/IP Ethernet, Modbus TCP/IP & RTU, - Profibus, IEC61850, BACNet , OPC etc"

Industrial Control System

P, I, D & Tuning with reference to Process Control & Drives Control

Process representation

P & I Diagrams and Interpretation, block diagrams

Design methodology

User Requirement Specifications (URS) System (Or Software) Requirement Specifications (SRS) Factory & Site Acceptance Tests (FAT & SAT) Quality Assurance System

Performance objectives

Response times (At various levels) Availability Calculation for the System (MTBF & MTTR) Resolution, Linearity, Accuracy

Case Study

Text Books

1. John Webb, “Programmable logic controllers, principles and applications,” Prentice Hall of India.
2. T. A. Hughes, “Programmable controller”, Instrument Society of America.
3. C. P. Johnson, “Process control instrumentation,” Prentice Hall of India.

Reference Books

1. John R. Hackworth and F. D. Hackworth, “PLC: Programming methods and applications,” Prentice Hall.
2. W. Botton, “Programmable Logic Controllers,” Elsevier.

Programme Name	**Bachelor of Technology in Electrical Engineering**	**Semester – VI**
Course Code	EE3103P	
Course Title	**Industrial Automation Lab**	

List of Experiments

1. Perform study of proportional controller.
2. Design a proportional-Integral controller.
3. Do study and analysis of proportional-integral-derivative controller.
4. Design ladder logic programming for different logic gates.
5. Build ladder logic program to implement timers in PLC.
6. Study and build ladder logic program to implement JUMP command in PLC.
7. Design ladder logic program to implement counters in PLC.
8. Design a ladder logic program for a given industrial process.

Text Books

1. John Webb, "Programmable logic controllers, principles and applications," Prentice Hall of India.
2. T. A. Hughes, "Programmable controller", Instrument Society of America.