UNIVERSITY OF CALICUT

SCHEME AND SYLLABI

FOR

THIRD AND FOURTH SEMESTERS

OF

BACHELOR OF TECHNOLOGY

IN

ELECTRICAL & ELECTRONICS ENGINEERING

FROM 2004 ADMISSION ONWARDS

CALICUT UNIVERSITY (P.O), THENHIPALAM

EE: ELECTRICAL & ELECTRONICS ENGINEERING

THIRD SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination	
		L	T	P/D		Hours	Marks
EN04 301A	ENGINEERING MATHEMATICS-III	3	1	-	50	3	100
EE04 302	COMPUTER PROGRAMMING IN C	2	-	2	50	3	100
EE04 303	STRENGTH OF MATERIALS	3	1	-	50	3	100
EE04 304	MECHANICAL ENGINEERING II	3	1	-	50	3	100
EE04 305	ELECTRONICS I	3	1	-	50	3	100
EE04 306	ELECTRIC CIRCUIT THEORY	3	1	-	50	3	100
EE04 307(P)	**ELECTRONICS LAB I**	-	-	3	50	3	100
EE04 308(P)	**BASIC ELECTRICAL ENGINEERING LAB**	-	-	3	50	3	100
TOTAL		**17**	**5**	**8**	**400**	**-**	**800**

FOURTH SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination	
		L	T	P/D		Hours	Marks
EN04 401A	ENGINEERING MATHEMATICS-IV	3	1	-	50	3	100
EN04 402	ENVIRONMENTAL STUDIES	3	1	-	50	3	100
EE04 403	ELECTRICAL MEASUREMENTS & MEASURING INSTRUMENTS	3	1	-	50	3	100
EE04 404	ELECTRONICS II	3	1	-	50	3	100
EE04 405	ELECTRICAL MACHINES I	3	1	-	50	3	100
EE04 406	LINEAR SYSTEMS ANALYSIS	3	1	-	50	3	100
EE04 407(P)	**MECHANICAL ENGINEERING LAB**	-	-	3	50	3	100
EE04 408(P)	**ELECTRICAL MEASUREMENTS LAB**	-	-	3	50	3	100
TOTAL		**18**	**6**	**6**	**400**	**-**	**800**

SYLLABI OF THIRD SEMESTER

EN04 301A ENGINEERING MATHEMATICS-III

(Common for all branches except CS and IT)

3 hours lecture and 1 hour tutorial per week

Module I : Linear Algebra

Vector spaces – Linear dependence and independence, and their computation – Bases and dimension – Subspaces – Inner product spaces – Gram-Schmidt orthogonalisation process – Linear transformations – Elementary properties of linear transformations – Matrix of a linear transformation. (Proofs of theorems omitted.)

Module II : Fourier Transforms

Fourier integral theorem (proof not required) – Fourier sine and cosine integral representations – Fourier transforms – Fourier sine and cosine transforms – Properties of Fourier transforms – Singularity functions and their Fourier transforms.

Module III : Probability Distributions

Random variables – Mean and variance of probability distributions – Binomial and Poisson distributions – Poisson approximation to binomial distribution – Hypergeometric and geometric distributions – Probability densities - Normal, uniform, and gamma distributions.

Module IV : Theory of Inference

Population and samples – Sampling distributions of mean and variance – Point and interval estimations – Confidence intervals for mean and variance - Tests of hypotheses - Hypotheses concerning one mean, two means, one variance, and two variances – Test of goodness of fit.

TEXT BOOKS

For Module I

K. B. Datta, *Matrix and Linear Algebra for Engineers*, Prentice-Hall of India, New Delhi, 2003.
(Sections: 5.1, 5.2, 5.3, 5.4, 5.5, 5.8, 6.1, 6.2, 6.3)

For Module II

C R Wylie & L C Barrett, *Advanced Engineering Mathematics (Sixth Edition)*, McGraw Hill.
(Sections: 9.1, 9.3, 9.5)

For Module III

Richard A Johnson, *Miller & Freund's Probability and Statistics for Engineers*, Pearson Education, 2000.
(Sections: 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 5.1, 5.2, 5.5, 5.7)

For Module IV

Richard A Johnson, *Miller & Freund's Probability and Statistics for Engineers*, Pearson Education, 2000.
(Sections: 6.1, 6.2, 6.3, 7.1, 7.2, 7.4, 7.5, 7.8, 8.1, 8.2, 8.3, 9.5)

REFERENCES

1. Bernard Kolman & David R Hill, *Introductory Linear Algebra with Applications (Seventh Edition)*, Pearson Education, 2003.
2. Lipschutz S, *Linear Algebra – Schaum's Outline Series*, McGraw Hill
3. Erwin Kreyszig, *Advanced Engineering Mathematics (Eighth Edition)*, John Wiley & Sons.
4. Larry C Andrews & Bhimsen K Shivamoggi, *Integral Transforms for Engineers*, Prentice-Hall of India, 2003.
5. Ronald E Walpole, et al, *Probability and Statistics for Engineers and Scientists(Seventh Edition)*, Pearson Education, 2004
6. Robert V Hogg & Elliot A Tanis, *Probability and Statistical Inference*, Pearson Education, 2003.
7. Chatfield C, *Statistics for Technology, Chapman & Hall*

Sessional work assessment:	
Assignments	30%
2 tests	60%
Regularity &Participation in class	10%
Total marks	= 50

University examination pattern

Q1 - 8 short type questions of 5 marks, 2 from each module
QII - 2 questions of 15 marks from module I with choice to answer any one
QIII - 2 questions of 15 marks from module II with choice to answer any one
QIV - 2 questions of 15 marks from module III with choice to answer any one
QV - 2 questions of 15 marks from module IV with choice to answer any one

EE04 302 COMPUTER PROGRAMMING IN C

(Common to all Branches except CS, IT & PT)

2 hours lecture & 2 hours practical per week

Module 1(12 hours)

Programming and problem solving – Basic computer organization – Developing algorithms – Flow charts – High level and low level languages – Compilers and Interpreters – Steps involved in computer programming –

Writing, Compiling and Executing a program – Debugging a program – Description of a programming language.

Module II (18 hours)

Basics of C – Overview of C – Program structure – Lexical elements – Numerical constants – Variables – Arithmetic operators – Arithmetic Expressions – Arithmetic conversion – Increment and Decrement operators

– Assignment Expressions – Multiple assignments – Input and Output – Format specifiers – Fundamental data

types – Bit level operators and applications – Relational operators – Relational expressions – Logical operators

– Logical expressions – Conditional operator – Precedence and associativity of operators.

Module III (16 hours)

Compound statements – Conditional statements – if statement – if else statement – nested if statement – switch

statement – Loop control statements – while statement - do while statement – for statement – continue statement – break statement – go to statement – Functions – user-defined functions – library functions – Recursion – Global, local and static variables.

Module IV(20hours)

Arrays – single dimensional – multi dimensional – Arrays in functions – Stacks – Strings – String processing –

Bit-wise operators – Enumerated data types – Structures – Typedef – Structures in Arrays – Arrays in Structures – Unions – Pointers – Pointers and Arrays – Pointers and Functions – Linear linked lists and list operations – Files – sequential files – unformatted files – text files.

Text Book:

Rajaraman V, Computer Programming in C, Prentice Hall of India

Reference Books:

1. Kernighan B.W. & Ritchie, D.M., The C Programming Language, Prentice Hall of India
2. Balaguruswami E, Progrmming in ANCI C, Tata McGraw Hill
3. Venugopal K.R. & Prasad S.R., Programming with C, Tata McGraw Hill

Sessional work assessment	
Assignments	30%
2 tests	60%
Regularity &Participation in class	10%
Total marks	= 50

University examination pattern

Q1 - 8 short type questions of 5 marks, 2 from each module

QII - 2 questions of 15 marks from module I with choice to answer any one

QIII - 2 questions of 15 marks from module II with choice to answer any one

QIV - 2 questions of 15 marks from module III with choice to answer any one

QV - 2 questions of 15 marks from module IV with choice to answer any one

EE04 303 STRENGTH OF MATERIALS

3 hours lecture and 1 hour tutorial per week

Module I

Tension, compression & shear: (7 hours)

Types of external loads - internal stresses - normal and shear stresses - strain - Hooke's law - Poisson's ratio - relationship between elastic constants - stress strain diagrams - elongation of prismatic bars - Temperature stresses.

Analysis of stress on oblique sections and strain: (5 hours)

Stress on inclined planes for axial and biaxial stress fields - principal stresses - Mohr's circle of stress - principal strains - strain rosette

Module II

Shear force & Bending Moment: (4 hours)

Review of Bending moment and shear force for Cantilever and Simply supported cases, SFD & BMD for over hanging beams (with concentrated load, u.d.l and Moment)

Stresses in laterally loaded symmetrical beams: (9 hours)

Theory of simple bending –assumptions and limitations – Stresses in beams – moment of resistance – Section modulus - shearing stresses in bending - Flitched Beam

Module III

Deflection of beams: (8 hours)

Differential equation of the elastic curve – Deflection of statically determinate beams - Method of successive integration – Macaulay's method

Torsion: (5 hours)

Torsion of circular bars – strength and stiffness of solid and hollow circular shafts (uniform cross section), Transmission of power. Close coiled helical springs.

Module IV

Theory of columns: (5 hours)

Combined Direct and bending stress - Euler's load for columns with different end conditions - Rankine formula

Thick Cylinders (5 hours)

Lame's equation - stresses in thick cylinders due to internal and external pressures - compound cylinders

Introduction to riveted and welded connection (2 hours)

Riveting – Lap joint, Butt joint, Staggered riveting, Chain riveting. Welding – Butt welds, Fillet welds.

Testing of materials (2 hours)

Tension, flexure, shear, hardness, toughness, fatigue

Text Books:

1. James M Gere & Stephen P Timoshenko , Mechanics of Materials , CBS Publishers & Distributers, New Delhi
2. Bhavikatti.S.S., Strength of Materials, Vikas Publishers, New Delhi
3. Vazirani & Ratwani, Analysis of Structures, Vol-1, Khanna Publishers

Reference books:

Timoshenko & Young, Elements of Strength of Materials, Affiliated East West Press Ltd.

Egor P Popov , Mechanics of solids, Prentice Hall of India, New Delhi.

Warnock F.V., Strength of Materials, Isaac Pitman

Nash W.A., Strength of Materials, Schaum's Outline Series, McGraw

Sessional work assessment	
2 Assignments	30%
2 tests	60%
Regularity &Participation in class	10%
Total Marks	=50

University Examination pattern

Q I	- 8 short type questions of 5 marks, 2 from each module
Q II	- 2 questions A and B of 15 marks from module I with choice to answer any one
QIII	- 2 questions A and B of 15 marks from module II with choice to answer any one
QIV	- 2 questions A and B of 15 marks from module III with choice to answer any one
QV	- 2 questions A and B of 15 marks from module IV with choice to answer any one

EE04 304 MECHANICAL ENGINEERING II

3 hours lecture and 1 hour tutorial per week

Module I (12 hours)

Fluid Mechanics – Fluid properties – density, viscosity, surface tension and capillarity – Newton Law of viscosity – Fluid statics – Fluid pressure – Variation of pressure in static fluid – Absolute and gauge pressure, Burden tube pressure gauge, manometers – Hydrostatic forces on plane and curved surfaces – Centre of pressure – Buoyancy and stability of submerged and floating bodies – Metacentric height – Simple numerical problems.

Module II (14 hours)

Fluid dynamics – Continuity equation, momentum equation and energy equations. One dimensional flow along a streamline – Euler's momentum equation, Bernoulli's equation, Pitot and pitot static tubes – Venturimeter, orifice meter, flow nozzle, notches and weirs – simple numerical problems.

Module III (14 hours)

Dimensional analysis – Rayleigh's method, Buckingham – -Theorem – Principles of modelling and similitude as applied to fluid mechanics problems – Non-dimensional parameter on fluid mechanics and fluid machinery.

Hydraulic machines – Hydraulic turbines – Impulse and reaction turbines – Pelton Wheel, Francis turbine and Kaplan turbines – their constructional features and performance characteristics – factors affecting performance – turbine selection criteria – Governing, Surging and Cavitation (theory only detailed analysis not expected)

Module IV (14 hours)

Hydraulic pumps – General features of positive displacement anxd roto dynamic pumps, Centrifugal pump – Classification – Principles of working. Multi-stage pumpsd – Self priming pumps – Deep well pumps. Reciprocating pumps – Use of air vessels – Pump characteristics. Rotary pumps – Gear pumps – Rotary piston pumps – Wane pump – Screw pumps (working principle only. Detailed syllabus not expected)

Mechanical Power Transmission – Belts and pulleys – Classification – Expression for ration of belt tension, slip, length of belt, centrifugal tension, Simple problems (V belts and flat belts) chain drivers – Classification, uses, ropes – application.

Text Books

1. Fluid Mechanics & Hydraulic Machines - Modi & Seth
2. Theory of Machines - P.L. Bellaney

Reference books

1. Hydraulic Machines - Dr. Jagdish Lal
2. Fluid mechanics - K.L. Kumar
3. Fluid mechanics - D.S. Kumar
4. Theory of Machines - Dr. Jagdish Lal

Sessional work assessment

Assignments	30%
2 tests	60%
Regularity &Participation in class	10%
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks, 2 from each module
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one

EE04 305 ELECTRONICS I

3 hours lecture & 1 hour tutorial per week

Objective:

Understanding the basics of electronics.
Procedures for design a simple electronic circuit involving diodes, transistors etc.
Understanding the selection of proper components from the specifications available and implement the same practically.

Module I: Semiconductors and devices (14 hours)

Field intensity - Potential energy - Mobility - Conductivity - Electrons and holes - Charge density in semiconductors - Electrical properties of silicon and germanium - Diffusion - Potential variation within graded semiconductors - Open circuit p-n junction - p-n junction as a rectifier - V-I characteristics - Temperature dependence - Diode resistance - Transition capacitance - Minority carrier storage - Diffusion capacitance - Breakdown diode - Schottky diode - Junction transistor - Current components - Construction - CE and CB characteristics - Ratings - Construction and characteristics of JFETS and MOSFETS

Module II: Diode circuits (12 hours)

Diode as a circuit element - Load line - Piecewise linear model - Single phase half wave and full wave rectifier circuits - Voltage regulation - Ripple factor - Rectifier efficiency - Transformer utilization factor- Bridge rectifier- Rectifier filters - LC and RC filters and comparison - Diode currents and supply line currents for various filters - Diode clipping circuits - Single level and two level clippers - Clamping circuits - Clamping circuit theorem

Module III: Amplifier circuits (13 hours)

Operating point of a BJT - Bias stability - Thermal runaway - Fixed bias and self bias design - Concept of small signal operation - Amplification in CE amplifier - Transconductance and its relation to CE voltage gain - h parameter model of a BJT- CE, CB and Emitter follower analysis and comparison using hybrid equivalent circuit - Considerations in cascading transistor amplifiers - Biasing a JFET and MOSFET - Small signal model - CS and CD amplifiers- Class B and Class AB Power amplifiers using BJT

Module IV: Frequency response of amplifiers (s-domain approach is envisaged) (13 hours)

Low frequency response of BJT and FET amplifiers - Dominant time constant - selection of coupling and bypass capacitors - Hybrid Π equivalent circuit of BJT - High frequency response of CE current gain - α cut off and β cut off frequencies - Gain bandwidth product - Miller effect - Emitter follower at high frequencies - FET at high frequencies.- Differential amplifiers - Common mode and differential mode gains - CMMR - Current source biasing - Offset behavior

Text Book :
1. Millman J., *Microelectronics*, McGraw Hill
2. David Abell- Electronic Devices and Circuits, Prentice Hall of India
3.Millman &Halkias –Integrated Electronics, McGraw Hill

Reference books

1. Schilling & Belove, *Electronic Circuits*, McGraw Hill
2. Sedra & Smith, *Microelectronic Circuits* Oxford University Press
3. Jaeger R.C., *Microelectronic Circuit Design*, McGraw Hill
4. Horowitz P. & Hill W., *The Art of Electronics*, Foundation
5. Boylested & Nashesky, *Electronic Devices & Circuit Theory*, Prentice Hall of India
6. Rama Reddy. S, Electronic Devices and Circuits, Narosa publications

Sessional work assessment	
Assignments	30%
2 tests	60%
Regularity &Participation in class	10%
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks, 2 from each module
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one

EE04 306 ELECTRIC CIRCUIT THEORY

3 hours lecture and 1 hour tutorial per week

Objective:

Familiarization of various network topologies related to two-phase and three-phase systems.
Understanding the various methods for analysis and synthesis of electrical networks.
Design and set up of simple analog filter circuits.

Module I Three phase systems(8 hours)

Review of three phase systems, Three phase loads with mutual coupling between phases - 3 wire and 4 wire systems - Neutral shift - Neutral current - Active power, reactive power, complex power, apparent power and power factor in balanced and unbalanced three phase systems - Symmetrical components - Analysis of unbalanced systems using symmetrical components - Sequence impedances - Analysis of three phase unbalanced systems with mutual coupling between phases using symmetrical components - Sequence coupling

Module II: S-domain analysis of circuits (16 hours)

Laplace transform - Transform pairs - Gate functions - Shifting theorem - Solution of differential equations by Laplace transforms - Initial and final value theorems - Laplace transforms of periodic signals - Inversion of transforms by partial fractions - Convolution theorem and convolution integral - Transformation of a circuit into s-domain - Transformed equivalent of inductance - Capacitance and mutual inductance - Impedance and admittance in the transform domain - Node analysis and mesh analysis of the transformed circuit - Nodal admittance matrix and mesh impedance matrix in the s -domain - Solution of transformed circuits including mutually coupled circuits - Input and transfer immittance functions - Transfer functions - Impulse response and transfer function - Poles and Zeros - Pole Zero plots.- Sinusoidal steady state from Laplace transform inversion - Frequency response by transform evaluation on jω axis - Frequency response from pole-zero plot by geometrical interpretation

Module III (13 hours)

Two port networks

Two port networks - Characterization in terms of impedances and admittances - Hybrid and transmission parameters - Inter relationships among parameter sets - Reciprocity theorem - Interconnection of two port networks - Series, parallel and cascade – Network functions - Pole zero plots and steady state response from pole - zero plots

Symmetrical two port networks

T and Π Equivalent of a two port network – Image impedance – Characteristic impedance and propagation constant of a symmetrical two port network – Properties of a symmetrical two port network

Symmetrical two port reactive networks as filters

Filter fundamentals - Pass and stop bands-behavior of iterative impedance-Constant-k low pass filter-Constant-k high pass filter- m-derived T and Π sections and their applications for infinite attenuation and filter terminations-band pass and band elimination filters

Module IV (15 hours)

Elementary synthesis operations- LC network synthesis- properties of RC network functions- Foster form of RC networks – properties of RL network functions - Foster form of RL networks- the Cauer form of RC and RL networks

Introduction to network topology

Definition of graph, trees, incidence matrix - Properties of incidence matrix - Cut sets - Fundamental cut sets - Cut set schedule - Tie sets - Fundamental tie sets - Tie set schedule - relationships among incidence matrix, cut set matrix and tie set matrix - Kirchhoff's laws in terms of network topological matrices - Formulation and solution of network equations using topological methods - Loop analysis - Cut set analysis

Text Book

1. Valkenberg, *Network Analysis*, Prentice Hall of India
2. Abhijit Chakrabarthi, Electric Circuit Theory, Dhanpat Rai &Sons

Reference books

1. Desoer C.A. & Kuh E.S., *Basic Circuit Theory*, McGraw Hill
2. Siskind C.S., *Electrical Circuits*, McGraw Hill
3. Ryder J.D., *Networks, Lines & Fields*, Prentice Hall
4. Edminister, *Electric Circuits - Schaum's Outline Series*, McGraw Hill
5. Huelsman L.P., *Basic Circuit Theory*, Prentice Hall of India
6. Balabanian, Network Synthesis , Prentice Hall of India
7. M.A.Pai, Introduction to Electric Circuits & Machines, East West.
8. Nilson, Electric Circuits, Adison Wiley.

Sessional work Assessment

Assignments	30%
2 tests	60%
Regularity &Participation in class	10%
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks, 2 from each module
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one

EE04 307(P) ELECTRONICS LAB I

3 hours practical per week

1. Study & Use of CRO: a) Measurement of current voltage, frequency and phase shift.
2. Semiconductor diodes: V-I and transfer characteristics of Si, Ge and zener diodes
3. Transistor characteristics in CB and CE configurations - Identification of cut off, active and saturation regions
4. JFET characteristics in the common source configuration- Determination of equivalent circuit parameters
5. RC coupled amplifier using BJT in CE configuration- Measurement of gain, input and output impedance and frequency response
6. FET amplifier- Measurement of voltage gain, current gain, input and output impedance
7. UJT relaxation oscillator- Design for a particular frequency
8. Rectifiers and filters with and without shunt capacitors- Characteristics of half-wave, full wave and bridge rectifiers- Ripple factor, Rectification efficiency, and % regulation
9. BJT emitter follower- Measurement of voltage gain, current gain, input impedance, output impedance and load characteristics
10. Characteristics of clipping and clamping circuits using diodes and zener diodes
11. Characteristics of voltage regulators- Design and testing of: a) simple zener voltage regulator b) zener regulator with emitter follower output

Sessional work assessment	
Record & Class work	=25
Attendance & Regularity	=5
Test	=20
Total	=50

EE04 308(P) BASIC ELECTRICAL ENGINEERING LAB

3 hours practical per week

1. Study of PMMC/MI voltmeters/ammeters, dynamometer type wattmeter, clip on ammeter ,analog/digital multimeters and static energy meters

2. a) Determination of voltage-current characteristics of a wire-wound rheostat and (b) an incandescent lamp

3. Methods of measurement for low/high resistance using voltmeter and ammeter

4. Potential divider connection of a rheostat and study of the dependence of output voltage upon the value of the load resistance

5. Verification of Kirchoff's laws in D.C circuit

6. Verification of super position theorem in a D.C circuit

7. Verification of Thevenin's theorem in D.C circuit

8. Verification of Generalised Reciprocity theorem in a D.C circuit

9. Determination of impedance, admittance, power factor and real/reactive/apparent power drawn in RLC series/parallel circuits

10. Determination of fusing time versus current characteristics and fusing factor different specimens of fuse wires

11. Single-phase power measurement using a dynamometer type wattmeter

12. Single-phase power measurement of 3 ammeter method and 3 voltmeter method

13. Three-phase power measurement using one wattmeter and two wattmeters.

Sessional work assessment	
Record & Class work	=25
Attendance & Regularity	=5
Test	=20
Total	=50

SYLLABI OF FOURTH SEMESTER

EN04 401A ENGINEERING MATHEMATICS-IV

(Common for all branches except CS and IT)

3 hours lecture and 1 hour tutorial per week

Module I : Functions of a Complex Variable I

Functions of a complex variable – Derivatives and analytic functions – Cauchy-Reimann equations - Laplace equation – Conformal mapping – Exponential function – Trigonometric functions - Hyperbolic functions - Logarithm - Linear fractional transformations

Module II : Functions of a Complex Variable II

Line integral in the complex plane – Cauchy's integral theorem (Proof of existence of indefinite integral to be omitted) – Cauchy's integral formula – Derivatives of analytic functions (Proof to be omitted) -Taylor series – Laurent series – Singularities and zeros - Residues and residue theorem – Evaluation of real integrals

Module III : Series Solutions of Differential Equations

(i) Power series method for solving ordinary differential equations – Legendre's equation and Legendre polynomials – Rodrigue's formula – Generating functions – Relations between Legendre polynomials – Orthogonality property of Legendre polynomials (proof omitted)

(ii) Frobenius method for solving ordinary differential equations – Bessel's equation – Bessel functions – Generating functions – Relations between Bessel functions – Orthogonality property of Bessel functions (proof omitted).

Module IV : Partial Differential Equations

Basic concepts - Classification of linear PDE's –Derivation of the one-dimensional wave equation and the one-dimensional heat equation – Solutions of these equations by the method of separation of variables – Solutions satisfying initial and boundary conditions – D' Alembert's solution of the one-dimensional wave equation – Steady-state two dimensional heat flow.

TEXT BOOK: Erwin Kreyszig, *Advanced Engineering Mathematics* (8th Edition) John Wiley & Sons.

Module 1
Sections: 12.3, 12.4, 12.5, 12.6, 12.7, 12.8, 12.9

Module 2
Sections: 13.1, 13.2, 13.3, 14.4, 15.1, 15.2, 15.3, 15.4

Module 3
Sections: 4.1, 4.3, 4.4, 4.5

Module 4
Sections: 11.1, 11.2, 11.3, 11.4, 11.5.

REFERENCES

1. C R Wylie & L C Barrett, *Advanced Engineering Mathematics (Sixth Edition),* McGraw Hill.
2. Churchill R V, Brown J W & Verhey R F, *Complex Variables and Applications,* McGraw Hill .
3. Pipes L A & Harvill L R, *Applied Mathematics for Engineers & Physicists,* McGraw Hill
4. Michael D Greenberg, *Advanced Engineering Mathematics* (*Second Edition*) Pearson education Asia.
5. Sastry S S, *Engineering Mathematics – Volumes 1 & 2,* Prentice Hall of India

Sessional work assessment:	
2Assignments	30%
2 tests	60%
Regularity &Participation in class	10%
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks, 2 from each module
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one
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Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one

EN04 402 ENVIRONMENTAL STUDIES

(Common for all branches)

3 hours lecture & 1 hour tutorial per week

Objective:

The importance of environmental science and environmental studies cannot be disputed. Continuing problems of pollution, loss of forest, solid waste disposal, degradation of environment, loss of bio diversity etc have made everyone aware of environment issues. The objective of this course is to create general awareness among the students regarding these environmental issues.

Module I (12 Hours)

The Multidisciplinary nature of environmental studies

Definition - scope and importance-need for public awareness.

Natural Resources

Renewable and non-renewable resources:

Natural resources and associated problems - forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their defects on forests and tribal people. - Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. - Food resources: World food problems, changes caused by agriculture overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. - Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, case studies - Land resources: Land as a resource, land degradation, man induced land slides, soil crosion and desertification - Role of an individual in conversation of natural resources - Equitable use of resources for sustainable lifestyle.

Module II (14 Hours)

Ecosystems - Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids - Introduction, types, characteristic features , structure and function of the following ecosystem:-Forest ecosystem - Grassland ecosystem - Desert ecosystem - Aquatic ecosystem(ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation

Introduction – Definition: genetic, species and ecosystem diversity - Biogeographical classification of India - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels - India as a mega-diversity nation – Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wild life, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Module III (11 Hours)

Environmental Pollution

Definition - Causes, effects and control measures of:- Air pollution - Water pollution - Soil pollution - Marine pollution-Noise pollution -Thermal pollution - Nuclear hazards - Solid waste Management: Causes, effects and control measures of urban and industrial wastes -Role of an individual in prevention of pollution - Pollution case studies - Disaster management : floods, earthquake, cyclone and landslides - Environmental Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and Control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation - Public Awareness

Module IV (10 Hours) Social Issues and the Environment

From unsustainable to sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, watershed management - Resettlement and rehabilitation of people; its problems and concerns,case studies - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies - Wasteland reclamation - Consumerism and waste products

Human Population and the environment

Population growth, variation among nations - Population explosion – Family welfare Programme - Environment and human health – Pollution hazards, Sanitation and health - Human Rights for clean environment - Value Education - HIV/AIDS-social concern - Women and Child Welfare - Role of information Technology in Environment and human health - Case studies

Field Work (5 Hours)

- Visit to a local area to document environmental assets – river/forest/grassland/hill/mountain
- Visit to local polluted site – Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds
- Study of simple ecosystems – pond, river, hill slopes, etc.

Text books:

1.Clark, R.S. Marine Pollution. Clanderson Press Oxford
2.Mhaskar A.K, Matter Hazardous. Techno-science Publications
3.Miller, T.G. Jr. Environmental Science. Wadsworth Publishing Co.
4.Townsend, C., Harper, J. and Michael Begon, Essential of Ecology. Blackwell Science
5.Trivedi. R.K. and Goel . P.K. Introduction to air pollution. Techno – Science Publications

References:

1. Agarval. K.C.2001 Environmental biology. Nidi Publ. Ltd. Bikaner
2. Bharucha Erach, Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email: mapin@icenet.net
3. Brunner, R.C. 1989. Hazardous Waste Incineration. McGraw Hill Inc. 480p
4. Cunningham, W.P., Cooper, T.H., Gorhani, E & Hepworth, M.T. 2001Environmental encyclopedia Jaico publ. House Mumbai 1196p
5. De, A.K. Environmental Chemistry. Wiley Eastern Ltd.
6. Down to Earth, Centre for Science and Environment
7. Gleick, H.P. 1993. Water in crisis. Pacific Institute for Studies in Dev., Environment and security, Stockholm Env. Institute. Oxford Univ. Press. 473p
8. Hawkins, R.E. Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay
9. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
10.Jadhav, H. & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi
11. Mckinney, M.L. & School, R.M. 1996. Environmental Science system & Solutions, Web enhanced edition, 639p.
12.Odum, E.P. 1971. Fundamentals of Ecology. W.B.Saunders Co. USA, 574p
13. Rao, M.N. & Datta, A.K 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd., 345p
14.Sharma, B.K. 2001. Environmental Chemistry. Goel Publ. House, Meerut.
15. Survey of the Environment, The Hindu (M)
16.Trivedi, R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol I and II . Enviro Media
17.Wagner.K.D. 1998. Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p
(M) Magazine

Internal assessment:

2 Tests	= 20
Field work and Report (Internal Assessment)	= 25
Regularity	= 5
Total marks	= 50

UniversityExamination Pattern :

Part A: Short answer questions 12 out of 16(4 from each module) - 12x5 = 60 Marks

Q II - 2 questions A and B of 10 marks from module I with choice to answer any one

Q III - 2 questions A and B of 10 marks from module II with choice to answer any one

Q IV - 2 questions A and B of 10 marks from module III with choice to answer any one

Q V - 2 questions A and B of 10 marks from module IV with choice to answer any one

EE04 403 ELECTRICAL MEASUREMENTS & MEASURING INSTRUMENTS

3 hours lecture and 1 hour tutorial per week

Objective:

Understanding the basic working principles of electrical measuring instruments.
Measurement of electrical parameters using appropriate instrument.
Design and calibrate an electrical measuring instrument.

Module I (13 hours)

Indicating instruments

Principle - Different types of control and damping arrangements in indicating instruments - Permanent magnet moving coil, moving iron, hot wire, electrostatic and dynamometer type meters - Ammeters and Voltmeters - Errors in indicating instruments - Rectifier type meters - Factors influencing its performance - Extension of instrument range - Shunts for ammeters - Voltmeter multipliers - Instrument transformers - Current transformer - Phasor diagram - Ratio and phase angle error - Use of instrument transformers with wattmeter - Clip on meters - Hall effect clip on meters - Errors

Module II (13 hours)

Wattmeters, energy meters and other measuring instruments

Measurement of energy and power - Dynamometer type wattmeter - Error and Compensation - Principle of working of ampere hour meter - Single and Three phase energy meters - Errors and Compensation - Calibration using wattmeter and rotating substandard - Static watt meters and Energy meters - Principles and block diagram - Tri vector meter - Frequency meters - Power factor meters

Module III (13 hours)

Measurement of resistance

Wheatstone`s bridge – Kelvin`s double bridge - Carry Foster Slide wire bridge - Sensitivity of dc bridges - Interchange of battery and galvanometer - Bridge current limitations - ohmmeter - Meggar - Measurement of insulation resistance by direct deflection method - Earth electrodes - Earth resistance - Earth tester - Localization of cable fault by Murray and Varley loop tests

AC bridges

Measurement of inductance using Maxwell and Anderson bridges - Measurement of capacitance using schering bridge

Module IV (13 hours)

Potentiometers

General principle - Modern form of dc potentiometers - Vernier dial principle - Standardization - ac potentiometers - Coordinate and polar types - Application of dc and ac potentiometers

Magnetic measurements

Classification of magnetic measurements - Measurement of flux and permeability - Hibbert's magnetic standard - Fluxmeter - Hall Effect Gaussmeter - Ballistic galvanometer - BH curve and permeability - Measurement of bar and ring specimen - Hysteresis measurement - Core loss and measurement with Lloyd - Fisher square

Text books

1. Sawhney A.K., *A course in Electrical & Electronic Measurements & Instrumentation*, Dhanpat Rai.
2. Golding E.W., *Electrical Measurements & Measuring Instruments*, Wheeler Pub

References

1. Cooper W.D., *Modern Electronics Instrumentation*, Prentice Hall of India
2. Stout M.B., *Basic Electrical Measurements*, Prentice Hall
3. Harris F.K., *Electrical Measurement*, John Wiley
4. Oliver & Cage, *Electronic Measurements & Instrumentation*, McGraw Hill
5. Baldwin C.T., *Fundamentals of Electrical Measurement*, Lyall Book Depo

Sessional work assessment

2Assignments	30%
2 tests	60%
Regularity &Participation in class	10%
Total Marks	=50

University examination pattern

Q I - 8 short type questions of 5 marks, 2 from each module
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any on

EE04 404 ELECTRONICS II

3 hours lecture and 1 hour tutorial per week

Objective:

Analysis of closed loop complex electronics circuits.
Understanding the fundamental topology related to Integrated Circuits.
Synthesize a signal processing environment involving ICs.

Module 1: Concepts of Feed back (13 hours)

Basics – negative and positive feed back – loop gain – types of feed back – analysis of the advantages of negative feed back and positive feed back – analysis of voltage series, voltage shunt, current series, current shunt, feed back circuits of BJT's
Oscillators basics bark hausen's criterion – phase shift oscillators- wein bridge oscillators – crystal oscillators- Stability - Advantages.

Module II: Linear Op amp Circuits (13 hours)

Operational amplifier - Ideal opamp properties - Properties of practical opamps - Different stages in an opamp - Internally compensated and externally compensated opamps - Slew rate - Offsets - Analysis of opamp circuits using ideal opamp model - Concept of virtual short and its relation to negative feedback - Non inverting amplifier - Gain bandwidth product - Voltage follower - Inverting amplifier - Summing amplifier - Subtracting circuits - Instrumentation amplifier - Voltage to current converter for floating and grounded loads - Opamp integrator - Opamp differentiator - Series voltage regulators - Monolithic regulators - Three terminal regulators - Regenerative comparator circuits using opamps - Comparator IC LM311 and its applications - Square, triangle and ramp generator circuits using opamps and comparator ICs - Effect of slew rate on waveform generation - Principles of VCO circuits.

Module III: Nonlinear IC Applications (13 hours)

Opamp based astable and monostable circuits - Precision half wave and full wave rectification using opamps - Log and anti-log amplifiers and applications - Analog multiplier based on log/antilog amplifiers.- Phase locked loops – Principles - Lock and Capture ranges - Capture process - Loop filter - PLL dynamics under locked condition - Study of NE565 - Applications of PLL in signal reconstruction - Noise rejection - Frequency multiplication - Frequency synthesis - FSK demodulation - FM demodulation - Line synchronization etc. Timer - 555 applications - Active filtering - Butterworth lowpass filter functions - Lowpass filter specifications - Order and cut off frequency of Butterworth function from lowpass specifications - Sallen and Key second order LP section - gain adjustment in Butterworth LP filters - Butterworth high pass filters - Second order wide band and narrow band bandpass filters.

Module IV: Signal conditioning and signal conversion (13 hours)

Analog switches - Sample and hold amplifier - Data conversion fundamentals - D/A conversion - Weighed resistor DAC - R/2R ladder DAC - Current switching DAC - Multiplying DAC - Bipolar DACs - A/D conversion - Quantiser characteristics - Single slope and dual slope ADCs - Counter ramp ADC - Tracking ADC - Successive approximation ADC - Simultaneous ADC.
Linear wave shaping - high pass and low pass by R&C – Steady State Responses to step, pulse, ramp and square wave inputs.

Text Book:

1. Millman J., *Microelectronics*, McGraw Hill
2. Gayakwad R.A., *OPAMPS & Linear Integrated Circuits*, Prentice Hall of India

Reference books

1. Schilling & Belove, *Electronic Circuits*, McGraw Hill
2. Sedra & Smith, *Microelectronic Circuits*, Oxford University Press
3. Jaeger R.C., *Microelectronic Circuit Design*, McGraw Hill
4. Anvekar D.K. & Sonde B.S., *Electronic Data Converters*, Tata McGraw Hill
5. Clayton G.B., *Operational Amplifiers*, ELBS
6. Frederiksen T.M., *Intuitive Operational Amplifiers*, McGraw Hill
7. Millman & Taub., Pulse Digital and switching waveforms
8. Robert F Coughlin, Operational Amplifiers and Linear Integrated Circuits

Sessional work assessment

2Assignments	30%
2 tests	60%
Regularity &Participation in class	10%
Total Marks	=50

University examination pattern

Q I - 8 short type questions of 5 marks, 2 from each module
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one

EE04 405 ELECTRICAL MACHINES I

3 hours lecture and 1 hour tutorial per week

Objective:

Understanding the basic working principle of electrical machines.
Analyzing the performance of electrical machines.
Conducting performance analysis of a given electrical machine.

Module I (12 hours)

Electromagnetic Machines: Fundamental principles - Classification - Generators, motors and transformers - Elements of electromagnetic machines -
DC Machines: Construction - Principle of operation - Magnetic circuit - Flux distribution curve in the air-gap -Armature windings - Lap and Wave Windings - Dummy coils Equalizer connections - Armature reaction - Demagnetising and cross magnetising ampere turns - Commutation - Methods to improve commutation performance

Module II (10 hours)

DC Generators: Working principle - EMF Equation - Types of Excitation - Power flow diagram - Circuit model - Magnetisation characteristics - Process of voltage build up - Terminal characteristics - Control of terminal voltage - Parallel operation - Applications

Module III (14 hours)
DC Motors: Working principle - Back EMF - Torque and speed equations - Power flow diagram - Circuit model - - Performance characteristics – Applications - Starting methods - Design of starters - Methods of speed control -Solid state speed controllers (Block Diagram) Testing - Swinburne's test - Hopkinson's test - Separation of losses - Retardation test - Permanent magnet DC motor

Module IV (16 hours)
Transformers: Types and construction - Principle of operation - Magnetising current – Harmonics - Ideal and real transformer - Dot convention - Current and voltage ratio - Equivalent circuit - Phasor diagram - Per unit impedance - OC and SC test Losses - efficiency and regulation - All day efficiency - Sumpner's test - Parallel operation - Tap changing - Switching transients - Auto transformers - Voltage and current relationships - Saving of copper - Different connections of three phase transformers - Notations - Scott connection - Cooling methods - Three winding transformer.

Text Books

1.Clayton & Hancock, *Performance & Design Of DC Machines*, ELBS
2.Dr.P.S.Bhimbra, Electrical Machinery, Khanna Publishers
3.Dr.K.Murukesh Kumar , DC Machines & Transformers, Vikas Publishing House Pvt Ltd.

Reference books

Langsdorf A. S., *Theory of DC Machinery*, McGraw Hill
Nagarath I. J. & Kothari. D. P., *Electric Machines*, Tata McGraw Hill
Fitzgerald,Charles Kingsley, Stephen Dumas, Electrical Machinery, Tata McGraw Hill
Chapman S.J., *Electric Machine Fundamentals*, McGraw Hill.
Toro V.D., *Electrical Machines & Power Systems*, Prentice Hall.
J.B.Gupta, Theory and Perfomance of Electrical Machines, S.Kataria and Sons.
Charles Hubert, Electric Machines., Pearson Education.

Sessional work assessment

2Assignments	30%
2 tests	60%
Regularity &Participation in class	10%
Total Marks	=50

University examination pattern

Q I - 8 short type questions of 5 marks, 2 from each module
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one

EE04 406 LINEAR SYSTEMS ANALYSIS

3 hours lecture and 1 hour tutorial per week

Objective:

Understanding the concepts of electro-mechanical systems.
Studying the various methods of analysis of linear systems.
Modeling and analysis of systems for various topologies.

Module I: System concepts and modelling of systems (11 hours)

Systems – Subsystems - Elements - Systems approach - Classification of systems - Static and dynamic systems - Linear and Nonlinear Systems - Distributed and lumped systems - Time invariant and time varying systems - Stochastic and deterministic systems - System modeling and approximations - Superposition principle - Homogeneity and additivity - Modelling of electrical systems - Active and Passive elements - Resistance inductance and capacitance - dynamic equations using Kirchhoff's current and voltage laws. RL, RC and RLC circuits and their dynamic equations - Block diagrams and signal flow graphs - Masons gain formula

Module II: Modelling of non-electrical systems (11 hours)

Modelling of translational and rotational mechanical systems - Differential equations for mass spring dashpot elements, D'Alembert's principle - Rotational Inertia - Stiffness and bearing friction - Gear trains - Equivalent inertia and Friction referred to primary and secondary shafts - Dynamic equations for typical mechanical systems - Electromechanical Analogues - Force-current and force-voltage analogue - Capacitance and Resistance of thermal, hydraulic pneumatic systems - Dynamic equations for simple systems - Comparison of electrical, electromechanical, hydraulic and pneumatic systems

Module III (16 hours)

Fourier series

Fourier series representation of non-sinusoidal periodic waveforms – Fourier coefficients -Determination of coefficients - Waveform symmetry - Exponential Fourier Series - Discrete amplitude and phase spectra - Steady state solution of circuits with non-sinusoidal periodic inputs by Fourier Series - Harmonics in three phase sources - Harmonic currents in star and delta connected non-linear loads - Triplen harmonics in three phase voltages and currents

Fourier transforms

Fourier representation of aperiodic signals - Fourier transform and inverse transform - Transform pairs - Properties of Fourier transforms - Continuous amplitude and phase spectra - Frequency response function - Impulse response and its Fourier transform – Relation € between Laplace transforms and Fourier transforms - Power spectral density - Energy spectral density - Parseval's theorem - Signal transmission systems - Signal distortion - Bandwidth requirement for signal transmission

Module IV: Transfer function and time domain analysis (12 hours)

Review of Laplace transforms - Impulse response - Convolution theorem and integral - Response to arbitrary inputs - Transfer function of typical systems discussed in Module I - Time domain analysis - Test Inputs - Step - velocity and ramp inputs - Transient and steady state response - First and second order - under damped and over damped responses - Maximum Overshoot - settling time - Rise time and time constant - Higher order systems - Steady state error - Error constants and error different types of inputs

Books

1. Cheng D.K. Addison Wesley, *Linear Systems Analysis*, Addison Wesley
2. Tripati J.N., *Linear Systems Analysis*, New Age International
3. Nilson, Electric Circuits, Adison Wiley.
4. Umesh Sinha, Electric Circuit Theory, Network Analysis & Synthesis, Sathya Prakash

Sessional work assessment

2Assignments	30%
2 tests	60%
Regularity &Participation in class	10%
Total Marks	=50

University examination pattern

Q I - 8 short type questions of 5 marks, 2 from each module
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one

EE04 407(P) MECHANICAL ENGINEERING LAB

3 hours per week

1. Fluid mechanics lab – calibration of flow meters – venturi meter, nuzzle meter, orifice meter, notches – pipe friction – metacentric height
2. Hydraulic machinery lab – characteristics of turbines and pumps – Pelton, Francis turbines – centrifugal, reciprocating, gear pumps, hydrams
3. Heat engines lab: constant speed characteristics of IC engines- SI engines, CI engines – air compressors, determination of viscosity, heat exchangers

Sessional work assessment	
Record & Class work	=25
Attendance & Regularity	=5
Test	=20
Total	=50

EE04 408(P) ELECTRICAL MEASUREMENTS LAB

3 hours per week

(Any TWELVE Experiments is to be done)

1. Determination of B-H curve of an iron ring specimen
2. Calibration of magnetic flux meter using standard solenoid and search coil and Hibbertz's magnetic standard
3. Measurement of resistance using Wheat stone's bridge and Kelvin's double bridge
4. Measurement of self/mutual inductance and coupling coefficient of iron cored coil and air cored coil
5. Calibration of dynamometer type wattmeter, using precision type vernier potentiometer
6. Extension of range of ammeter/voltmeter and calibration of the extended meters using standard ammeter/voltmeter
7. Extension of range of a dynamometer type wattmeter using CT/PT and calibration of the extended meter using a standard wattmeter
8. Calibration of single-phase energy meter by direct loading and phantom loading at various power factors
9. Calibration of 3 phase energy meter using standard wattmeter
10. Measurement of capacitance using Schering bridge
11. Determination of hysteresis loop of an iron ring specimen using 6 point method and CRO
12. Measurement of branch voltages in a series RLC circuit using A.C potentiometer
13. Calibration of static Energy Meter.(Single Phase & Three phase)
14. Murray-Varley loop test - Cable fault location

Sessional work assessment	
Record & Class work	=25
Attendance & Regularity	=5
Test	=20
Total	=50