SYLLABUS OF 1 TO 8 SEMESTERS

OF

B.TECH. in POWER ENGINEERING
(Mechanical / Electrical)

AS FINALISED BY THE
UNIVERSITY SYLLABUS COMMITTEE
IN THE MEETING HELD ON 14.07.03
At

National Power Training Institute(NR)
An ISO 9001:2000 & ISO 14001 Organisation
(Under the Ministry of Power, Government of India)
BADARPUR, NEW DELHI.

FIRST SEMESTER EXAMINATION

B.Tech (Power Engineering) Electrical / Mechanical Specialisation

Code No.	Paper	L	T/P	Credits
THEORY PAPERS				
ETMA 101	Applied Mathematics – I	3	1	4
ETPH 103	Applied Physics – I	2	1	3
ETCH 105	Applied Chemistry – I	2	1	3
ETME 107	Manufacturing Process	2	0	2
ETCS 109	Introduction to Computers and Auto CAD	2	1	3
ETEL 111	Communication Skills – I	2	1	3
ETEL 113*	Impact of Science & Technology on Society	1	0	1
PRACTICAL/VIVA VOCE				
ETPH 151	Applied Physics Lab. – I	-	2	1
ETCH 153	Applied Chemistry Lab. – I	-	2	1
ETCS 155	Introduction to Auto CAD Office Automation and Web Design	-	3	2
ETME 157	Workshop Practice	-	3	2
ETME 159	Engineering Graphics Lab.	-	2	1
	TOTAL	**14**	**17**	**26**

ETEL-113* is NUES

BACHELOR OF TECHNOLOGY
(B.TECH.) DEGREE COURSE (Common to all branches)

SECOND SEMESTER EXAMINATION

Code No.	Paper	L	T/P	Credits
THEORY PAPERS				
ETMA 102	Applied Mathematics – II	3	1	4
ETPH 104	Applied Physics – II	2	1	3
ETCH 106	Applied Chemistry – II	2	1	3
ETCS 108	Introduction to Programming	2	1	3
ETME 110	Engineering Mechanics	2	1	3
ETEC 112	Electrical Science	2	1	3
ETEL 114	Communication Skills – II	2	1	3
PRACTICAL/VIVA VOCE				
ETPH 152	Applied Physics Lab. – II	-	2	1
ETCH 154	Applied Chemistry Lab. – II	-	2	1
ETCS 156	C Programming Lab.	-	2	1
ETME 158	Engineering Mechanics Lab.	-	3	2
ETEC 160	Electrical Science Lab.	-	2	1
	TOTAL	**15**	**18**	**28**

Paper Code: ETMA-101   **L   T   C**
Paper: Applied Mathematics – I   **3   1   4**

UNIT I
COMPLEX NUMBERS AND INFINITE SERIES:
De Moivre's theorem and roots of complex numbers. Euler's theorem, Logarithmic Functions, Circular, Hyperbolic Functions and their Inverses.

Convergence and Divergence of Infinite series, Comparison test d'Alembert's ratio test. Higher ratio test, Cauchy's root test. Alternating series, Lebnitz test, Absolute and conditioinal convergence. **(No. of Hrs. 10)**
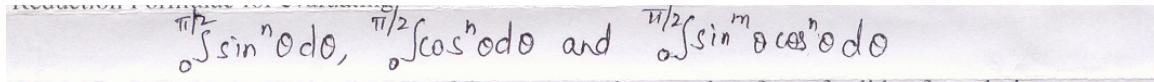
UNIT II
CALCULUS OF ONE VARIABLE:
Successive differentiation. Leibnitz theorem (without proof) McLaurin's and Taylor's expansion of functions, errors and approximation.

Asymptotes of Cartesian curves.

Curveture of curves in Cartesian, parametric and polar coordinates, Tracing of curves in Cartesian, parametric and polar coordinates (like conics, astroid, hypocycloid, Folium of Descartes, Cycloid, Circle, Cardiode, Lemniscate of Bernoulli, equiangular spiral).

$$\int_0^{\pi/2} \sin^n\theta\, d\theta, \quad \int_0^{\pi/2} \cos^n\theta\, d\theta \quad \text{and} \quad \int_0^{\pi/2} \sin^m\theta \cos^n\theta\, d\theta$$

Reduction Formulae for evaluating
Finding area under the curves, Length of the curves, volume and surface of solids of revolution.
(No. of Hrs. 15)

UNIT III
LINEAR ALGEBRA – MATERICES:
Rank of matrix, Linear transformations, Hermitian and skeew – Hermitian forms, Inverse of matrix by elementary operations. Consistency of linear simultaneous equations, Diagonalisation of a matrix, Eigen values and eigen vectors. Caley – Hamilton theorem (without proof).
(No. of Hrs. 09)

UNIT IV
ORDINARY DIFFERENTIAL EQUATIONS:
First order differential equations – exact and reducible to exact form. Linear differential equations of higher order with constant coefficients. Solution of simultaneous differential equations. Variation of parameters, Solution of homogeneous differential equations – Canchy and Legendre forms.

(No. of Hrs. 10)

Text books:
1. Kresyzig, E., "Advanced Engineering Mathematics", John Wiley and Sons. (Latest edition).
2. Jain, R. K. and Iyengar, S. R. K., "Advanced Engineering Mathematics", Narosa,

2003 (2nd Ed.).
3. "Advanced Engineering Mathematics", Dr. A. B. Mathur, V. P. Jaggi (Khanna publications)

References books:

1.   Mitin, V. V.; Polis, M. P. and Romanov, D. A., "Modern Advanced Mathematics for Engineers", John Wiley and Sons, 2001.
2.   Wylie, R., "Advanced Engineering Mathematics", McGraw-Hill, 1995.

Paper Code: ETPH – 103   **L   T   C**

Paper: APPLIED PHYSICS – I   **2   1   3**

UNIT I

Interference of Light: Interference due to division of wavefront and division of amplitude, Young's double slit expt., Interference, Principle of Superposition, Theory of Biprism, Interference from parallel thin films, wedge shaped films, Newton rings, Michelson interferometer.

Diffraction: Fresnel Diffraction, Diffraction at a straight edge, Fraunhoffer diffraction due to N slits, Diffraction grating, absent spectra, dispersive power of Grating, resolving power of prism and grating.

(No. of Hrs. 8)

UNIT II

Polarization: Introduction, production of plane polarized light by different methods, Brewster and Malus Laws. Double refraction, Quarter & half wave plate, Nicol prism, specific rotation, Laurent's half shade polarimeter.

Optical Instruments : Ramdson & Huygen Eye pieces, Electron microscope.

(No. of Hrs. 7)

UNIT III

Laser: Introduction, temporal and spatial coherence, principle of Laser, stimulated and spontaneous emission, Einstein's Coefficients, He-Ne Laser, Ruby Laser, Application of Lasers.

Fibre Optics: Introduction, numerical aperture, step index and graded index fibres, attenuation & dispersion mechanism in optical fibers (Qualitative only), application of optical fibres, optical communication (block diagram only)

(No. of Hrs. 8)

UNIT IV

Mechanics: Central and non-central forces, Inverse square force, SHM, Damped, undamped and forced Oscillations.

Special theory of Relativity: Frame of reference, Michelson-Morley experiment, basic postulates of special relativity, Lorentz transformations (space – time coordinates & velocity only), mass energy relation.

(No. of Hrs. 8)

Text Books:
1.   A. Ghatak, "Optics"
2.   N. Subrahmanyam and Brij Lal, "Optics"
3.   Jenkins and White, "Fundamentals of Optics"
4.   C. Kittle, "Mechanics", Berkeley Physics Course, Vol.- I.
5.   A. Beiser, "Concepts of Modern Physics"

Paper Code: ETCH – 105　　　　　　　　　　　　　　　　　**L**　**T**　**C**
Paper: Applied Chemistry – I　　　　　　　　　　　　　　　**2**　**1**　**3**

UNIT I
Water: Specifications for water, analysis of water – alkalinity, hardness and its determination (EDTA method only). Water for domestic use, Water softening processes – Lime – Soda process, Ion exchange method, boiler feed water, boiler problems-scale, sludge, priming and foaming, caustic embitterment and corrosion, their causes and prevention, removal of silica, removal of dissolved gases, carbonate and phosphate conditioning, colloidal conditioning, calgon treatment, Numerical problems on alkalinity, hardness, Lime-Soda process and Ion exchange method, EDTA method.　　　　　　　　**[No. of Hrs: 08]**

UNIT II
Fuels: Classification, combustion and chemical principles involved in it, calorific value: gross and net calorific values and their determination by bomb calorimeter and Boy's gas calorimeter.
Solid Fuels: Proximate and ultimate analysis of coal and their importance, High and low temperature carbonisation, Coke: Its manufacture by Otto Hoffman oven.
Liquid Fuels: Conversion of coal into liquid fuels (Bergius process and Fisher-Tropsch Process) and mechanism, Petroleum: its chemical composition and fractional distillation, cracking of heavy oil residues – thermal and catalytic cracking, knocking and chemical structure, octane number and cetane number and their significance, power alcohol, Analysis of flue gases by Orsat's apparatus, Numerical on calorific value, combustion, proximate and ultimate analysis of coal, flue gas analysis.

　　　　　　　　　　　　　　　　　　　　　　　　　　　[No. of Hrs: 08]

UNIT III
Environmental Pollution and Control:
Air Pollution: Types of pollutants, source effects, sink and control of primary pollutants – CO, No_x, HC, So_x and particulates, effects of pollutants on man and environment – photochemical smog and acid rain.
Water Pollution: Classification of pollutants, their sources, waste water treatment – domestic and industrial.
Soil Pollution: Composition of soil, classification and effects of soil pollutants and their control.
Solid Waste Pollution: Classification, waste treatment & Disposal methods (Composting, sanitary landfilling, thermal processes, recycling and reuse).
Hazardous Wastes: Classification – radioactive, biomedical and chemical, treatment and disposal – physical, chemical and biological processes.

　　　　　　　　　　　　　　　　　　　　　　　　　　　[No. of Hrs: 08]

UNIT IV
Solutions: Ideal and non-ideal solutions, Raoult's Law, Distillation of binary solutions, Henry's Law, Nernst distribution law, Arrhenius theory and special behaviour of strong electrolytes.

Corrosion: Types of corrosion (dry, wet, atmospheric and soil corrosion), theories of corrosion, protective measures against corrosion.　　　　　　　**[No. of Hrs: 08]**

Text Books:
1. Chemistry in Engineering & Technology (Vol I & II) (Latest ed.), By J.C. Kuriacose & J. Rajaram
2. Environmental Chemistry & Pollution Control (Latest ed.), By S.S. Dara
3. Applied Chemistry (Latest ed.), By H.D. Gesser

Paper Code: ETME 107   **L**   **T**   **C**

Paper: Manufacturing Processes   **2**   **0**   **2**

UNIT-I

Casting Processes:

Principles of metal casting: Pattern materials, types and allowance; Study of moulding, sand moulding, tools, moulding materials, classification of moulds, core, elements of gating system, casting defects, description and operation of cupola: special casting processes e.g. die-casting, permanent mould casting, centrifugal casting, investment casting.

[No. of Hrs. 6]

UNIT-II

Smithy and Forging:

Basic operation e.g. upsetting, fullering, flattening, drawing, swaging: tools and appliances: drop forging, press forging.

Bench Work and Fitting

Fitting, sawing, chipping, thread cutting (die), tapping; Study of hand tools, Marking and marking tools. **[No. of Hrs. 6]**

UNIT-III

Metal joining:

Welding principles, classification of welding techniques; Oxyacetylene Gas welding, equipment and field of application, Arc-welding, metal arc, Carbon arc, submerged arc and atomic hydrogen welding, Electric resistance welding: spot, seam, butt, and percussion welding; Flux: composition, properties and function; Electrodes, Types of joints and edge preparation, Brazing and soldering.

[No. of Hrs. 6]

UNIT-IV

Sheet Metal Work:

Common processes, tools and equipments; metals used for sheets, standard specification for sheets, spinning, bending, embossing and coining.

[No. of Hrs. 5]

Text Books:
1. Manufacturing Process by Raghuvanshi.
1. 1. Manufacturing Technology by P.N.Rao (TMH publications)

Reference Books:
1. 1. Workshop Technology by Hazra-Chowdhary
2. 2. Production Engineering by R.K.Jain
3. 3. Workshop Technology by Chapman

Paper Code: ETCS 109   *L   T   C*

Paper: Introduction to Computer Systems   **2   1   3**

UNIT I

Introduction to Computer:

Overview of Computer organization and historical perspective computer applications in various fields of science and management.

Data representation: Number systems, character representation codes, Binary, hex, octal codes and their inter conversions.

Binary arithmetic, Floating-point arithmetic, signed and unsigned numbers.

[No. of Hrs. 8]

UNIT II

Introduction to OS and Office Automation

Concept of computing, Introduction to Operating Systems such as DOS, windows 2000/Xp, UNIX, Client Server Technology, etc. (only brief user level description).

Introduction to World Processing, Spread Sheet & Presentation software e.g. MS-Word, MS-Excel, MS-Power Point.

[No. of Hrs. 8]

UNIT III

Introduction to Auto CAD

Coordinate System, 2D drafting: lines, circles, arc, polygon, etc., Editing, 3D, Solid modeling, Rendering, Use of Auto CAD for engineering drawing practices.

[No. of Hrs. 8]

UNIT IV

Web Technologies

Introduction to World Wide Web, Search engines, e-mail, news, gopher, Audio & Video Conferencing, Internet Protocols: FTP, telnet, TCP/IP, SMTP, HTTP, Languages used for WEB Technology: HTML, practical examples using DHTML and Static HTML

[No. of Hrs. 8]

Text Books:

1. Rajaraman, "Fundamentals of Computers", Prentice Hall of India, 3rd Edition.
2. Mark Middlebrook, "Autocad 2004 for Dummies", Pustak Mahel Prakashan, 2000.
3. Alexis Leon & Mathews Leon, "Fundamentals of Computer Science & Communication Engineering", Leon Techworld, 1998.

Reference Books:

1. Omura, "Mastering Autocad 2000 for Mechanical Eng ineers" BPB Publications, 2nd Edition, 1998.
2. A.S. Tanenbaum, " Computer Networks", Pearson Education India Ltd., 3rd Edition, 2002.

Paper Code: ETEL-111	L	T	C
Paper: Communication Skills – I	2	1	3

Unit I
Remedial Grammar: Errors of Accidence and syntax with reference to Parts of Speech; Agreement of Subject and Verb; Tense and Concord; Conditional Clauses; Use of connectives in Complex and Compound sentences; Question tags and short responses.

[No. of Hrs: 06]

Unit II
Vocabulary and Usage: Word Formations (by adding suffixes and prefixes); Technical Word Formation; Synonyms, Antonyms, Homophones, and Homonyms; One Word Substitution; Misappropriations; Indianisms; Redundant Words; Phrasal Verb Idioms.

[No. of Hrs: 06]

Unit III
Technical Writing:
(A)   Scientific Attitude and Impersonal Style; Plain Statements, Definitions; Description and Explanations (of objects, instruments, Processes, Scientific Principles, etc.)
Summarizing and abstracting; Expressing ideas within a restricted word limit; Paragraph Writing (Paragraph division, introduction and the conclusion, Variety in sentences and paragraphs)
Interpretation and use of charts, graphs and tables in technical writing.
Punctuation
(B)   Reading at various speeds (slow, fast, very fast); reading different kinds of texts for different purpose (e.g. for relaxation, for information, for discussion at a later stage, etc.); reading between the lines.
Comprehension of Unseen Passages   **[No. of Hrs: 10]**

Unit IV
Text: The following prose pieces from *Best Science Writing : Reading and Insights* edited by Robert Gannon prescribed text (Hyderabad: University Press (India) Limited, 1991).
1.   Chapter 2: "After 63 years, Why Are They Still Testing Einstein?" by C.P. Gilmore
2.   Chapter 5: "Star Wars : The Leaky Shield" By Carl Sagan
3.   Chapter 10: "Chaos : The Ultimate Asymmetry" by Arthur Fisher
4.   Chapter 11: "Bill Moss, Tentmaker" by Robert Gannon
5.   Chapter 12: "Totality - A Report" by Michael Rogers

[No. of Hrs: 10]

Text Books:
1.   Maison, Margaret M. Examine Your English, Hyderabad: Orient Longman, 1980
2.   Sharma, R.S. Technical Writing. Delhi: Radha Publication, 1999
3.   Sudarsanam, R. Understanding Technical English. Delhi: Sterling Publishers Pvt. Ltd., 1992

4.   Gannon, Robert, Edt. Best Science Writing: Readings and Insights. Hyderabad: University Press (India) Limited, 1991.

Paper Code: ETEL-113   **L**   **T**   **C**
Paper: Impact of Science & Technology on Society   **1**   **0**   **1**

*Non University Examination Scheme (NUES)

There will not be any external examination of the university. The performance of the candidates should continuously be evaluated by an internal committee. The committee may conduct viva-voce at the end for the award of the marks.

Paper Code: ETPH-151   **P**   **C**
Paper: APPLIED PHYSICS LAB – I   **2**   **1**

List of Experiments

(1)　　To plot a graph between the distance of the knife-edge from the center of the gravity and the time period of bar pendulum. From the graph, find

     (a)　　The acceleration due to gravity
     (b)　　The radius of gyration and the moment of inertia of the bar about an axis.

(2)　　To determine the moment of inertia of a flywheel about its own axis of rotation.

(3)　　To determine the value of acceleration due to gravity using koter's pendulum.

(4)　　To determine the frequency of A.C. mains using sonometer and an electromagnet.

(5)　　To determine the frequency of electrically maintained turning fork by Melde's method.

(6)　　To determine the dispersive power of prism using spectrometer and mercury source.

(7)　　To determine the wavelength of sodium light by Newton's Ring.

(8)　　To determine the wavelength of sodium light using diffraction grating.

(9)　　To determine the refractive index of a prism using spectrometer.

(10)　　To determine the specific rotation of cane sugar solution with the help of polarimeter.

(11)　　To find the wavelength of He-Ne Laser using transmission diffraction grating.

(12)　　To determine the numeral aperture (NA) of a Optical Fibre.

(13)　　Compute simulation (simple application of Monte Carlo) e.g. Brownian motion, charging & discharging of capacitor.

Note:　Any 8-10 experiments out of the list may be chosen. Proper error – analysis must be carried out with all the experiments.

Paper Code: ETCH – 153   **P   C**
Paper: Applied Chemistry Lab – I   **2   1**

List of Experiments

1. To determine the percentage composition of a mixture of Sodium hydroxide and Sodium Chloride.

2. To determine the amount of Sodium Carbonate in the given mixture of Sodium Carbonate and Sodium Bicarbonate.

3. Determine the amount of Oxalic Acid and Sulphuric Acid/Hydrochloric Acid in one litre of solution given standard Sodium Hydroxide and Potassium Permanganate.

4. To determine the Carbonate, Bicarbonate and Chloride contents in irrigation water.

5. To determine the no. of water molecules of crystallization in Mohr's salt provided standard dichromate solution using internal indicator.

6. Determine the amount of Cu in the copper ore solution provided hypo solution.

7. Iodometric Titration of $K_2Cr_2O_7$ v/s $Na_2S_2O_3$ to determine the percentage purity of $K_2Cr_2O_7$ sample.

8. Argentometric titration one each of Vohlard's method and of Mohr's method.

9. Complexometric Titrations.

10. Detrmination of dissolved Oxygen in given sample if water.

Text Books:
1. Vogel's Textbook of Quantitative Chemical Analysis (Latest ed.), Revised by G.H. Jeffery, J. Bassett, J. Mendham & R.C. Denney
2. Applied Chemistry: Theory and Practice (Latest ed.), By O.P. Vermani & A.K. Narula

Paper Code: ETCS 155   **P   C**
Paper: Introduction to AutoCAD, Office Automation and Web Design 3   2

List of Experiments

1.   Use Microsoft-Word to perform the following:
      a)   Send out invitation letter to several people using mail merge facility.
      b)   Create tabular data in word and insert graph to represent data.
      c)   Create a Macro and use it in an application.

2.   Use Microsoft-Excel to perform the following:
      a)   Create a Macro and use it in an application
      b)   Enter the name and marks of 10 students and perform various mathematical
              functions on it.
      c)   Enter first quarter performance of five companies and create a pie chart showing
              there shareholders in the market.

3.   Use Microsoft Power-Point to perform the following
      a)   Create a slide show on any subject of your choice using minimum five slides.
      b)   Create slideshow in operating sound.
      c)   Create an animation using group, ungroup, order, textbox image insert etc.

4.   Use HTML to design a Home page for IGIT using all the features of HTML like buttons,
      frames, marquee check boxes etc..

5.   Use AutoCAD to do the following:
      a)   Use of Drawing & Editing Properties: Modify Object Properties and a know how
              of layers, colors and prototype drawing.
      b)   Draw line (Poly line, multi line, linear line), polygon, ellipse, circle, arc, rectangle
              and use cross hatching, regions, boundary, spline, donut, fillet and extent
              commands.
      c)   Dimensioning commands, styles, control scale factors, drawing set-up, grip editing
      objects snaps, utility commands.
      d)   Projection of points, lines and solids,
      e)   Section of Solids
      f)   Development and Intersection of Surface
      g)   Isomeric Projections

**Create a WEB page containing hyperlinks to the pages having information about Science and
Technology.**

Paper Code: ETME-157   **P   C**
Paper: Workshop Practice   **3   2**

UNIT I
Materials: Spectrography method for finding composition of materials.
Wood Working Shop: Making of various joints, Pattern making.

UNIT II
Foundary Shop: Bench moulding with single piece pattern and two piece pattern.
Floor moulding – Making of bend pipe mould etc.
Machine moulding – Making of mould using Match-plate pattern.
Core making- Making and baking of dry sand cores for placing in horizontal, vertical and hanging positions in the mould cavity.

Fitting Shop: Learning use of fitting hand tools, marking tools, marking gauge.
Exercises: Jobs made out of MS Flats, making saw – cut filling V-cut taper at the corners, circular cut, fitting square in square, triangle in square.

UNIT III
Welding Shop: Electric arc welding, Edge preparations, Exercises making of various joints. Bead formation in horizontal, vertical and overhead positions.
Gas Welding: Oxy-Acetylene welding and cutting of ferrous metals.
Soldering: Dip soldering.
Brazing: With Oxy-Acetylene gas.

UNIT 4
Sheet Metal Shop: Learning use of sheet-metal tools, Exercises: Making jobs out of GI sheet metal. Cylindrical, Conical and Prismatic shapes.

Project Shop: **Extrusion of soft metals, Plastic coating of copper wires, Plastic moulding**.

Paper Code: ETME-159   **P**   **C**
Paper: Engineering Graphics Lab   **2**   **1**

UNIT I
General: Importance, Significance and scope of engineering drawing, Lettering, Dimensioning, Scales, Sense of proportioning, Different types of projections, Orthographic Projection, B.I.S. Specifications,

Projections of Point and Lines: Introduction of planes of projection, Reference and auxiliary planes, projections of points and Lines in different quadrants, traces, inclinations, and true lengths of the lines, projections on Auxiliary planes, shortest distance, intersecting and non-intersecting lines.

Unit II
Planes other than the Reference Planes: Introduction of other planes (perpendicular and oblique), their traces, inclinations etc., Projections of points and lines lying in the planes, conversion of oblique plane into auxiliary Plane and solution of related problems.

Projections of Plane Figures: Different cases of plane figures (of different shapes) making different angles with one or both reference planes and lines lying in the plane figures making different given angles (with one of both reference planes). Obtaining true shape of the plane figure by projection.

Unit III
Projection of Solids: Simple cases when solid is placed in different positions, Axis faces and lines lying in the faces of the solid making given angles.
CADD

Unit-IV
Isometric Projection
Nomography : Basic Concepts and use.

Text Books:
1.   Engineering drawing by N.D.Bhatt (Charotar Publications).

Reference Books:
1.   Engineering Drawing by S.C.Sharma & Navin Kumar (Galgotia Publications)
2.   Engineering Drawing by Venugopalan.
3.   Engineering Drawing by P.S.Gill

Paper Code:ETMA-102   **L**   **T**   **C**

Paper: Applied Mathematics - II   **3**   **1**   **4**

UNIT I
CALCULUS OF SEVERAL VARIABLES:

Partial differentiation, ordinary derivatives of first and second order in terms of partial derivaties, Euler's theorem on homogeneous functions, change of variables, Taylor's theorem of two variables and its application to approximate errors. Maxima and Minima of two variables, Langranges method of undermined multipliers and Jacobians.

[No. of Hrs. 12]

UNIT II
FUNCTIONS OF COMPLEX VARIABLES:

Derivatives of complex functions, Analytic functions, Cauchy-Riemann equations, Harmonic Conjugates, Conformal mapping, Standard mappings – linear, square, inverse and bilinear. Complex line integral, Cauchy's integral theorem, Cauchy's integral formula, Zeros and Singularities / Taylor series, Laurents series, Calculation of residues. Residue theorem, Evaluation and real integrals.   **[No. of Hrs. 12]**

Unit III
VECTOR CALCULUS:

Scalar and Vector point functions, Gradient, Divergence, Curl with geometrical physical interpretations, Directional: derivatives, Properties.

Line integrals and application to work done, Green's Lemma, Surface integrals and Volume integrals, Stoke's theorem and Gauss divergence theorem (both without proof).

[No. of Hrs. 10]

Unit IV
LAPLACE TRANSFORMATION:

Existence condition, Laplace transform of standard functions, Properties, Inverse Laplace transform of functions using partial fractions, Convolution and coinvolution theorem. Solving linear differential equations using Laplace transform. Unit step function, Impulse function and Periodic function and their transforms.   **[No. of Hrs. 10]**

Text books:
1. Kresyzig, E., "Advanced Engineering Mathematics", John Wiley and Sons. (Latest edition).
2. Jain, R. K. and Iyengar, S. R. K. "Advanced Engineering Mathematics", Narosa, 2003 (2nd Ed.).
3. "Advanced Engineering Mathematics", Dr. A. B. Mathur, V. P. Jaggi (Khanna Publishers)

References:

1. Mitin, V. V.; Polis, M. P. and Romanov, D. A. "Modern Advanced Mathematics for Engineers", John Wiley and Sons, 2001.
2. Wylie, R., "Advanced Engineering Mathematics", McGraw-Hill, 1995.

INSTRUCTIONS TO PAPER SETTERS: MAXIMUM MARKS: 75
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

UNIT I
Electromagnetic Theory (EMT)
Motion of Charged Particles in crossed electric & magnetic fields, Velocity Selector & Magnetic focussing, Gauss law, continuity equation, inconsistency in Ampere's Law, Maxwell's equations (differential and integral forms), poynting vector, Poynting Theorem (Statement only), propagation of plane electromagnetic waves in conducting and non-conducting medium.
                    [No. of Hrs. 8]

UNIT II
Quantum Mechanics & Statistical Physics:
De-Broglie Hypothesis, Davisson Germer experiment, wave function and its properties, expectation value, Wave Packet, Uncertainity principle. Schrodinger Equation for free Particle, Time Dependent Schrodinger Equation, Particle in a box (1-D), Single step Barrier, Tunneling effect.
Qualitative Features of Maxwell Bollzman, Bose-Einstein and Fermi-Dirac statistics distribution, functions & their comparison (no derivation)   **[No. of Hrs. 8]**

UNIT III
Solid State Physics
Formation of energy bands in metals, semiconductors and insulators; intrinsic and extrinsic semiconductors, Fermi energy levels for doped, undoped semiconductors and pn junction; Tunnel diode, Zener diode.
Superconductivity: Meissner Effect, Type I and Type II Superconductors, BCS theory (Qualitative only), London's equation, properties of superconductors & applications.
                    [No. of Hrs. 8]

Unit IV
X-Rays: production and properties, Crystalline and Anorphous solids (Brief) Bragg's Law, Applications.
Ultrasonics: Introduction, Production of Ultrasonics (Magentostriction and piezoelectric methods), engineering applications.   **[No. of Hrs. 8]**

Text Books:

1. Concept of Modern Physics : A. BEISER
2. Atomic Physics : Rajam
3. Greiner : Quantum Physics
4. Griffth : Introduction to Electrodynamics

Reference Books
1. Electromagnetic waves and Radiating Systems :Jordan & Balmain

2. Solid State Physics :   Kittel
3. Solid State Physics :   R.L. Singhal
4. Quantum Mechanics : Schiff

Paper Code: ETCH – 106　　　　　　　　　　　　　　　　　　　**L　　T　　C**

Paper: Applied Chemistry – II　　　　　　　　　　　　　　　　　**2　　1　　3**

UNIT I

Chemical Bonding:

Potential Energy curve for H_2 molecule, co-ordinate bond, Werner's theory, effective atomic numbers, isomerism in co-ordinate compounds. Hydrogen bonding, Vander Waal's forces, hybridization including d-orbitals, Valence shell Electron Repulsion Theory (VSEPR). Discussion of structures of IF_3, $SnCl_2$, CO_3^{2-}, Molecular Orbital theory, Linear combination of atomic orbitals (LCAO) method. Structures of simple heteronuclear diatomic molecules such as CO, NO, HF, HCl.　　**[No. of Hrs: 08]**

UNIT II

Gaseous State: Gas laws and Kinetic theory of gases, Distribution of molecular velocities, Mean free path, Real gases – non ideal behaviour, causes of deviation from ideal behaviour, Vander Waal's equation. Liquefaction of gases. Numericals based on above topics.

Thermochemistry: Hess's Law, Heat of a reaction, Effect of temperature on heat of reaction at constant pressure (Kirchoff's eq.), heat of dilution, heat of hydration, heat of neutralization and heat of combustion, Flame temperature.

[No. of Hrs: 08]

UNIT III

Catalysis: Criteria for catalysis : Homogeneous catalysis – acid-base, Enzymatic catalysis, Catalysis by metal salts, Heterogeneous catalysis, concepts of promoters, inhibitors and poisoning, physiosorption, chemisorption, surface area.

The Phase Rule: Definitions of various terms, Gibb's Phase rule, Application of phase rule to one component system – the water system and Sulphur system. Two component system : Lead – Silver, $FeCl_3$ – water, Na_2SO_4 – water.

[No. of Hrs: 08]

UNIT IV

Polymers and Composites: Functionality, Degree of polymerization, concept of molecular weight (number average, weight average & numerical based on them), Linear, branched and cross-linked polymers, Tacticity of polymers, Homo and Copolymers (Classification based on repeat unit), Structure – property relationship of polymers. Industrial applications of important thermoplastic, thermosetting polymers, Elastomers, Natural Polymers.

Conducting Polymers : Properties and applications.

Composites : Classification, Fibre and particle reinforced composites.

[No. of Hrs: 08]

Text Books:

1. Inorganic Chemistry (Latest ed.) By J.D. Lee
2. Chemistry in Engineering & Technology (Vol I & II) (Latest ed.) By J.C. Kuriacose & J. Rajaram
3. Principles of Physical Chemistry (Latest ed.) By Puri, Sharma & Pathania
4. Polymer Science (Latest ed.) By V.R. Gowarikar, N.V. Viswanathan & Jayadev Sreedha

Paper Code: ETCS 108   *L*   *T*   *C*

Paper: Introduction to Programming   **2**   **1**   **3**

UNIT I

Introduction to Programming:

Concept of algorithms, Flow Charts, Data Flow diagrams etc., Introduction to the Editing tools such as vi or MS-VC editors, Concepts of the finite storage, bits bytes, kilo, mega and gigabytes. Concepts of character representation, Number Systems & Binary Arithmetic.

[No. of Hrs. 8]

UNIT II

Programming using C

The emphasis should be more on programming techniques rather than the language itself. The C Programming language is being chosen mainly because of the availability of the compilers, books and other reference materials.

Example of some simple C program. Concept of variables, program statements and function calls from the library (Printf for example)

C data types, int, char, float etc., C expressions, arithmetic operation, relational and logic operations, C assignment statements, extension of assignment of the operations. C primitive input output using getchar and putchar, exposure to the scanf and printf functions, C Statements, conditional executing using if, else. Optionally switch and break statements may be mentioned.

[No. of Hrs. 8]

UNIT III

Iterations and Subprograms

Concept of loops, example of loops in C using for, while and do-while. Optionally continue may be mentioned.

One dimensional arrays and example of iterative programs using arrays, 2-d arrays Use in matrix computations.

Concept of Sub-programming, functions Example of functions. Argument passing mainly for the simple variables.   **[No. of Hrs. 8]**

UNIT 4

Pointers and Strings

Pointers, relationship between arrays and pointers Argument passing using pointers Array of pointers. Passing arrays as arguments.

Strings and C string library.

Structure and Unions. Defining C structures, passing strings as arguments Programming examples.   **[No. of Hrs. 8]**

Text Books:
1. Yashwant Kanetkar, "Let us C", BPB Publications, 2nd Edition, 2001.
2. Herbert Schildt, "C:The complete reference", Osbourne Mcgraw Hill, 4th Edition, 2002.

Reference Book:
1. Raja Raman, "Computer Programming in C", Prentice Hall of India, 1995.
2. Kernighan & Ritchie, "C Programming Language", The (Ansi C Version), PHI, 2nd Edition.

Paper Code: ETME 110　　　　　　　　　　　　　　　　**L**　　**T**　　**C**

Paper: Engineering Mechanics　　　　　　　　　　　**2**　　**1**　　**3**

UNIT I

Force system: Free body diagram, Eqilibrium equations and applications.

Friction: Static and Kinetic friction, laws of dry friction, co-efficient of friction, angle of friction, angle of repose, cone of friction, friction lock, friction of flat pivot and collared thrust bearings, Belt drive- derivation of equation.

$$T_1/T_2 = e^{\mu\theta}$$ and its application

[No. of Hrs. 8]

UNIT II

Structure: Plane truss, perfect and imperfect truss, assumption in the truss analysis, analysis of perfect plane trusses by the method of joints, method of section.

Distributed Force: Determination of center of gravity, center of mass and centroid by direct integration and by the method of composite bodies, mass moment of inertia and area moment of inertia by direct integration and composite bodies method, radius of gyration, parallel axis theorem, Pappus theorems, polar moment of inertia.

[No. of Hrs. 8]

Unit-III

Kinematics of Particles: Rectilinear motion, plane curvilinear motion-rectangular coordinates, normal and tangential component.

Kinetics of Particles: Equation of motion, rectilinear motion and curvilinear motion, work energy equation, conservation of energy, impulse and momentum conservation of momentum, impact of bodies, co-efficient of restitution, loss of energy during impact.

[No. of Hrs. 8]

UNIT-IV

Kinematics of Rigid Bodies: Concept of rigid body, type of rigid body motion, absolute motion, introduction to relative velocity, relative acceleration (Corioli's component excluded) and instantaneous center of velocity, Velocity and acceleration polygons for four bar mechanism and single slider mechanism.

Kinetics of Rigid Bodies: Equation of motion, translatory motion and fixed axis   rotation, application of work energy principles to rigid bodies conservation of energy.

Shear force and bending Moment Diagram.

[No. of Hrs. 8]

Text Books:
1.　　Engg Mechanics by A.K.Tayal (Umesh Publications).
2.　　Engg Mechanics by Sadhu Singh (Khanna Publishers).

Reference Books:

1.   Engg Mechanics by Irving H. Shames (PHI publications).
2.   Engg Mechanics by U.C.Jindal (Galgotia Publications).
3.   Engg Mechanics by Beer & Johnston, TMH
4.   Engg Mechanics by Subramanyam

Paper Code: ETEC-112
Paper: ELECTRICAL SCIENCE

L	T	C
2	1	3

UNIT I
Circuit Analysis
Ohm's Law, KCL, KVL Mesh and Nodal Analysis, Circuit parameters, energy storage aspects, Superposition, Thevenin's, Norton's, Reciprocity, Maximum Power Transfer Theorem, Millman's Theorem, Star-Delta Transformation. Application of theorem to the Analysis of dc circuits.
[No. of Hrs. 8]

UNIT II
A.C.Circuits
R-L, R-C, R-L-C circuits (series and parallel), Time Constant, Phasor representation, Response of R-L, R-C and R-L-C circuit to soinusoidal input Resonance-series and parallel R-L-C Circuits, Q-factor, Bandwidth.   **[No. of Hrs. 7]**

UNIT III
Measuring Instruments
Principles, Construction and application of moving coil, moving iron, dynamometer type, induction type instruments, extension of range of ammeter, voltmeter (shunt and multiplier), Two-wattmeter method, for the measurement of power, Cathol-ray Oscilloscope and Applications.
[No. of Hrs. 7]

UNIT IV
Transformers
Construction and Working principles and phaser diagrams of Single-phase Transformer, Emf equation, Equivalent circuit, Regulation and efficiency, and Auto transformer.
Rotating Machines
Construction and working principles of dc motor and generator and its characteristics Applications of DC machines

Construction and working principles of 3-φ-Induction motor, Torque-speed characteristics, and Industrial applications.

[No. of Hrs. 10]

Text Books:
1. P.C. Sen "Principles of Electric Machines and Power Electronics", Wiley Eastern 2003.
2. Vincent DEL TORO "Electrical Engineering Fundamental's Prentice Hall India", Ed 2002.

Paper Code: ETEL-114	L	T	C
Paper: Communication Skills – II	2	1	3

Unit I
Basic Concepts in Communication: Communication as sharing; context of communication; the speaker/writer and the listener/reader; medium of communication; barriers to communication; accuracy, brevity, clarity and appropriateness in communication.
        [No. of Hrs: 05]

Unit II
Writing Skills: Types of writings (Expository, Descriptive, Analytic, Argumentative, Narrative etc) and their main features. Resumes and CV's and Cover letters. Memos and Notices. Basics of Formal Reports.   **[No. of Hrs: 08]**

Unit III
Verbal, Non-Verbal and Listening Skills: Elementary Phonetics (Speech Mechanism, The Description of Speech Sounds, The Phoneme, the syllable; Prosodic Features, Word Accent, Features of Connected Speech); Paralanguage and Body language; and Classroom Presentations, Hearing and Listening; Essentials of Good Listening: Achieving ability to comprehend material delivered at relatively fast speed.
        [No. of Hrs: 08]

Unit IV
Group Discussion: Use of persuasive strategies including some rhetorical devices for emphasizing (for instance; being polite and firm; handling questions and taking in criticism of self; turn-taking strategies and effective intervention; use of body language).
          [No. of Hrs: 09]

Text Books:
1.   Bansal, R.K. and J. B. Harrison. *Spoken English For India: A Manual of Speech and Phonetics*, Hyderabad: Orient Longman, 1983.
2.   Lewis, Hedwig. *Body Language*: *A Guide For Professionals*. New Delhi: Response Books (A division of Sage Publication), 2000
3.   Sides, Charles H. *How to Write & Present Technical Information*. Cambridge: CUP, 1999.
4.   Forsyth, Sandy & Lesley Hutchison. *Practical Composition*. Edinburgh : Oliver & Boyd, 1981

Paper Code: ETPH-152   **P**   **C**
Paper: Applied Physics Lab – II   **2**   **1**

List of Experiments

1.   To determine the value of e/m of electron by J.J. Thomson method.

2.   To determine unknown resistance of a wire by Carey Foster's Bridge.

3.   To determine the internal resistance of Leclanche cell using potentiometer.

4.   To study the charging and discharging of a capacitor and to find out the time constant.

5.   To find the thermal conductivity of a poor conductor by Lee's disk method.

6.   To study the thermo emf using thermocouple and resistance using Pt. Resistance thermometer.

7.   To determine the velocity of ultrasound waves using an ultrasonic spectrometer in a given liquid (Kerosene Oil)

8.   To measure the frequency of a sine-wave voltage obtain from signal generator and to obtain lissajous pattern on the CRO screen by feeding two sine wave voltage from two signal generator.

9.   To determine the temp. coefficient of resistance of platinum by Callender & Griffith's Bridge.

10.   To study Hall effect.

11.   To determine plank's constant.

Note:
Atleast 8 experiments must be carried out.
Proper error – analysis must be carried out with all the experiments.

Paper Code: ETCH – 154   **P   C**
Paper: Applied Chemistry Lab – II   **2   1**

List of Experiments

1. Determine the heat of hydration of $CuSO_4.5H_2O$/$FeSO_4.7H_2O$.

2. Determine the heat of neutralization of strong Acid (say H_2SO_4/HCl) with strong base (NaOH).

3. Determine the heat of neutralization of Weak Acid with strong base.

4. Determine the molecular weight of a substance by Rast Method.

5. Determine the reaction rate constant for 1st order reaction.

6. Determine the surface tension of a liquid using drop weight method.

7. To determine the viscosity of the given liquid (density to be determined).

8. Preparation of a Polymer.

9. To determine the cell constant of a conductivity cell.

10. Titration of strong acid/strong base conduct metrically.

Text Books:
1.   Practical Physical Chemistry (Latest ed.), By B.D. Khosla, A. Gulati & V.C. Garg
2.   Laboratory Manual on Engineering Chemistry (Latest ed.), By S.K. Bhasin and Sudha Rani

Paper Code: ETCS 156   **P   C**
Paper: C Programming Lab.   **2   1**

List of Experiments

1.   Write a program to produce ASCII equivalent of given number
2.   Write a program to find divisor or factorial of a given number.
3.   Write a program to evaluate the following algebraic expressions after reading necessary values from the user
     - ❖   (ax+b)/(ax-b)
     - ❖   2.5 log x-cos 30+ | x^2-y^2|+sqrt (2xy)
     - ❖   (x^5+10x^4+8x^3+4x+2
4.   Write a program to find sum of a geometric series
5.   Write a program to cipher a string
6.   Write a program to check whether a given string follows English capitalization rules
7.   Write a program to find sum of the following series
      1+ ½ + 1/3 +_____+1/20
8.   Write a program to search whether a given substring exist in an input string or not and then delete this string from input string.
9.   Write a recursive program for tower of Hanoi problem
10.   The fibonacci sequence of numbers is 1,1,2,3,5,8……. Based on the recurrence relation
            F(n)=F(n-1)+F(n-2)for n>2
      Write a recursive program to print the first m Fibonacci number
11.   Write a menu driven program for matrices to do the following operation depending on whether the operation requires one or two matrices
      a)   Addition of two matrices
      b)   Subtraction of two matrices
      c)   Finding upper and lower triangular matrices
      d)   Trace of a matrix
      e)   Transpose of a matrix
      f)   Check of matrix symmetry
      g)   Product of two matrices.

12.   Write a program that takes two operands and one operator from the user perform the operation and then print the answer
13.   Write a program to print the following outputs:
```
      1                                                    1
      2    2                                           2      2
      3    3    3                                   3     3    3
      4    4    4    4                          4    4      4  4
      5    5    5    5    5                  5    5      5    5   5
```
14.   Write functions to add, subtract, multiply and divide two complex numbers (x+iy) and (a+ib) Also write the main program.
15.   Write a menu driven program for searching an sorting with following options:-
      a)   Searching   (1)   Linear searching
                              (2)   Binary searching

        b)   Sorting   (1)   Insersection sort
                                       (2)   Selection sorting

16.   Write a program to copy one file to other, use command line arguments.
17.   Write a program to mask some bit of a number (using bit operations)
18.   An array of record contains information of managers and workers of a company. Print all the data of managers and workers in separate files.

Paper Code: ETME 158   **P   C**
Paper: Engineering Mechanics Lab   **3   2**

List of Experiments

1.   To verify the law of Force Polygon

2.   To verify the law of Moments using Parallel Force apparatus. (simply supported type)

3.   To determine the co-efficient of friction between wood and various surface (like Leather, Wood, Aluminum) on an inclined plane.

4.   To find the forces in the members of Jib Crane.

5.   To determine the mechanical advantage, Velocity ratio and efficiency of a screw jack.

6.   To determine the mechanical advantage, Velocity ratio and Mechanical efficiency of the Wheel and Axle

7.   To determine the MA, VR, η of Worm Wheel (2-start)

8.   Verification of force transmitted by members of given truss.

9.   To verify the law of moments using Bell crank lever

10.   To find CG and moment of Inertia of an irregular body using Computation method.

Paper Code: ETEC 160   **P**   **C**
Paper: Electrical Science Lab   **2**   **1**

List of Experiments

1. Verification of Thevenin's theorem

2. Verification of Superposition theorem

3. Phasor Diagram and Power factor of LCR circuit.

4. Measurement of Power and Power factor in single phase Load using three ammeters/voltmeters.

5. Calibration of Energy Meter/Wattmeter/Voltmeter/Ammeter

6. Two wattmeter method of measuring power in three phase circuit (resistive load only)

7. Load test on Single Phase Transformer, Regulation and Efficiency of Transformer

8. Short Circuit/Open Circuit tests on Single Phase transformer

9. Measure the armature and field resistance of a D.C. Machine

10. Connection and starting of a Three Phase Induction Motor using direct on line or Star Delta Starter.

11. Starting and Speed Control of a D.C. shunt motor

12. Resonance

ETPE 201   MATERIAL SCIENCE & METALLURGY   L   T/P
                                                      3   0

Crystal structure, structure determined by X-ray diffraction.
Structure of metals and alloys, Ionic crystals, silicates and organic polymers.
Crystal imperfections, phase diagrams, diffusion in solids, phase transformations, modifications of properties through changes in microstructure.
Elastic behaviour, plastic deformation, fracture, oxidation and corrosion, heat treatment of steel & non-ferrous alloys.
Tensile, hardness, impact, fatigue and creep testing.
Conductors and resistors – conductor and resistor materials, their properties and applications, superconductivity – superconductors: properties and applications.
Semiconductors – energy gap in solids, intrinsic and extrinsic semiconductors, hall effect, types of semiconducting materials – application wise, fabrication of integrated circuits, photoconductivity.
Magnetic materials – types and properties of magnetic materials: diamagnetism, paramagnetism, ferromagnetism, ferrites, antiferromagnetism, curie temperature, hard and soft magnetic materials, permanent magnets, application of magnetic materials.
Dielectric materials – insulating materials, types and properties, dielectric gases, liquid and solid insulating materials, applications of insulating materials, thermal classifications.
Iron carbon diagram, TTL curve, Heat treatment.

Suggested Text Books:
1.   V Raghavan, "Material Science & Engineering", PHI
2.   Lawrence H Van Vlack, "Elements of Material Science", Addison Wesley
3.   S P Seth, PV Gupta, "Electronic Engineering Materials", Dhanpat Rai Publications
4.   GE Dieter, "Mechanical Metallurgy", McGraw Hill
5.   AVK Suriyanarayana, "Testing of Metallic Materials", TMH

ETPE 203   THERMODYNAMICS   **L   T/P**
                                                                3   1

Fundamentals and Definitions
System, Control Volume, properties, state change, and diagram, Dimensions and units.
Work
Mechanics and Thermodynamics, definitions, Displacement work at part of a system boundary, Engine Indicator, Displacement work in various quasi-static processes, shaft work, electrical work.
Heat
Temperature, thermal equilibrium, zeroth law of thermodynamics, sign convention for heat transfer.
First Law of Thermodynamics
Statement, Application to non-cyclic process, Energy, modes of energy, Pure substance, Specific heats, First Law for Control Volumes.
Second Law of Thermodynamics
Direct and reversed heat engines, Kelvin-Planck and Clausius Statements and their equality, reversible and irreversible processes, Carnot cycle, thermodynamic temperature scale.
Entropy
Definition, calculation through Tds relations, T-S diagrams, entropy as a measure of irreversibility Properties of pure substances-Use of steam Tables and Mollier Diagram.
Ideal gas
Properties of ideal gas and ideal gas mixtures with and without a condensable vapour-psychrometry.
Second Law Analysis of Engineering Processes
Availability and irreversibility and their application in Thermal Engineering
Analysis of vapour power cycles
Carnot cycle; Simple Rankine Cycle, Cycle with superheating, reheating and regeneration.
Analysis of air standard cycles
Carnot, Otto, diesel, dual and Joule cycles; Gas turbine cycles with heat exchange and regeneration; Stirling and Ericson cycles
Natural Gas, CNG, LPG, their properties

Suggested Text Books :
1.   Nag, P.K., "Engineering Thermodynamics", Tata McGraw Hill, 2nd edition, 1998.
Reference:
        1.   Spalding, D.B. and Cole, E.H., "Engineering Thermodynamics", Edward Arnold, 1959.
2.   Hawkins, G.A., "Engineering Thermodynamics", John Wiley and Sons, 1955.
3.   Van Wylen, G.J. and Sonntag, R.E., "Fundamentals of Classical Thermodynamics", John Wiley and Sons, 4th edition, 1997.
4.   Holman Thermodynamics
5.   Huang Engineering Thermodynamics
6.   Jones Dugan Engineering Thermodynamics Prentice Hall

ETPE 205   STRENGTH OF MATERIALS & THEORY OF MACHINES

L   T/P
3   1

1.   **Simple Stress & Strain:**   Mechanical properties of solids, concept of stress and strain, normal and shear stresses, Hook's law, principle of St. Venant, stress-strain diagrams, principle of superposition, stress and strain in bars subjected to tension and compression, elongation due to self weight, composite sections, thermal stresses, poisson's ratio, relation between elastic constants.

2.   **Torsion of circular shafts:** Torque and horse-power, angle of twist, shear stresses in hollow and solids shafts within elastic limit, derivation of torsion equation, assumptions, stepped and composite shafts, closed coil helical springs subjected to axial loads and couple.

3.   **Thin walled vessels:** Thin cylinders subjected to internal pressure, circumferential and longitudinal stresses and strains, maximum shear stress, increase in diameter and volume of vessel, thin spherical shells subjected to internal pressure, thin cylinders with hemispherical ends, wire winding of thin cylinders.

4.   **Shearing force and bending moment in beams:** Types of loads and supports, various types of beams, inter relation between SF & BM diagrams, shearing force and bending moment diagrams for various types of loading and supports, maximum bending moment and point of contraflexure.

5.   **Theory of simple bending:** Stresses due to bending of initially straight beams, theory and assumptions, geometrical characteristics of sections, application of bending formula to simply supported beams of circular, rectangular and I sections, flitched beams.

6.   **Gears:** Types of gears, gear terminology, condition for correct gearing, cycloidal and involutes profiles of gear teeth, pressure angle, path of contact, arc of contact, interference, undercutting, minimum number of teeth, number of pairs of teeth in contact, helical, spiral, worm and worm gear, bevel gear.

7.   **Gear trains:** Gear trains, simple, compound, reverted, and epicyclic, solution of gear trains, sun and planet gear, bevel epicyclic gear, compound epicyclic gear, pre-selective gear box, differential of automobile, torque in gear trains.

8.   **Governors:** Types of governors: watt, porter, proell, spring loaded centrifugal, intertia, sensitiveness, stability, isochronism's, hunting, effort and power of governor, controlling force.

9.   **Balancing:** Static and dynamic balancing of rotating parts, balancing of IC engines, balancing of multi-cylinder engine, V-engines and radial engines, balancing of machines

10.   **Cam, Belt & Rope Drive**: Basic Concepts, Introduction to Applications.

Reference Books/ Text Books:

1. Strength of Materials, Ramamrutham, Dhanpat Rai Pubs.
2. Strength of Materials, Sadhu Singh, Khana Pubs.
3. Engineering Mechanics of Solids, Popov, PHI
4. Theory of Machines, SS Rattan, TMH
5. Theory of Mechanics & Machines, Jagdish Lal, Metropolitan Book Co.
6. Mechanism, J S Beggs, TMH

ETPE 207   CIRCUIT THEORY   **L   T/P**
                                                                            3   1

Networks: Network graphs and their applications in network analysis, KCL, KVL Nodal and Mesh/Loop, analysis of electric circuits, sinusoidal steady state analysis, ideal voltage and current sources, transient response, resonance (series and parallel circuits), selectivity, coupled circuits, dot convention in coupled circuits and elementary concepts of filters.

Fourier series and signal spectra: Fourier series, evaluation of fourier coefficients, waveform symmetries as related to fourier coefficients, convergence in truncated series, exponential form of the fourier series, steady-state response to periodic signals.

Signal: The unit step, unit impulse, unit ramp, sinusoidal and exponential function, periodic waveforms. Classification of signals and system modelling in terms of differential equation for linear time invariant (LTI).

Laplace Transform: Some basic theorems for laplace transformation, examples of the solution of problems with the laplace transformation for step and impulse response of RLC circuits, waveform synthesis and laplace transform of complex waveform.

Network Theorems: Thevenin's theorems and Norton's theorem, superposition theorem, reciprocity, millman theorem, maximum power transfer theorem and tellegen's theorem with complex impedance.

Two-Port Parameters: Relationship of two-port variables, short-circuit admittance parameters, the open-circuit impedance parameters, transmission parameters, hybrid parameters, relationship between parameter sets and condition of reciprocity and symmetry in two-port.

Reference Books/ Text Books:
1.   Van Valkenburg, "Network Analysis", PHI
2.   Franklin F. Fuo, "Network Analysis & Synthesis", Wiley Intl. Edn.
3.   Edminister, "Electric Circuits", TMH
4.   Hayt and Kimmeley, "Engineering Circuit Analysis", TMH

ETPE 209 – ANALOG ELECTRONICS   **L**   **T/P**

                                                                3   **1**

Semiconductor Diodes and Rectifiers:
Introduction, general characteristics, energy levels, extrinsic materials n & p type, ideal diode, basic construction and characteristics, DC & AC resistance, equivalent circuits, drift & diffusion currents, transition & diffusion capacitance, reverse recovery times, temperature effects, diode specifications, different types of diodes (Zener, Varactor, Schottky, Power, Tunnel, Photodiode & LED). Half wave & full wave rectifiers. Switched Mode Power Supply

Bipolar junction transistor:
Introduction, Transistor, construction, transistor operations, BJT characteristics, load line, operating point, leakage currents, saturation and cut off mode of operations Eber-moll's model.

Bias stabilization:
Need for stabilization, fixed Bias, emitter bias, self bias, bias stability with respect to variations in $I_{co,}$ V_{BE} & β, Stabilization factors, thermal stability.

Small signal amplifiers:
CB, CE, CC configurations, hybrid model for transistor at low frequencies, RC coupled amplifiers, mid band model, gain & impedance, comparisons of different configurations, Darlington pair, Hybrid π-model at high frequencies, Cascaded amplifiers.

Multistage Amplifiers:
Cascaded amplifiers, Calculation of gain Impedance and bandwidth, Design of multistage amplifiers.

Feedback Amplifiers:
Feedback concept, Classification of Feedback amplifiers, Properties of negative Feedback amplifiers, Impedance considerations in different Configurations, Examples of analysis of feedback Amplifiers

Field Effect Transistor:
Introduction, Classification, FET characteristics, Operating point, Biasing, enhancement & Depletion type MOSFETS.

Reference Books:

1. Electronic Devices and Circuits, Millman and Halkias, Tata Mc. Graw Hill publishers ltd.
2. Electronic Principles, Malvino
        3. Electronic Devices and Circuits, J B Gupta, Kataria publishers ltd.

ETPE 211   ELECTRICAL MACHINES -I   **L**   **T/P**

                                                                 3   **1**

Electro-Magnetics And Transformers: single-phase transformers-construction principle of operation, equivalent circuit, performance analysis, regulation, losses & efficiency, testing. Three-phase transformers, special constructional features, alternative winding arrangements, cooling methodology, conservators, breathers, buchholz relay, alternative phase connections, vector phase groups, phase conversion –3 to 1,3 to 2,3 to 6 & 3 to 12. Parallel operation and load sharing, special purpose transformers and applications-pulse, isolation, welding, rectifier, high frequency.

D C Machines: Review of constructional features, method of excitation, armature winding, power source, voltage & torque equations, operation as generator-self excitation principles, characteristics, armature reaction, commutation, operation as a motor-characteristics and their control, starting, speed control including solid state controllers, braking, losses, efficiency, testing and applications of dc motors.

Induction Machines: Principle of operation, types, construction, ratings, equivalent circuit, torque-slip characteristics, starters for squirrel cage and wound rotor type induction motors, speed control, braking and power factor control, double cage and deep bar rotors, testing, induction motor applications, induction generators and their applications

Polyphase Synchronous Machines: Constructional features, poly-phase distributed AC winding, types, distribution, coil span and winding factors, excitation systems, emf equation and harmonic elimination, generator mode, interaction between excitation flux and armature mmf, equivalent circuit model and phasor diagram for cylindrical rotor machines, salient pole machines, two reaction theory, equivalent circuit model and phasor diagram, power angle equations and characteristics, voltage regulation and effect of AVR operation on infinite busbar, Motoring mode, transition from motoring to generating mode, phasor diagram, steady state operation characteristics, V-curves, starting, synchronous condenser, hunting-damper winding, effects,

Special Machines: Different types of fractional HP Motors used in domestic and industrial applications

References:

1.   Syed A Nasser "electric Machine and Transforme", New York, Macmillan, 1984
2.   P C Sen, "Principle of Electric Machines and Power Electronics", John wiley & Sons, 1997, 2nd ed.
3.   M G Say, "Alternating Current Machines", ELBS, 1986
4.   Fitzgerable, C Kingsley, S D Umans, "Electric Machinery", TMH, 1992
5.   M McPherson and R D Laramore "An Introduction to Electrical Machines and Transformer", John Wiley, 1990
6.   A E Clayton, "Performance & Design of Direct Current Machines", 3rd ed. Pitman, 1961

7.   M G Say and E O Taylor, "Direct Current Machines", 2nd Ed., ELBS, 1985
8.   I L Kosow, "Electrical Machinery & Power Systems", PHI, 2nd Ed., 1992
9.   Syed A Nasser, "Electrical Machines & Power Systems, Vol-I", TMH, USA, 1995
10.   Syed A Nasser & L F Unnewehr, "Electromechanics & Electrical Machines", Volume II, John Wiley, Canada, 1979
11.   E Openshaw Taylor, "The Performance & Design of A C Commutator Motors", A H Wheeler & Co., Allahaban, 1971
12.   A E Fitzgerald & Charles Kingsley Jr, "Electrical Machinery" TMH, Japan

ETPE 251   THERMODYNAMICS LAB   **L   T/P**
                                                                     0   2

1.   Study of four stroke cycle Petrol Engine
2.   Study of four stroke cycle Diesel Engine
3.   Study of two stroke cycle Petrol Engine
4.   Study of two stroke cycle Diesel Engine
5.   Study of Cochran Boiler
6.   Study of Wilcox and Babcock Boiler
7.   Study of Locomotive Boiler
8.   To conduct an Experiment on Baby Boiler and Plot pressure Vs Saturation temperature curve.
9.   To determine the various psychrometric properties of air using sling psychrometer.
10.   To study a gas Turbine model

ETPE 253   **STRENGTH OF MATERIALS & THEORY OF MACHINES LAB**

L   **T/P**
0   **4**

1. To study the universal impact testing m/c and to find the impact strength of the given specimen.
2. To study the pendulum type impact testing m/c and to find the impact strength of given specimen.
3. To study the universal testing machine (UTM) and to perform tensile test on it.
4. To perform compression test on UTM for a given specimen.
5. To perform shear test on UTM for a given specimen.
6. To determine the value of modulus of elasticity of a given specimen using extensometer on UTM.
7. To perform bending test on UTM for a given specimen.
8. To study the torsion testing machine and to find the modulus of rigidity, torsional strength and modulus of rupture in torsion for a given specimen.
9. To study the spring testing machine and to find the stiffness of given spring.
10. (a) To determine experimentally, the moment of Intertia of a flywheel and axle and compare with theoretical values.
    (b) To determine the frictional torque between flywheel axle and ball bearing.
11. To perform the experiment of balancing of rotating parts and find the unbalanced couples and forces.
12. To determine experimentally the unbalance forces and couples of reciprocating parts.
13. To study the different type of centrifugal and Inertia governors.

ETPE 202   ENGINEERING ECONOMICS   **L   T/P**
                                                            3   1

Economics: Concepts, Fundamental Terms, Business Economics, Economic Analysis, Economic Motives.

Demand and Supply Analysis: Meaning of Demand, Type of Demand, The low of demand, Demand elasticities, Supply Curve, Elasticity of Supply

Production and Cost Analysis: Production function, Low of Returns, Returns to Scale, Nature and type of cost, Accounting and economic cost, Cost function, Linear Programming, input-output analysis.

Theory of Firm and Pricing: Objectives of the firm, Marginal cost pricing versus full cost pricing, Depreciation Price System and its functions.

Project Evaluation: Net present value, Internal rate of Return, Cost benefit analysis

Corporate form of organization, financial statements, industrial finance, money and capital markets, commercial and development banks. Industrial relationship and support sectors, System dynamics

Books:
1.   Modern Micro Economics – A Koutsayiannis
2.   Modern Economic Theory – Sampat Mukherjee, Wishawa Prakes
3.   Industrial Organization in India – Lokanthan
4.   Some Aspects of Industrial Finance in India – George Rosen
5.   Reading in Industrial Capital – L.C. Gupta

ETPE 204   ENERGY CONVERSION   **L   T/P**
                                                 3   1

Principle of Thermal Energy Release, Structure of Hydro carbons, Analysis of Fuel, Combustion Theory, Mass Balance, Energy Release, Flue Gas Analysis.

Principle of Thermal Energy to Work, Phase change cycles, carnot, Renkine, Reheat, Regenerative and Binay Vapour Cycles, Non Phase Change Cycles-Stirling, Otto, Diesel, Dual, Atkinson, Joule or Brayton and Ericson Cycloe, Optimization of Reheat Pressure and Degree of Regeneration.

Steam Generators, Low & High Pressure boilers, Boilers, Accessories and Mountings, Feed water Treatment.

Steam Nozzles – Study flow energy equation, Nozzle efficiency Mass of discharge through Nozzles. Steam Turbine, Classification (Impulse Reaction), Compounding, Optimum velocity ratio, velocity diagram, introduction to hydel turbine.

Steam Condenser detail – types of condensers, vacuum efficiency, Condenser efficiency, air ejectors, cooling towers, numericals.

Introduction to SI & CI engine, Introduction to Non-conventional source of Energy – solar, Tidal wind, Geo-thermal, Nuclear.

ETPE 206　　HEAT & MASS TRANSFER　　　　　　**L**　　**T/P**
　　　　　　　　　　　　　　　　　　　　　　　　　3　　　1

Introduction:
Definition of heat; Modes of Heat Transfer; Basic Laws of heat transfer; Electrical Analogy of heat conduction; Conduction through composite walls; Overall heat transfer coefficient.

Conduction:
The general conduction equation in Cartesian, coordinates; steady one dimensional heat conduction without internal heat generation; the plane slab; the cylindrical shell; the spherical shell; critical thickness of insulation. Fins of uniform cross-section; Governing equation; Temperature distribution and heat dissipation rate; Efficiency and effectiveness of fins.

Convection:
Free and forced convection; Newton's law of cooling; convective heat transfer Coefficient; Nusselt number; Dimensional analysis of free and forced convection; the concept of boundary layer; hydrodynamic and thermal boundary layer; Analysis of free convection; governing equations for velocity and temperature fields. Relation between fluid friction and heat transfer, Reynolds analogy, Dimensionless numbers; Reynolds, Prandtl, Nusselt, Grashoff and Stanton Numbers and their significance, Heat transfer with change of phase; Nusselt theory of laminar film condensation.

Radiation:
Theories of thermal radiation; Absorption, reflection and transmission; Monochromatic and total emissive power; Black body concept; Planck's distribution law; Stefan Boltzman law; Wien's displacement law; Lambert's cosine law; Kirchoff's law;

Heat Exchangers:
Introduction; classification of heat exchangers; Logarithmic mean temperature Difference; Area calculation for parallel and counter flow heat exchangers; Effectiveness of heat exchangers; NTU method of heat exchanger design, Applications of heat exchangers.

Diffusion in fluids:
Molecular and eddy diffusion, Diffusivity, Diffusion through liquids and gases.

Reference and Text Books:

1.　　　A text book on heat transfer, S.P. Sukhatme, University Press
2.　　　Heat Transfer, Holman, McGraw-Hill
3.　　　Heat and Mass Transfer, Dr. D. S. Kumar, Katson Publishing House, Ludhiana.
4.　　　Heat and Mass Transfer, R. Yadav, Central Publishing House, Allahabad.

ETPE 208   FLUID MECHANICS AND MACHINES   L   T/P
3   1

1.   **Fluid Statics:**
Properties of fluid, Fluid pressure, Pascal's law, General equation of Fluid statics, Pressure head of a fluid, Absolute and gauge pressure, Measurement of pressure, Simple manometers, Differential manometers, Mechanical gauges, Forced on submerged surfaces: Horizontal, Vertical.

2.   **Fluid Kinematics:**
Langrangian and Eulerian methods, flow lines, types of flow (Steady, unsteady, compressible, incompressible), Rate of flow, Continuity equation), Stream function, Velocity potential function.

3.   **Fluid Dynamics:**
Euler's equation, Bernoulli's equation, Energy equation, Practical application of Bernoulli's equation (Venturimeter, Orifice meter, pitot tube), Momentum equation.

4.   **Viscous flow:**
Reynolds experiments, flow of viscous fluid in circular pipes, Hagen-Poiseuille equation, Viscometers; Capillary tube.

5.   **Pipe flow:**
Major energy losses in pipes, Darcy Weisback and Chezy's formulae, Hydraulic gradient and total energy lines, pipes in series, pipes in parallel, equivalent pipe, Siphon, Power transmission through pipes, Water hammer, flow through nozzles.

6.   **Boundary layer theory:**
Introduction, Boundary layer characteristics, boundary layer parameters (Thickness, displacement, momentum, and energy), Drag on a flat plate, Laminar boundary layer, Total drag on a flat plate, Boundary layer separation.

7.   **Principles of Hydraulic machines:**
Impact of jet on stationary and moving flat and curved plates, force on series of vanes, Radial vanes.

8.   **Impulse & Reaction turbines:**
Pelton turbine its components, number and dimension of buckets, speed rotation, jet ratio, energy conversion, condition for maximum efficiency, governing etc. Francis turbine: components, working principles, draft tube, evolution of axial flow turbines, Kaplan turbine, governing etc.

9. **Centrifugal & Reciprocating pumps:**
   Introduction, classification, components, principle of working, various heads, energy conversion, effect of finite number of vanes, losses and efficiencies, minimum starting speed, limitation of suction lift, Net Positive Suction Head (NPSH), multistage pumps, specific speed and performance, classification of Reciprocating pumps discharge, slip, power input, indicator diagram, effect of friction acceleration and pipe friction, maximum speed, air vessels.

10. **Dimensional analysis:**
    Units and dimensions, dimensional homogeneity, dimensional analysis method: Rayleigh and Buckingham methods, application and limitation of dimensional analysis, dimensionless numbers, similitude laws.

11. **Hydraulic systems:**
    Hydraulic accumulators, hydraulic intensifier, hydraulic lift, hydraulic crane, torque convertor, hydraulic ram.

Reference and Text Books:

1. Fluid Mechanics and Machinery, S.K. Agrawal, Tata-McGraw-Hill
2. Fluid Mechanics and Fluid Power Engineering, D. S. Kumar, Katson Publications.
3. Fluid Mechanics and Hydraulic Machines, S. S. Rattan, Khanna Publications.
4. Introduction to Fluid Mechanics and Machinery, Som and Biswas, Tata-McGraw Hill
5. Hydraulics & Fluid Mechanics, P.N. Modi & S.M. Seth, Standard Book House.

ETPE 210   DIGITAL ELECTRONICS   L   T/P
**   3   0**

Boolean Algebra & Gates
Analog & Digital signals, AND, OR, NOT, NAND, NOR & XOR gates, Boolean algebra.

Reduction Techniques
Standard representation of Logical functions, K-map representation and simplification of logical functions Don't care conditions, X-OR & X-NOR simplification of K-maps

Combinational Circuits
Combinational circuits: Multiplexers, demultiplexers, Decoders & Encoders, Adders & Subtractors, Code Converters, comparators, decoder/drivers for display devices, Logic Implementations using ROM, PAL, & PLA.

Flip flops
Flip Flops: S-R, J-K, D&T filp-flops, excitation table of a flip-flop, race around condition.

Sequential Circuits
Sequential circuits: Shift registers, Ripple counter, Synchronous counters.

Timer & ADC /DAC
555 Timer and its application as mono-stable and astable multi-vibrator, A/D and D/A converters.

Semiconductors Family and organisation
TTL and CMOS Logic families. Semiconductor Memories: Memory organization & operation, classification and characteristics of memories, RAM,ROM and content addressable memory.

Text:
1.   Jain, R.P., Modern Digital Electronics; TMH
2.   Mano M. Morris, Digital Design; PHI

References:
1.   Malvino A.P., Digital Computer Electronics, TMH
2.   Balabanian N. & Carlson B., Digital Logic Design Principles, Wiley Pub.
3.   Yarbrough J.M., Digital Logic; Thomson Learning Press

ETPE 212   CONTROL ENGINEERING   **L   T /P**
                                                          3   1

Mathematical Models:
Transfer function and its limitations, Examples of mechanical, electrical and electromechanical systems, Analogous systems, Gears, Open loop and Closed loop systems, Block diagram simplification, Signal flow graphs, Mason's gain formula.

Stability:
Absolute stability, Relative stability, Routh-Hurwitz stability criteria, Examples.

Time Response Analysis:
Standard Test Signals, Response of first order and second order systems to step and ramp excitations, Steady state error, Time response specification of second order system, System types and steady state error.

Types of Control Action:
Proportional, Proportional-Derivate (PD), Proportional-Integral (PI) and Proportional-Integral-Derivative (PID) control actions, Relative Advantages.

Frequency Response Analysis:
Concepts, Advantages, Frequency response specifications, Correlation with time response specification, Bode plots, Polar plot & Nyquist stability criterion, Phase and Gain Margins, Constant M and Constant N circles, Nichols Chart.

Root Locus:
Construction of Root Locus and Stability Analysis, Simple Problems on Root Locus.

Compensators:
Lag, Lead & Lag-Lead Compensator; Basic Design with these compensators in the loop.

State Space Analysis:
Solution, Stability, Controllability, Observability.

Components:
Potentiometer, Synchros, Armature and Field controlled DC Generator, DC Servomotors, AC Servomotors, Power Amplifiers, Techogenerators.

Introduction to Digital Control Systems:
Basic block diagrammatic description of implementation of controls using digital computers.

Reference books:
1.   Control Systems: Principles & Design by Gopal, TMH
2.   Modern Control Engineering by Ogata, PHI
3.   Automatic Control System by B.C. Kuo, PHI

Code No: ETPE 252   **P**
Lab: Heat & Mass Transfer Lab.   **3**

The practicals will be based on the following paper:

1)   Heat & Mass Transfer

Code No: ETPE 254   **P**
Lab: Fluid Mechanics & Machines Lab.   **3**

The practicals will be based on the following Paper:

1)   Fluid Mechanics & Machines

Code No: ETPE 256   **P**
Lab: Digital Electronics Lab.   **2**

The practicals will be based on the following Paper:

1)   Digital Electronics

Code No: ETPE 258   **P**
Lab: Control Engineering Lab.   **2**

The practicals will be based on the following Paper:

1)   Control Engineering

SCHEME OF EXAMINATION

B. TECH. in POWER ENGINEERING (Mechanical / Electrical)

	L	**T**	**P**	**S**	**Credits**
	16	6	10	0	27

FIFTH SEMESTER EXAMINATION

Code No.	Paper	L	T	P	S	Credits
THEORY PAPERS						
ETPE 301	Power Generation Engineering	3	1	0	0	4
ETPE 303	Steam Generator & Its Auxiliaries	3	1	0	0	4
ETPE 305	Steam Turbine and Its Auxiliaries	3	1	0	0	4
ETPE 307	Power Plant Electrical Machines & Systems	3	1	0	0	4
ETPE 309	Power System	2	1	0	0	3
ETPE 311 ETPE 313	Refrigeration and Air Conditioning *(For Mechanical specialization)* Electrical & Electronic Measurements and Instrumentation *(For Electrical specialization)*	2	1	0	0	3
PRACTICAL / **VIVA-VOCE**						
ETPE 351	Thermal Power Plant Scheme Tracing	0	0	4	0	1
ETPE 353	Microprocessor Lab.	0	0	4	0	1
ETPE 355 ETPE 357	Refrigeration and Air Conditioning Lab. *(For Mechanical specialization)* Electrical & Electronic Measurements and Instrumentation Lab. *(For Electrical specialization)*	0	0	2	0	1
	SESSIONAL					
ETPE 359	Practical Training at the end of Fourth semester	0	0	0	0	2
	Total	**16**	**6**	**10**	0	**27**

B. Tech. (Power Engineering)   **V Semester**

ETPE 301   POWER GENERATION ENGINEERING

L	T	C
3	1	4

Introduction : Conventional & Non-Conventional Sources of Energy and their availability in India, Different Types of Power Plants, Choice of Type of Power Generation, Power Plants in India.

Hydro Power Generation : Hydrology – Hydrographs, Flow Duration Curve, Mass Curve; Principle of working, Classification, Site selection; Different components & their functions; Types of Dams; Types, Characteristics & Selection of Hydro-Turbines; Specific Speed of Hydro-Turbines; Power Output Equation; Turbine Governing; Draft Tube; Bearings; Water Hammer & Surge Tank, Cavitation, General arrangement and Operation of Hydro-electric Power Plant, Mini & Micro Hydro Power Plants, Pumped Storage Power Plants; Advantages of Hydro-electric Power Plants; Hydro Power in India & future trends.

Nuclear Power Generation : Principle of Nuclear Energy, Nuclear Power Plant Components & their Functions; Nuclear Fuels, Radioactivity, Nuclear Reaction & Classification; Nuclear Reactors – Types & Classification, Main Parts; Problems in Reactor Operation; Radiation Hazards; Safety Measures; Nuclear Waste & its Disposal; Nuclear Power in India.

Gas Power Generation : Operating Principle; Classification – Open Cycle, Closed Cycle, Combined Cycle; Fuels for Gas Turbine Power Plants; Different Components and their functions; Gas Turbine Characteristics, Cycle Efficiency, Operational Aspects, Advantages and Limitations.

Diesel Power Generation : Working principle, Types of Diesel Engines, Different parts / systems and their functions, Performance of Diesel Engine, Plant Operation and Efficiency, Heat Balance, Advantages and Disadvantages, Applications.

Thermal Power Generation : Operating Principle, Site selection, Coal to Electricity, General Layout of Thermal Power Plant, Brief description of different parts/systems and their functions, Advantages and Limitations.

Co-Generation : Concept; Schemes; Brief Description; Benefits & Limitations; Applications.

Non-Conventional Energy Sources : Types, Brief Description, Advantages & Limitations.

Suggested Text Books & References :

1.   Morse F. T., "Power Plant Engineering", Affiliated East-West Press Pvt. Ltd., New Delhi.
2.   Verma Mahesh, "Power Plant Engineering", Metropolitan Book Company Ltd., New Delhi.
3.   S. Rao & Dr. B. B. Parulekar, "'Energy Technology'", Khanna Publishers.
4.   Arora & S. Domkundwar, "'A Course in Power Plant Engineering", Dhanpat Rai & Sons.
5.   G.D.Rai, "Non-conventional Energy Sources", Khanna Publishers.
6.   P.K.Nag, "Power Plant Engineering", Tata McGraw Hill Publications.
7.   Deshpande, M.V. "Elements of Electric Power Station Design", A. H. Wheeler and Company, Allahabad,1979.
8.   M. M. Vakil, "Power Plant Technology"

-:oOo:-

	L	**T**	**C**
ETPE 303 STEAM GENERATOR & ITS AUXILIARIES	**3**	**1**	**4**

Coal: Types of coal and their characteristics, their suitability for different kinds of Boilers, Alternations in firing methods due to change of coal composition.

Coal Handling System: Location and layout, main equipments and their functions, coal transportation, preparation, storage and reclamation, MGR systems, safety aspects, fire prevention and fire fighting in Coal Handling Plant.

Combustion Theory: Definition, combustion requirements, factor influencing combustion, composition of fuels, gross and net calorific value.

Fuel Oil Systems: Location and site selection, types of fuels oils used, main equipments and their functions, transportation, handling, storage, fuel oil preparation before firing.

Plant Visit: Visit to Coal Handling Plant, Visit to Fuel Oil Station.

Description of Main Boiler: Classification and types, arrangements of main boiler, fundamentals of boiler design, location of various pressure parts.

Boiler Circulation Theory: Water walls, boiling phenomena, nucleate / film boiling, natural / controlled / forced circulation.

Construction Details of Super Heaters, Re-heaters, Economizers, De-super heaters.

Steam Separation Theory: Boiler Drum & its internals.

Audio-Visual / **CBT** Session on Drum internals.

Draught System: Theory of natural, induced, balance and forced draught, drought loss, stack effect.

Various Fans and their salient features: Construction details / lubricating oil system for PA Fan, FD Fan, ID Fan.

Air Pre-heaters: Types and functions, constructional details, SCAPH, soot blowers.

Ventilation and Air Conditioning:

Pulverisers and Feeders: Classification of mills, constructional features of bowl mill, pulverization of coal, factors affecting milling plant performance, coal feeders and its type.

Fuel Firing Arrangements and Burners: Corner, front and rear wall firing, Direct and indirect firing, details of coal and oil burners, burners tilting mechanism, atomization of fuel oil in oil burners and ignitors.

Electrostatic Precipitator (ESP): Need of fly ash separation, working principle, corona effect, constructional details, rapping mechanism.

Ash Handling System: Fly ash handling system, bottom ash disposal system, ash handling plant operation, ash handling pump, disposal of ash slurry, utilization of ash.

Plant Visit: Milling plant, main boiler and fans, ash handling.

Furnace, Safeguard, Supervisory System (FSSS): Description of Field equipments (no C&I).

Audio Visual Session: FSSS

Water Supply System: Soft Water, Circulated Water, Cooling Water, and D.M. Water.

<u>**Suggested Text Books & References :**</u>

1. P.K.Nag, "Power Plant Engineering", Tata McGraw Hill Publications.
2. Arora & S. Domkundwar, "A Course in Power Plant Engineering", Dhanpat Rai & Sons.
3. "Modern Power Station Practice", Volume B, British Electricity International Ltd., Central Electricity Generating Board, Pergamon Press, Oxford, 1991.
4.   "Steam Generator and Its Auxiliaries", Manufacturer's Power Plant Manual.
5. 'Power Plant Familiarisation – Vol. II', NPTI Publication.

-:oOo:-

	L	T	C
ETPE 305 STEAM TURBINE & ITS AUXILIARIES	3	1	4

Steam Cycle Theory: Carnot Cycle, Rankine Cycle, with reference to a specific unit 500/210 MW, steam properties.

Steam Turbines: Classification of Turbines, Metallurgical considerations, working principles.
Description of main components i. e. Turbine casing, rotor, blades stream admission valves, couplings, bearing etc.

Turbine Lubrication Oil System: Construction and working principles of main oil pumps, starting oil pumps, AC, DC oil pumps, Oil coolers.

Steam Condensation and Condensers: Film wide / drop wise condensation, direct / indirect condensation and vacuum creation.

Audio-Visual: Vacuum System, Turbine Lubricating System.

Power Station Pumps: Classification of pumps, centrifugal pumps, positive displacement pumps.

Boiler Feed Pump: Function of BFP, Constructional details.

Circulating Water System: Open / closed system, CW Pumps, Cooling Towers, CT Pumps, CT Fans.

Plant Visit: CW System including cooling towers, CT Pumps, CT Fans, condensers, ejector, BFP.

Regenerative Feed Heating System: Working Principal and constructional details of L. P. Heaters, Deaerators, H.P. Heaters, GSC, Ejector.

Visit to Regenerating /feed Heating System, Turbine Lubricating Oil System, Water Treatment Plant.

Turbine Governing System: Types of Governing System, various components, systems and their functions, oil circuit for governing system, overall working of governing system with reference to load throw off, load raising.

Audio / **Visual** Session on Governing System.

HP / **LP Bypass System and PRDS:** HP / LP bypass circuit and its utility, Various interlocks for operation, Oil circuit in HP / LP by pass system, auxiliary PRDS circuit, pressure regulating system of PRDS circuit.

Audio / **Visual Session** on HP / LP Bypass System.

Plant Visit: Governing System HP / LP Bypass System.

Suggested Text Books & References :
1. Rajmohan Gupta, '"Steam Turbine", Oxford & IBH Publishing Co. Pvt. Ltd.
2. P.K.Nag,"Power Plant Engineering", Tata McGraw Hill Publications.
3. R. Yadav, "Steam Turbine", Khanna Publishers.
4. "Modern Power Station Practice", Volume C, British Electricity International Ltd., Central Electricity Generating Board, Pergamon Press, Oxford, 1991.
5. "SteamTurbine and Its Auxiliaries", Manufacturer's Power Plant Manual.
6. "Power Plant Familiarisation – Vol. III", NPTI Publication.
7. M. M. Vakil, "Power Plant Technology"

B. Tech. (Power Engineering)   **V Semester**

		L	T	C

ETPE 307   POWER PLANT ELECTRICAL MACHINES & SYSTEMS   **3   1   4**

Generator Constructional Details: Basic principle of electricity generation, Development of generator design, Constructional details of rotor, stator etc.

Tutorial / General Discussion.

Hydrogen Cooling System and Stator Water Cooling System: Different types of cooling arrangements for rotor and stator, Selection and properties of coolant, Air cooling, Hydrogen cooling, Stator water cooling, H_2 Charging / Purging Cycle.

Audio Visual on Hydrogen cooling system:

Hydrogen Seal Oil System: Details of the system, Function and purpose of differential pressure regulator and pressure oil regulators, Types of hydrogen seals and their constructional details.

Generator Excitation System and AVR: Principles, Simple arrangement of exciter and its field winding, Classification of excitation system and exciter development, High Frequency Excitations System, Static Excitation System, Brushless Excitation system – their merits and demerits, Automatic Voltage Regulator and its control.

Audio / Visual Session on Excitation System.

Plant Visit: Generator and Auxiliaries, Hydrogen cooling, Stator water-cooling system, Hydrogen seal oil system.

Transformers: Working Principle, Various types of transformers used in a power station, Constructional features of main transformer and accessories, Bucholtz relay and main protections, Types of cooling, Mulsifire and other fire protection systems.

Audio/Visual / Discussion Session.

Motors: Fundamentals, Constructional details of HT / LT motors, Various motors used in Power Stations.

Plant visit: Transformers / Excitation System.

HT-LT Supply System / **DC Supply System**: A typical layout of 6.6 KV, 3.3 KV and 415 KV supply system in a TPS, DC supply system in a TPS.

Audio Visual on Electrical System.

Switchyard: A typical layout of Switchyard of a Thermal Power Station, Bus system, Isolators, CTs, PTs, Earthing, Oil Circuit Breakers, Air Blast Circuit Breakers, SF6 Circuit Breakers, Vacuum Circuit Breakers.

Plant Visit: Switchyard, HT/LT Supply System, DC Supply System.

Audio / Visual Session.

Discussion.

Generators of Hydro/Nuclear/Gas/Diesel Power Plants, their characteristics and comparison.

Suggested Text Books & References :

1. "Modern Power Station Practice", Volume C & D, British Electricity International Ltd., Central Electricity Generating Board, Pergamon Press, Oxford, 1991.
2. Deshpande, M.V. "Elements of Electric Power Station Design", A. H. Wheeler and Company, Allahabad,1979.
3. "Power Plant Familiarisation – Vol. IV", NPTI Publication.
4. "Power Plant Electrical Machines & Systems", Manufacturer's Power Plant Manual.

-:oOo:-

B. Tech. (Power Engineering)   **V Semester**

	L	**T**	**C**

ETPE 309   POWER SYSTEM   **2   1   3**

Introduction : General concepts of Generation, Transmission, Distribution and Utilization; Structure of Power System.

Power Generation and Load: Types of power plants; Types of loads; Load Prediction; Load curves & Load-duration curves and their significance; Terms & Factors; Base Load & Peak Load Power Plants; Reserves – Cold, Hot, Spinning; Cost of Generation; Advantages of combined operation of different power plants.

Transmission And Distribution Systems : DC 2-wire and 3-wire systems; AC single phase, three phase and 4-wire systems; Comparison of copper efficiency.

Distribution Systems: Primary and Secondary distribution systems, Concentrated & uniformly distributed loads on distributors fed at one and both ends, Ring distribution, Submains and Tapered mains, Voltage drop and Power loss calculations, Voltage regulators.

Overhead Transmission Lines : Types of Conductors; Line parameters - calculation of inductance and capacitance of single and double circuit transmission lines; Three phase lines with stranded and bundle conductors; Generalized ABCD constants and equivalent circuits of short, medium & long lines; Line Performance - regulation and efficiency of short, medium and long lines; Ferranti effect, Proximity effect, Skin effect ; Series and Shunt compensation, Introduction to FACTS.

Overhead Line Insulators : Types, String efficiency, Voltage distribution in string of suspended insulators, Grading ring, Preventive maintenance.

Mechanical Design Of Transmission Lines : Different types of tower, Sag-tension calculations, Sag-template, String charts; Vibrations & Damping.

Corona : Effects, Corona losses; Radio & Audio noise; Transmission line – Communication line interference.

Cables : Calculations of capacity of cables; Charging current, Stress, Grading, Heating of cables; Construction and characteristics of HV & EHV cable.

Tariffs : Definition & different tariffs for domestic, commercial, industrial application.

Introduction To EHV / HVDC Transmission : Brief description of both the systems with working & constructional details.

Power Factor Improvement : Power factor & its effects, Methods of improving power factor.

Suggested Text Books & References:

1. Grainger John, J. and Stevenson, Jr. W.D., "Power System Analysis", McGraw Hill, 1994.
2. Harder Edwin, I., "Fundamentals of Energy Production", Johjn Wiley and Sons, 1982.
3. Deshpande, M.V. "Elements of Electric Power Station Design", A. H. Wheeler and Company, Allahabad,1979.
4. "Modern Power System Practice", Volume 1 to 8, Central Electricity Generating Board, Pergamon Press, Oxford, 1994.
5. Burke James, J., "Power Distribution Engineering: Fundamentals and Applications", Marcel Dekker Inc., 1996.

6. "Electric Transmission and Distribution Reference Book", Westinghouse Electric Corporation: East Pittsburg, Pa., 1964.
7. Wadhwa, C.L. "Electric Power Systems", New Age International (P) Ltd., Publishers, 2003
8. Nagrath, I.J. and Kothari, D.P., "Power System Engineering". Tata McGraw Hill,1995.

-:oOo:-

	L	T	C
ETPE 311 **REFRIGERATION & AIR CONDITIONING**	2	1	3

(For Mechanical specialization)

Introduction: Necessity: Methods of refrigeration: Unit of refrigeration: Coefficient of performance (COP): Fundamentals of air conditioning system: Refrigerants Definition, Classification, Nomenclature, Desirable properties, Comparative study, secondary refrigerants. Introduction to eco-friendly refrigerants: Introduction to Cryogenics.

Air Refrigeration Systems: Carnot refrigeration cycle. Temp. Limitations: Brayton refrigeration of the Bell Coleman air refrigeration cycle: Necessity of cooling the aero plane, Air craft refrigeration system – Simple cooling and simple cooling evaporative types, Boot strap and Boot strap evaporative types. Regenerative type and Reduced Ambient type systems, Comparison of different systems, Problems.

Vapour Compression (VC) Refrigeration System: Simple VC Refrigeration Systems – Limitations of Reversed Carnot cycle with vapour as the refrigerant, Analysis of V.C. cycle considering degrees of sub cooling and super heating, VC cycle on p.v., t.s. and p.h. diagrams., Comparision of VC Cycle with Air Refrigeration cycle, Concepts of Multi-Stage Refrigeration Systems.

Vapour Absorption Refrigeration System : Basic Systems, Actual System, COP of the System Performance, Relative merits and demerits: Properties of aqua ammonia: Electrolux Refrigerator, Problems; Concepts of Steam Jet Refrigeration System and Cascade Refrigeration Systems.

Psychrometry Of Air & Air Conditioning Processes: Properties of moist Air Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temp. Thermodynamics wet bulb temp. Psychometrics chart, Psychrometry of air conditioning processes, Mixing Process, Basic Processes in conditioning of air; Psychrometric processes in air washer Problems.

Suggested Text Books & References :

1. C.P. Arora, "Refrigeration & Air Conditioning" , Tata McGraw Hill Publication.
2. R.C. Jordand & G.B. Prister, "Refrigeration & Air Conditioning", Prentice Hall of India Publication.
3. W.F. Stocker & J.W. Jones, "Refrigeration & Air Conditioning", Tata McGraw Hill Publication.
4. Dr. Manohar Prasad, "Refrigeration & Air Conditioning", Wiley Eastern.
5. S. Domkundwar, "A Course in Refrigeration & Air Conditioning", Dhanpat Rai & Sons

-:oOo:-

	L	**T**	**C**

ETPE 313 ELECTRICAL & ELECTRONIC MEASUREMENTS AND INSTRUMENTATION   2   1   3
(For Electrical specialization)

ELECTRICAL MEASUREMENTS

Measurements and Instruments : Measurements – Significance, Methods, Types; Instruments – Types, Classification; Functions of Instruments and Measurement Systems ; Generalized Measurement System; Application of Measurement Systems.

Performance Characteristics of Instruments : Drift, Error, Reproductibility, Repeatability, Noise, Uncertainity, Accuracy, Precision, Resolution, Threshold, Sensitivity, Efficiency, Linearity, Dead Time, Dead Band, Friction, Backlash, Hysteresis, Zero stability, Overshoot, Loading effect.

Errors in Measurement : True value, Types of Error, Error Analysis.

Units and Standards : Absolute Units; SI Units – Base Units, Supplementary Units, Derived Units; Standards and their classification (International, Primary, Secondary and Working Standards).

Review of Measurement of Resistance, Inductance and Capacitance : Methods of measurement of low, medium and high resistances, Kelvin's double bridge, Wheatstone bridge, Meggers & Ohmmeters, Insulation resistance measurement,   Earth resistance measurements, AC bridges for inductance and capacitance measurements, Mutual Inductance measurement, Shielding and Earthing.

Review of Measurement of Current and Voltage : Permanent Magnet Moving Coil (PMMC) and Moving Iron (MI) instruments, Electrodynamometer Type & Electrostatic Type Instruments, Measurement of DC / AC voltage and current, Extension of Range, Errors (Both on AC/DC), Multimeter.

Instrument Transformers : Current and Potential Transformers, Need & Functions, Construction, Theory, Ratio & Phase Angle Errors and their minimisation, Design considerations, Testing of instrument transformers by absolute and comparison methods.

Measurement of Power and Energy : Power in DC & AC Circuits; Types of Wattmeters; Construction, Operating principle, Torque equation, Shape of scale, Errors, Advantages & Disadvantages of Electrodynamometer type and Induction type Wattmeters; Measurement of Power using Instrument Transformers; Measurement of Power in three phase circuits, Three Phase Wattmeters, Measurement of Reactive Power; Classification of Energy Meters; Single Phase Induction Type Energy Meter – Construction, Theory & Operation, Errors, Adjustments & Compensation; Three Phase Energy Meters; Maximum Demand Indicator; KVAH & KVARH Metering; Measurement of KVA; Trivector Meter; Testing of Energymeters; Meters used for special purposes.

Measurement of Phase, Frequency & Speed : Phase (or Power Factor) Meters - Electrodynamometer and Moving Iron types; Frequency Meters –- Mechanical Resonance type, Electrical Resonance type, Weston type frequency meters; Phase Sequence Indicator; Synchroscopes; Tachogenerator, Tachometer, Photo-electric meter, Stroboscope.

ELECTRONIC MEASUREMENTS

Electronic Voltmeter, Multimeter, Wattmeter & Energy meter; Time, Frequency and Phase Angle measurements; CRO & Special purpose Oscilloscopes; Q-meters; Potentiometric Recorders; Spectrum Analyzer, Wave Analyzer; Harmonic Analyzer; Power Analyzer; Distortion Meter; Digital Voltmeter, Multimeter, Frequency Counter, and Storage oscilloscope; Display Devices - Nixie Tubes, LED, LCD.

INSTRUMENTATION

Transducers, Classification & Selection of transducers, Thermocouples, Thermisters, LVDT, Strain gauges, Piezoelectric crystal, Use of Transducers in measurement of non-electrical quantities like temperature, pressure, liquid level, flow-rate, displacement, acceleration, noise level etc., Data Acquisition Systems (DAS), A/D and D/A converters.

<u>**Suggested Text Books / References :**</u>

1. Helfrick and Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI, Reprint 1988.
2. Jones, B.E., "Instrumentation Measurement and Feedback", Tata McGraw-Hill, 1986.
3. Golding,E.W.,"Electrical Measurements and Measuring Instruments", 3rd Edn., Sir Issac Pitman & Sons, 1960.
4. Buckingham, H. and Price, E.N., "Principles of Electrical Measurements", 1961.
5. Stout, "Basic Electrical Measurements", Prentice Hall
6. E.O.Doebin, "Measuring Systems", McGraw Hill.
7. A. K. Sawhney, "Electrical & Electronic Measurements and Instrumentation", Dhanpat Rai and Sons, 2003.
8. Umesh Sinha, "Electrical & Electronic Measurement and Instrumentation", Satya Prakashan, New Delhi.

-:oOo:-

B. Tech. (Power Engineering)   **V**
Semester

		P	**C**
ETPE 351	**THERMAL POWER PLANT SCHEME TRACING**	**4**	**1**

Based on the courses ETPE 303, 305 & 307

		P	**C**
ETPE 353	**MICROPROCESSOR LAB.**	**4**	**1**

		P	**C**
ETPE 355	**REFRIGERATION & AIR-CONDITIONING LAB.**	**2**	**1**
	(For Mechanical specialization)		

Based on the course ETPE 311

		P	**C**
ETPE 357	**ELECTRICAL & ELECTRONIC MEASUREMENTS AND INSTRUMENTATION LAB.**	**2**	**1**
	(For Electrical specialization)		

Based on the course ETPE 313

		C
ETPE 359	**PRACTICAL TRAINING AT THE END OF FOURTH SEMESTER**	**2**

-:oOo:-

B. TECH. in POWER ENGINEERING (Mechanical / Electrical)

	L	T	P	C
	16	**6**	**19**	**27**

SIXTH SEMESTER EXAMINATION

Code No.	Paper	L	T	P	Credits
THEORY PAPERS					
ETPE 302	Power System Protection and Switchgear	3	1	0	4
ETPE 304	Thermal Power Plant Engineering – Related Topics – I (Power Plant Commissioning, NDT, Industrial Safety)	3	1	0	4
ETPE 306	Power Plant Operation	3	1	0	4
ETPE 308	Power Plant Control and Instrumentation	3	1	0	4
ETPE 310 ETPE 312	I. C. Engines & Gas Dynamics *(For Mechanical Specialization)* Power Electronics & Electric Drives *(For Electrical Specialization)*	2	1	0	3
ETPE 314 ETPE 316	Machine Design *(For Mechanical Specialization)* Engineering Electromagnetics *(For Electrical Specialization)*	2	1	0	3
PRACTICAL / VIVA-VOCE					
ETPE 352	Power System Protection and Switchgear Lab.	0	0	2	1
ETPE 354	Rotational On-Job Training (Operation - Steam Generator & Its Auxiliaries)	0	0	5	1
ETPE 356	Rotational On-Job Training (Operation - Steam Turbine & Its Auxiliaries)	0	0	5	1
ETPE 358	Rotational On-Job Training (Operation - Power Plant Electrical Machines & Systems)	0	0	5	1
ETPE 360 ETPE 362	I. C. Engines Lab. *(For Mechanical Specialization)* Power Electronics & Electric Drives Lab. *(For Electrical Specialization)*	0	0	2	1
Total		**16**	**6**	**19**	**27**

Note: Training programme of 6 weeks is to be conducted during Summer-break after the VI Sem. This carries three (3) credits which will be accounted for in the VII Sem.

		L	**T**	**C**

ETPE 302   **POWER SYSTEM PROTECTION AND SWITCHGEAR**   **3** **1** **4**

PROTECTION

Protection System : Importance of protective relaying in power systems; Fundamental requirements of a good protection scheme; Zones of protection, Primary and Back–up Relaying.

Protective Relays : Terms used in protective relaying; Classifications of Relays - Constructional / Functional; Electromagnetic Relays – attracted armature, induction disc, induction cup types relays; Overcurrent and   Earth fault relays, Directional, Differential, Distance Relays etc.; Principles & Characteristics of relays; Operation, setting, testing and applications, maintenance requirements of relays; Translay relay; Negative Sequence relays; Universal Relay Torque Equation; Electronic relays; Static relays; Digital relays; Microprocessor and PC based relaying; Current & Future trends.

SWITCHGEAR

Circuit Interruption : Fuses - Types of fuses, Terms (Fusing factor, Breaking capacity etc.), Fuse selection, HRC fuses and their applications; Arcing phenomena, Essential properties of arc, Initiation and Maintenance of an arc, Arc voltage, Arc interruption theories, Recovery and Restriking voltages, Rate of Rise of Restriking Voltage (RRRV), Resistance Switching, Inductive current chopping, Capacitive current breaking.

Circuit Breakers : AC and DC circuit breaking, Types of Circuit Breakers - ACB, OCB, ABCB, SF_6CB, VCB; Static Circuit Breakers; Comparative merits and demerits of different types of CBs, Rating of Circuit Breakers, Testing and Selection of Circuit Breakers, Autoreclosing.

POWER PLANT PROTECTION

Protection Schemes: Schemes for protection of transmission line; Merz-Price circulating current scheme, Percentage differential relay, Restricted earth fault protection, Negative Sequence protection, Translay scheme, Carrier relaying scheme, Pilot relaying scheme, Static and other relays used in transmission line protection.

Generator Protection : Neutral earthing, stator and rotor earth faults, sustained external faults, instability, protective systems.

Transformer Protection : Various transformer protections, protective systems for Generator Transformers (GTs), Unit Auxiliary Transformers (UATs) and Station Transformers (STs).

Motor Protection : Faults and Protection systems.

Busbar Protection : Continuity of supply, Discrimination, Circulating current systems, special features relating to different voltage systems.

Feeder Protection : Continuity of supply discrimination, outline of protection systems – Pilot wire, carrier current, distance protection, PLCC – Telemetry Communication.

Suggested Text Books and References :

1. The Electricity Council, "Power System Protection", Vol.1, 2 & 3, Peter Peregrinus Ltd., 1990.
2. Van, A. R., & Warrington, C., "Protective Relays : Their Theory and Practice", Vol. 1 & 2, Chapman and Hall, 1969.
3. Paithankar, Y. G., "Transmission Network Protection : Theory and Practice", Marcel Dekker, Inc., 1998.
4. GEC Measurements, "Protective Relays: Application Guide", GEC Measurements, 1987.
5. C. R. Meson,"The Art and Science of Protective Relaying", Wiley Eastern Ltd., 1970
6. B. Ram and D. N. Vishwakarma, "Power System Protection & Switchgear", TMH
7. B. Ravindranath and M. Chander, "Power System Protection and Switchgear", Wiley Eastern Ltd.
8. M. V. Despande, " Switchgear and Protection"
9. Sunil S. Rao, "Switchgear and Protection", Khanna Publishers.
10. T. S. M. Rao, "Power System Protection: Static Relays with Microprocessor Applications", TMH.
11. L. P. Singh, "Digital Protection", New Age International.
12. "Modern Power Station Practice", Vol. D & K, British Electricity International Ltd., Central Electricity Generating Board, Pergamon Press, Oxford, 1991.

<div align="center">-:o0o:-</div>

	L	**T**	**C**

ETPE 304   THERMAL POWER PLANT ENGINEERING – RELATED TOPICS – I   3   1   4
(Power Plant Commissioning, NDT, Industrial Safety)

Power Plant Commissioning

Preparation of commissioning, trial run of various equipments, commissioning of valves, air and gas tightness test of boiler. Chemical cleaning boiler, preparation for boiler light up, thermal flow test of water walls and economizers, steam blowing.

Safety valves setting, reliable run of boiler. Hydraulic test of boiler.

Alkaline flushing and commissioning of regenerative system, acid cleaning of oil pipe lines, oil flushing procedure of lubricating oil and governing system.

Turbine Lubricating oil flow testing steam blowing, reheater safety valve, vacuum tightness test, ejector testing.

Commissioning of governing system and ATRS & ATT, and TSE.

Commissioning of generator and auxiliaries (Generator testing, rotor and stator cooling system, excitation system)Commissioning of electrical system (Circuit breakers, isolators, CT and PT, rectifiers, switchgear, DC System).

C&I Commissioning activities (Minimum instrumentations required for major C&I commissioning, commissioning of control valve, tuning of control valves).

Discussion/Appraisal.

NDT (Non-Destructive Testing)

Purpose of NDT and types of defects covered by NDT.

NDT Methods used in power station (Principle, equipments, utilization, merits and de-merits).

Industrial Safety

Accidents (Causes & Factors, Cost of Accidents, Accident Prevention, Investigation of Accidents, Reporting and Recording Systems for Accidents.First Aid (Basics of First Aid, How injuries are caused in lifting, falls etc.) Fire Fighting (Fundamentals of Fire, Fire Fighting Equipments and Systems, Fire Extinguishing Methods, Demonstration of various Fire).

Industrial Safety & Hazards (Industrial Hazards, Protective Clothing and Equipment, Safe Working Practices in Power Plant, Permit to work system, Safety in Movement and storage of Materials, House Keeping, Safety Rules.

Suggested Text Books and References :

1.   Power Plant Operation   - NPTI
2.   BHEL Manual
3.   Power Plant Engineering by P.K.Nag, TMH
4.   Power Plant Engineering by Morse

	L	**T**	**C**

ETPE 306   **POWER PLANT OPERATION**   **3**   **1**   **4**

Availability of electrical supply to the equipment (source feeder of each equipment, points of isolation of the equipment, locking during isolation, permit to work system).

Boiler pre light up checks. (Meaning of light up, shut down, tripping, starting etc.,l No pending permits, local checks).

Operation of service auxiliaries (cooling water pump, compressors, auxiliary steam, fuel oil pump)

Operation of air-pre heater and ID fan)(Rechecks, flow path line up, permissives, interlocks).

Operation of FD & PA Fans (pre checks, flow path line up permissives, interlocks).

Mill operation (pre checks, flow path line up, permissives, interlocks).

FSSS (Secondary air, burner tilt, fuel and air control).

Drum level control, Super Heater, Re-Heater, temperature control and their interlocks.

Operation of turbine lubricating system and barring gear.
Operation of condensate and feed water system (BFP, Heaters CEP).

HP/LP Bypass operation and turbine heating.
Turbine rolling and synchronization.

Operation of generator cooling system (stator and hydrogen cooling).
Operation of Generator excitation system AVR.

Operation of Turbine governing system.
Integrated operation of unit (unit loading and shut down sequence)

Operational difference between cold start up, warm start up and hot start up. Load dispatching and coordination with load dispatch center.

Power plant emergencies (Boiler & Turbine)
Discussion and appraisal.

Suggested Text Books and References :

1.   Power plant operation – NPTI Publication
2.   BHEL manual
3.   CEGB Manual on power Plant Operation
4.   Power Plant Engineering by P.K.Nag, TMH
5.   Power Plant Engineering by Morse

-:o0o:-

B. TECH. in POWER ENGINEERING (Mechanical / Electrical)　　　　　　　**VI Semester**

		L	**T**	**C**
ETPE 308	**POWER PLANT CONTROL AND INSTRUMENTATION**	**3**	**1**	**4**

Transducers, Classification, Analog & Digital transducers, Selection of transducers, Strain gauges, Inductive & Capacitive transducers, Piezoelectric and Hall-effect transducers, Measurement of non-electrical quantities like temperature, pressure, liquid level, flow-rate, displacement, velocity, acceleration, noise level etc., Thermisters, Thermocouples, LVDT, Photo-diodes & Photo-transistors, Encoder type digital transducers, Signal conditioning and telemetry, Basic concepts of smart sensors and application, Data Acquisition Systems (DAS), A/D and D/A converters.

Concept and layout of Control and Instrumentation in Thermal Power Plant

Measurement & Measuring instruments
Pressure Measurement and measuring instruments, Temperature Measurement and measuring Instruments, Flow measurement and measuring instruments,Level Measurement and measuring instruments

Practical demonstration on pressure , flow, level and temperature measurements

Protection and interlocks of Boiler, Turbine and their auxiliaries

Introduction to auto control, Auto control loops used in thermal power stations

Turbovisory instrumentation (Parameters limits, Basic concepts of measuring devices)

Commissioning of control loops – Practical demonstration

ATRS

Visit to control and instrumentation lab. and control / control stations in thermal power stations

Analytical Instrumentation for Boiler (Water, Steam, Flue Gas, H_2 / O_2 / CO_2)

Practical demonstration and practice on analytical instruments (Correct approach for sampling and testing)

Introduction to DDC and DAS in Thermal Power Station

Introduction to new / latest technology in Control and Instrumentation in modern thermal power station

Suggested Text Books and References :

1. A.K.Sawhney, "Electrical & Electronic Measurements and Instrumentation", Dhanpat Rai and Sons, 2003.
2. "Modern Power Station Practice", Volume F, British Electricity International Ltd., Central Electricity Generating Board, Pergamon Press, Oxford, 1991.
3. "Control & Instrumentation", NPTI Manuals Volumes I, II, III.
4. "Control & Instrumentation", Manufacturer's Manuals.

-:o0o:-

	L	**T**	**C**

ETPE 310   I.C. ENGINES & GAS DYNAMICS   **2   1   3**

Internal Combustion (I.C.) Engines

I.C. ENGINE CYCLES: Otto, Diesel and Dual cycles. Fuel air cycles volumetric, combustion and overall efficiency. Fundamental difference between SI and CI engines. Deviation of actual cycle from ideal cycle. Calculation of IHP & BHP. Numericals

S.I. ENGINES – Principles of carburetion. Factors affecting carburetion, Air fuel ratio, working principle of simple carburetion, effect of nozzle tip and compressibility, jet size and depression at venture, choke, compensation, Introduction to multipoint fuel injection system, valve timing diagrams, Flame development and its propagation, ignition lag, effect of engine parameters, pre-ignition, combustion chamber, Battery and Coil ignition system, Magneto system, spark advancing, octane Number.

C.I. ENGINES: Introduction, Injection System, Injection pump - Jwerk type and distributor type, Injection nozzle, direct and indirect injection. Valve timing diagram, stages of combustion in C.I. engines. Factors affecting delay period, knocking, comparison of knock is SI and CI engine Cetane number, aniline point, Diesel index, Alternative fuels.

COOLING AND LUBRICATION: types of cooling system – liquid and air cooling system. Forced circulation system, pressure cooling system, Radiator, cooling fins, Baffles. Types of lubrication system; Mist, Wet sump lubrication system, oil additives.

Gas Dynamics

ISENTROPIC FLOW: Acoustic velocity, - Mach number, Mach line and Mach angle, Flow parameters, Stagnation temperature and pressure.

ADIABATIC FLOW: Stagnation temperature change, Rayleigh line, Pressure ratio and temperature ratio, entropy consideration, Maximum heat transfer, Detonation and Deflagnation.

FLOW WITH FRICTION   : The fanning equation, friction factor and friction parameter, Fanno line Fanno equation.

WAVE PHENOMENA – Classification of wave phenomena, Analysis of shock phenomena, weak waves, compression waves,   oblique shocks, Normal shock waves, entropy considerations, Rayleigh pilot equation.

Suggested Text Books and References :

I.C. ENGINES

1. Internal Combustion Engines – V. Ganesan – TMH
2. Internal Combustion Engines – Mathur & Sharma Dhanpat Rai Publications.
3. The I.C. Engines – Taylor & Taylor – E.S. MIT Press.
4. Elements of I.C. Engines – Rogowskli, A.R. – MC Grawhill.
5. I.C. Engines – Maleegv, MC Grawhill.

GAS DYNAMICS

1. Gas Dynamics – Compbell & Jenninys – MC Grawhill.
2. Introduction to Gas Dynamics – Rolty – Waley.
3. Element of Gas Dynamics – Liepmann & Rashko – Wisley.
4. The Dynamics & Thermodynamics of Compressible fluid flow – Shaplo – (Ronold press)

-:o0o:-

B. TECH. in POWER ENGINEERING (Mechanical / Electrical)   **VI Semester**

	L	**T**	**C**

ETPE 312   **POWER ELECTRONICS AND ELECTRIC DRIVES**   **2   1   3**

POWER ELECTRONICS

SCR and its characteristics – gate characteristics, SCR ratings, series and parallel connections of SCRs. Triac, GTO, IGBT characteristics and ratings. Unijunction Transistors. Triggering circuits and optocouplers.

Linear commutated converters – single pulse, two pulse mid point, three pulse mid-point and 3 phase six pulse converters. Effect of source inductance on converters. Free wheeling diode effect.

D.C. Choppers – Principles of step down chopper, step up chopper and classification . Impulse commutated and resonant pulse choppers. Multiphase choppers. Application of choppers.

Single phase and three phase bridge inverters. Commutation and trigger circuits for forced commutated thirstier inverters. Output voltage control. Harmonies in output voltage waveform harmonics attenuation by filters. Harmonic reduction by pulse width modulation. Working of current source inverters. Switched Mode Power Supplies.

ELECTRIC DRIVES

Review of characteristics of A.C. and D.C. Motors, Phase controlled and chopper controlled drive of D.C. motor. Pulse width modulated (PWM) Induction motor drive (voltage source and current source inverters).

Digital Control Drive, Steper Motors, Electrical drives in steel, cement, Textile, paper mills, Machine tool drive and computerized numerical control (CNC).

Suggested Text Books and References :

1.   Power Electronics Circuits Devices and Applications – M.H. Rashid
2.   Elements of Electrical Drives – G.K. Dubey.
3.   Power Electronics for technology – Ashfaq Ahmed, Pearson Education
4.   Power Electronics by P.S. Bhimbra - Khanna Publisher.

-:o0o:-

	L	**T**	**C**
ETPE 314 MACHINE DESIGN	**2**	**1**	**3**

Mechanical Joints: ISO Screw Threads, Bolted joints in tension, Eccentrically loaded bolted joints in shear and under combined stresses, Design of Power Screws, Design of various types of welding joints under different static load conditions, Numericals.

Riveted Joints, Cotter & Knuckle Joints: Design of various types of riveted joints under different static loading conditions, Boiler joints & Eccentrically loaded riveted joints, design of interference joints, Numericals.

Power Transmission Systems: Types of mechanical drives, Design of belt drives, Flat & V-belt devices, Condition of Transmission of max.   Power, Selection of belts, Numericals.

Keys, Couplings & Flywheel: Design of Keys, - Flat, Kennedy Keys, Splines, Couplings design – Rigid & Flexible coupling, Numericals.

Bearings: Selection of ball and roller bearings based on static and dynamic load carrying capacity using load-life relationship. Selection of bearings from manufacture's catalogue, types of lubrication – boundary, mixed and hydrodynamic lubrication, design of journal bearings using Ramondi and Boyd's equation, Lubricants and their properties, Selection of suitable lubricants, Problems.

Gears: Classification, Selection of gears, Terminology of gears, Fo4rce analysis, Selection of material for gears, Beam & wear strength of gear tooth, Form of Lewis factor for gear tooth, Dynamic load on gear teeth-barth equation and Buckingham equation and their comparison, Design of spur including the consideration for maximum power transmitting capacity. Gear lubrication Problems.

Suggested Text Books and References :

1.   SH. P.C. Sharma , Sh. D.K. Agrawal & Sh. S.K. Kataria & Sons.
2.   Sh. Pandey & Sh. Saha.
3.   Sh. K.L.Khurmee.
4.   Joseph Edward Shingley – Mc-Graw Hill

-:o0o:-

	L	**T**	**C**

ETPE 316   ENGINEERING ELECTROMAGNETICS   **2   1   3**
    (For Electrical Specialization)

Electrostatic Fields

Coulomb's Law, Gauss's Law, Potential Function, Field due to a continuous distribution of charge, Equipotential surfaces, Gauss's Theorem, Poisson's equation, Laplace's Equation, Finite difference equivalent of Laplace's equation, Method of electrical images, Capacitance, Electrostatic energy, Boundary conditions between dielectrics, The Electrostatic Uniqueness Theorem, Far field of a charge distribution, Dirac Delta representation for a point charge and an infinitesimal dipole.

Magnetostatic Fields

Biot-Savart's Law, Ampere's Work Law in the differential vector form, Ampere's Law for a current element, Volume distribution of current and the Dirac Delta, Ampere's Force Law, Magnetic vector potential, Vector potential (Alternative derivation), Far field of current distribution, Boundary conditions, Inductance, Analogies between electric and magnetic fields.

Electromagnetic Fields (Time Varying Fields)

Faraday's Law, Displacement Current, Maxwell's equations in point form and integral form, Equation of continuity for time varying fields, Inconsistency of Ampere's Law, Interpretation of Maxwell's Equations, Boundary conditions, Relation between field theory and circuit theory, Electromagnetic waves in a homogeneous medium, Solution for free space conditions, Uniform Plane wave propagation, Relation between E & H in a uniform plane wave, Wave propagation in conducting medium and dielectrics, Wave propagation in good conductor and good dielectric, Depth of penetration, Polarization (linear, circular and elliptical), Reflection and/or Refraction of plane waves by a perfect conductor and perfect dielectric, Both normal incidence as well as oblique incidence, Reflection at the surfaces of a conductive medium, Surface impedance, Transmission line analogy, Poynting Theorem, Interpretation of ExH, Power loss in a plane conductor.

Transmission Lines

Transmission line as a distributed circuit, Transmission line equation, Travelling waves, Standing waves, Impedance of terminated line, Reflection coefficient, Voltage Standing Wave Ratio (VSWR).

Suggested Text Books and References :

1. Jordan, E. C. and Balmain, K. G. "Electromagnetic Waves and Radiating Systems", 2nd Edition, Prentice Hall, India, 1995.
2. Mathew, N., Sadiku, O., "Elements of Electromagnetics", 2nd Edition, Saunders College Publishing, 1994.
3. Hayt William H. and Buck J. A., "Engineering Electromagnetics", 6th Edition, Tata McGraw Hill, 2001.
4. Krauss, J. D., "Electromagnetics", 3rd Edition, McGraw Hill, 1989.
5. Rao, N.N., "Elements of Engineering Elctromagnetics", 3rd Edition, Prentice Hall, India, 1982.
6. Ramo S., Whinnery, S. and Van Duzer, T., "Fields and Waves in Communication Electronics", 3rd Edition, John Wiley and Sons, 1984.
7. Seth, S.P., "Elements of Electromagnetic Theory", 2nd Edition, Dhanpat Rai Publications, 2003.

-:o0o:-

-:o0o:-

			P	**C**
ETPE 352	**POWER SYSTEM PROTECTION AND SWITCHGEAR LAB.**		**2**	**1**
	Based on the course ETPE 302			

			P	**C**
ETPE 354	**ROTATIONAL ON-JOB TRAINING**		**5**	**1**
	(OPERATION – STEAM GENERATOR & ITS AUXILIARIES)			
	Based on the course ETPE 306			

			P	**C**
ETPE 356	**ROTATIONAL ON-JOB TRAINING**		**5**	**1**
	(OPERATION – STEAM TURBINE & ITS AUXILIARIES)			
	Based on the course ETPE 306			

			P	**C**
ETPE 358	**ROTATIONAL ON-JOB TRAINING**			
5	**1**			
	(OPERATION – POWER PLANT ELECTRICAL MACHINES & SYSTEMS)			
	Based on the course ETPE 306			

			P	**C**
ETPE 360	**I.C. ENGINES LAB.**		**2**	**3**
	(For Mechanical Specialization)			
	Based on the course ETPE 310			

			P	**C**
ETPE 362	**POWER ELECTRONICS AND ELECTRIC DRIVES LAB.**		**2**	**3**
	(For Electrical Specialization)			
	Based on the course ETPE 312			

-:o0o:-

	L	**T**	**P**	**C**
	16	5	17	28

SEVENTH SEMESTER EXAMINATION

Code No.	Paper	L	T	P	Credits
THEORY PAPERS					
ETPE 401	Power Distribution and Utilisation	3	1	0	4
ETPE 403	Thermal Power Plant Engineering – Related Topics – II (Performance & Efficiency Calculations, Maintenance Planning & Cost Control)	2	1	0	3
ETPE 405	Power Plant Maintenance	3	1	0	4
ETPE 407	Theory of Machine *(For Mechanical Specialization)*	3	1	0	4
ETPE 409	Power System Analysis & Stability *(For Electrical Specialization)*				
ETPE 411	Manufacturing & Industrial Engineering *(For Mechanical Specialization)*	3	1	0	4
ETPE 413	Communication Engineering *(For Electrical Specialization)*				
ETPE 415	Civil Works in Power Engineering* (*Non-University Examination Subject)	2	0	0	1
PRACTICAL / VIVA-VOCE					
ETPE 451	Rotational On-Job Training (Maintenance – Steam Generator & Its Auxiliaries)	0	0	5	1
ETPE 453	Rotational On-Job Training (Maintenance – Steam Turbine & Its Auxiliaries)	0	0	5	1
ETPE 455	Rotational On-Job Training (Maintenance – Power Plant Electrical Machines & Systems)	0	0	5	1
ETPE 457	Theory of Machine Lab. *(For Mechanical Specialization)*	0	0	2	1
ETPE 459	Power System Lab. *(For Electrical Specialization)*				
SEMINAR					
ETPE 461	Seminar	0	0	0	1
SESSIONAL					
ETPE 463	Practical Training at the end of Sixth Semester	0	0	0	3
Total		**16**	**5**	**17**	**28**

L   T   C

ETPE 401   POWER DISTRIBUTION AND UTILISATION   **3   1   4**

POWER DISTRIBUTION

Distribution System Planning:
Load forecasting, Power Quality parameters, Choice of systems for different consumers, Planning Criteria, Standards, System layout.

Distribution Lines / Cables:
Towers/Poles, Stay wires; Conductor - Types, characteristics & selection; Underground Cables - Selection, laying, cable box and jointing; Earth wire; Insulators & hardware fittings; Distributors, Feeders, Services Mains (LV, MV, HV); Clearances; Pole-mounted sub-stations and its location; Earthing HT & LT poles/supports; Selection & fixing of control devices.

Distribution Sub-stations:
Types, General Arrangement, Layout, Bus-bar arrangements; Sub-station equipment – Construction details, selection and specification of equipment (distribution transformer, Circuit Breakers, etc.); Auxiliary Systems; Earthing of sub-station equipment; Basic operational aspects of equipments/systems.

Meters & Metering :
Meters/Indicators – Types & Function; Metering system; Location of meters; Testing & Setting of meters/indicators; Latest development in metering technologies.

Distribution Losses and Efficient Energy Management:
Classification, Causes and Calculation of power losses; Methods of reducing power losses and Anti-theft measures; Causes and cures for breakdowns, tripping and fluctuations in distribution system; System voltage drops and improvements; Distribution transformer failures – causes & remedies; Demand Side Management (DSM), HVDS, Energy efficiency monitoring and corrective measures.

Cost Economics / Commercial Aspects:
Cost Engineering, Costing & Control, Estimation, Estimate for providing service (LT/HT) connections; Tariff structure & types, Rational & Competitive tariff, Energy Accounting, Energy Billing and Revenue realization.

POWER UTILISATION

Electric Heating and Welding:
Electric Heating – Advantages, Methods, Resistance ovens, Induction heating, Dielectric heating, Arc Furnace, Heating of buildings; Electric Welding – Resistance and Arc Welding, Control Devices and Welding Equipment.

Electrolytic Process:
Principle of Electro-deposition, Laws of Electrolysis, Extraction and Refining of Metals, Electro-plating, Factors affecting electro-deposition, Manufacture of chemicals, Application of Electrolysis.

Illumination:
Laws of Illumination, Polar curves, Distribution and Control of light, Lighting calculations, Factory lighting, Flood lighting, Street lighting, Different types of lamps – Incandescent, Fluorescent, Vapour, CFL and their working, Glare and its remedy.

Electric Traction:

Salient features, Comparison with other types of traction systems, Types of electric traction, Systems of track electrification, Speed-Time curves, Tractive effort and specific energy consumption, Co-efficient of Adhesion, Suitability of electric motors for traction service, Conventional and Solid-state control of traction motors, Electric braking, Current collection systems, DC & AC substations, Signaling systems, Diesel electric traction, Train lighting system.

Suggested Text Books / References :

9. Burke James, J., "Power Distribution Engineering: Fundamentals and Applications", Marcel Dekker Inc., 1996.

- Please Turn Over

10. H. Lee Willis, "Power Distribution Planning Reference Book", Marcel Dekker, Inc.
11. Turan Gonen, "Electric Power Distribution Engineering", McGraw Hill.
12. N. K. Jangalwa, "Modern Trends and Practices in Power Sub-Transmission and Distribution Systems", Central Board of Irrigation and Power, Volumes I & II, 1996.
13. A. S. Pabla, "Electric Power Distribution", 5th Edition, Tata McGraw Hill, 1997.
14. A. J. Pansini, "Electrical Distribution Engineering", McGraw Hill.
15. Kersting, W. H., "Distribution System – Modeling and Analysis", CRC Press.
16. H. Cotton," Transmission & Distribution of Electrical Energy",
17. Westinghouse Electric Corporation, " Electrical Transmission & Distribution Reference Book", East Pittsburgh, Pa., 1964.
18. A. J. Pansini, "Guide to Electrical Distribution Design", McGraw Hill.
19. G. Ramamurthy,"Hand Book of Electrical Power Distribution", Orient Longman Pvt. Ltd., Hyderabad.
20. T. W. Berrie, "Electric Economics & Planning", Peter Peregrinus Ltd., London, 1992.
21. S. Rao, "EHV – AC, HVDC Transmission & Distribution Engineering", Khanna Publishers, 2003.
22. C.L.Wadhwa, "Electrical Distribution & Utilisation", New Age Publishing Co.
23. E. O. Taylor, " Utilisation of Electrical Energy", Pitman & Sons.
24. Soni, Gupta & Bhatnagar, "A Course in Electrical Power",
25. J. B. Gupta, "Utilisation of Electric Power and Electric Traction", S. K. Kataria & Sons.

-:oOo:-

B. Tech. in Power Engineering (Mechanical/ Electrical)　　　　　　　　　**VII Semester**

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　L　T　C
ETPE 403　THERMAL POWER PLANT ENGINEERING – RELATED TOPICS - II　　**2　1　3**
　　　　　　　(Performance & Efficiency Calculations,
　　　　　　　　Maintenance Planning and Cost Control)

PERFORMANCE & EFFICIENCY CALCULATIONS

Introduction, Need for performance monitoring, uncontrollable factors, basic requirements. Factors influencing performance of boilers and optimization (Fuel properties, excess air, finess of P.F. etc.).

Performance Monitoring of Boiler Auxiliaries (Pulverisers, factors, sampling of pulverized, coal classifier adjustments, mill rejects, causes and remedies) Air Heaters (effect of AH outlet temperature, performance tests) Fans) Fans (Performance, curves, optimum operating point). Boiler efficiency calculation (Direct method, calculation, limitations in adopting direct method.) Losses method, other standard method.

　　　　Factors influencing performance of turbine (Steam pressure, temperature and back pressure, cylinder efficiency, deposits on turbine blades, blade roughness, effect of loading). Turbine Losses. Factors affecting performance of condenser and feed heater (TTD, CW inlet, temperature, CW flow, heat transfer across tubes) Heaters (air accumulation, steam side/water side fouling drainage, effect of attemperation in reheaters) Heat balancing.

Turbine heat rate calculation: Method, parameters required). Optimization of auxiliary power consumption (scope variable speed drives, operation of un-necessary running auxiliaries).
Logging and recording (Scope of logging and recording, use of DAS/DDC in performance monitoring). Discussion and appraisal.

MAINTENANCE PLANNING AND COST CONTROL

　　　　Aims and objective of maintenance efficient service, high plant availability, maintenance and planning engineer's duties. Integration of maintenance with operational requirements, plant reliability, plant outages and daily work programmes.

Preventive maintenance of running units. Planning of major plant overhauls during shutdowns.

Planning techniques – critical path analysis, charting system etc. Purchasing and stores control – standards cost codes, control of stores and store records.

Cost control, direct costs, indirect costs, outage costs, budgeting and costing work, budgetary control. Contract procedures (conditions of contract, capital applications and procedures, project evaluation, interest and depreciation charges.)

Use of computers in maintenance planning. Group Discussion and practice.

Suggested Text Books / References :

1. A. B. Gill, "Power Plant Performance".
2. NPTI Manual on Performance & Efficiency.
3. NPTI Manual on Maintenance Planning and Cost Control.

-:oOo:-

B. Tech. in Power Engineering (Mechanical/ Electrical)   **VII Semester**

	L	**T**	**C**

ETPE 405   POWER PLANT MAINTENANCE   **3   1   4**

BOILER AND ITS AUXILIARIES

Boiler structure steel work – Importance, Inspection and maintenance aspects, Problems in structure works & hanging arrangements.

BOILER PRESSURE PARTS

Economizer: - Tube size, material, spacing and their alignment; Causes and effects of erosion & corrosion on tubes; Causes for failure of economizer tubes; Inspection for damage of tubes and their repair / replacement methods.

Boiler Drum & Drum internals – Different connections to boiler drum & their Maintenance, Instrumentation tapings, Safety valves and air vents Problems, Causes and Remedies.

Water Wall Tube Arrangement - Tube materials, spacing and connections, Expansion & Sealing of boiler bottom and prevention of dust accumulation in seal chamber, Effect of water, erosion & corrosion on water wall tubes, Inspections of water valve tubes, Causes of tube failures, Repair/Replacement Procedures of punctured / damaged tubes, Procedure for alkali boil out & acid cleaning, preservation & flushing, Hydraulic statics test.

Superheaters - Causes of tube failures, Pattern of tube punctures and their repair / welding / replacement procedures, Different types of welding utilized.

Re-heaters -Inspections of tubes for erosion and corrosion & failures.

BOILER DRAUGHT SYSTEM

Draught Fans – ID Fan, FD Fan, PA Fan and their ducts, Causes of erosion and corrosion, Remedial action, Vibration analysis, Bearing/ coupling Maintenance and Shaft Alignment.

Air Pre-Heater - Seal arrangement settings & replacement, Cold end corrosion in Air heaters, Causes & remedies, Driving Unit and its maintenance.

SCAPH - **Inspection of tubes for erosion and corrosion.**

SOOT BLOWERS MAINTENANCE

PULVERISERS & RAW COAL FEEDERS

Pulverisers -Setting of spring assembly, Fitting of bearings and rollers on journals shaft, Mounting worm gear and shaft, Lubrication system of mills, Setting of classifier vanes, Repair of discharge dampers, Major problems encountered in coal mills & their causes and remedies, Constructional details working and maintenance aspect of driving units and PIV gearbox, Maintenance of coal flow indicators & inlet gate of coal, Maintenance of coal carrying system, i.e. drag link chain / conveyers / rotating blades.

ESP

COAL HANDLING PLANT & ASH HANDLING PLANTS MAINTENANCE - Coal handling machines -their working and maintenance aspects, Bunker & Chutes- Effect of erosion and corrosion due to coal and their rectification, Coal crusher- Maintenance problems and repairs.

TURBINE MAINTENANCE - Pre-checks & dismantling sequence of Turbine Measurement of clearances, Checking the conditions of babbit metal for score pitting, chipping of or lack of bondage between the babbit and the shell, Checking of turbo supervisory instrument for total expansion & differential expansion, Checking of turbine cylinders for cracks/ deformation, Turbine support arrangements, Cleaning inspection and NDT, Centering of shafts, Alignment of rotors of HP, IP & LP rotors w.r.t. generator, Turbine generating system & control valves and governors, Inspection of barring gears, Vibration analysis, Turbine insulation inspection.

TURBINE AUXILIARIES MAINTENANCE - Boiler feed pump, C.W. pump, Feed Heaters- LP & HP Heater, Condensers- Inspection cleaning & repair of tubes, Chemical dozing pumps- reciprocating pumps, Condensate extraction pump, Construction & function of each part and maintenance problems of all equipments, Removal of complete cartridge of boiler feed pump, Inspection of shaft, bearings, seals, glands, balancing arrangements and ever rings, Dismounting & mounting of bearings, Maintenance of Hydraulic coupling, Alignment of pumps, Trouble shooting of pumps.

GENERATOR MAINTENANCE - Stator & Rotor maintenance, Vibration monitoring, Hydrogen leakage, Rotor earth fault detection, Excitation system maintenance.

ELECTRICAL PLANT & AUXILIARY EQUIPMENT MAINTENANCE –
Switchgears, Isolators, Motors, Transformers, Batteries, Cable & earthing, Actuators.

Major Maintenance aspects of Hydro-electric/Gas Power Stations.

Suggested Text Books / References :

1.   Modern Power Station Practice. C.E.G.B. Vol-III.
2.   Operator's hand book - CEGB
3.   NPTI Manual on Power Plant Maintenance.
4.   BHEL Operation & Maintenance Manual.

-:oOo:-

<div align="right">

L   T   C

</div>

ETPE 407   THEORY OF MACHINE   **3   1   4**
            (For Mechanical specialization)

STATIC AND INERTIA FORCE ANALYSIS:

Static force Analysis of reciprocating engine mechanism and quick return mechanism. Effect of friction, kinematically equivalent systems and its application for inertia analysis, Numericals.

BALANCING OF ROTATING COMPONENTS:

Unbalance in one & several planes, Balancing machines, influence coefficient method of balancing, numericals.

TURNING MOMENT DIAGRAM & FLYWHEEL:

Approximate expression, Turning moment diagram, Coefficients of fluctuation of energy & speed, Flywheel (An approximate analysis), Flywheel in punching press, Numericals.

DYNAMOMETERS:

Dynamometers, measurement of power by Prony brake and Rope brake dynamometers, Transmission dynamometer, Hydraulic dynamometer, Numericals.

GYROSCOPIE:

Gyroscopic forces & couple, Thin rod rotating about its centroidal axis, Gyrospic stabilization, Stability of a four & two wheel vehicles, Numericals.

VIBRATION:

Free vibrations of a body with single degree of freedom; transverse vibration of beams with uniform and concentrated loads by Rayleigh method; torsional free Vibrations of two rotor system, three rotor system and geared systems; damped free vibrations with viscous damping; logarithmic decrement; response of damped spring mass system to a harmonic force; whirling of shafts, vibration isolation and vibration of mass supported on foundations subject to vibrations; vibration simulation.

Suggested Text Books / References :

1.   Theory of Mechanism and Machines – A Ghosh & A.K. Malik, Affiliated East-West Press Pvt. Ltd. New Delhi (Unit I, VI, VII).
2.   Mechanism and machine Theory – J.S. Rao & R.V. Dukkipati, Willeyn Eastern Ltd., new Delhi (Unit II, III, IV, V & VIII).
3.   Theory of Machine – Shigley.
4.   Theory of Machine - S.S. Rattan, Tata McGraw Hill Publ., New Delhi.

<div align="center">

-:oOo:-

</div>

		L	T	C

ETPE 409 POWER SYSTEM ANALYSIS & STABILITY   **3   1   4**
        (For Electrical specialization)

POWER SYSTEM ANALYSIS

System Modeling and Formation of Network Matrices:
Modeling of synchronous machine, transformer, transmission line, load; Per-Unit (PU) System and its advantages, Single-Line (or One-Line) diagram, Impedance and reactance diagrams, Bus admittance (Y_{bus}) and impedance (Z_{bus}) matrices and their formation.

Load Flow Analysis:
Load flow problem, Bus classification, Power System Equations, Solution Techniques – Gauss Iterative Method, Gauss-Seidel (G-S) method, Newton – Raphson (N-R) method, Fast Decoupled Load Flow (FDLF) method, Comparison of load flow solution methods.

Economic (Optimal) Operation of Power Systems:
System Constraints, Optimal distribution of load between units within a plant, Distribution of load between plants, Transmission loss equation, Classical Economic Dispatch with losses.

Short Circuit Studies:
Symmetrical Three-Phase Fault Analysis - Short circuit transient on a transmission line, Short circuit of synchronous machines (unloaded & loaded), Fault calculations, Selection of circuit breakers.
Symmetrical Components - Resolution of unbalanced phasors into their symmetrical components, Phase shift of symmetrical components in Y - Δ transformer bank, Power in terms of symmetrical components, Sequence impedances and sequence networks, Sequence impedance of power system elements (Alternator, Transformer and Transmission Line), Positive, Negative and Zero Sequence networks of power system elements.
Unsymmetrical Fault Analysis - Single Line-to-Ground (L-G) faults, Line-to-Line (L-L) faults, Double Line-to-Ground (L-L-G) faults, Open-conductor faults, Unsymmetrical faults on an unloaded alternator, Unsymmetrical faults on a power system, Faults through impedance, Fault current calculations.

POWER SYSTEM STABILITY

Steady State Stability & Transient Stability:
Stability Problem, Rotor dynamics and the Swing Equation, Power angle equation & diagram, Steady State Stability, Transient Stability, Equal area criterion and its applications, Critical clearing angle, Fault clearing time, Step-by-Step solution of swing curve, Factors influencing transient stability, Methods of improving stability.

Suggested Text Books / References :

1. Grainger John, J. and Stevenson Jr., W. D., "Power System Analysis", McGraw Hill,1994.
2. Elgerd, O. I., "Electric Energy Systems Theory : An Introduction", Tata McGraw Hill, 2nd Edn., 1982.
3. Stagg, G. W. and El-Abiad, A. H., " Computer Methods in Power System Analysis", McGraw Hill International Edition.
4. Kundur, P., "Power System Stability and Control", McGraw Hill Inc., 1994.
5. L. K. Kirchmeyer, "Economic Operation of Power Systems", John Wiley & Sons Inc., 1958 (Wiley Eastern Ltd., 1993)
6. Kimbark, E. W., "Power System Stability, Vol.I: Elements of Stability Calculations", John Wiley & Sons, 1948.
7. Westinghouse Electric Corporation, " Electrical Transmission & Distribution Reference Book", East Pittsburgh, Pa., 1964.

8. I. J. Nagrath and D. P. Kothari, "Power System Engineering", Tata McGraw Hill, 1994.
9. Wadhwa, C. L., "Electric Power Systems", Second Edition, Wiley Eastern Ltd., 1985.
10. C.A. Gross, "Power System Analysis", John Wiley & Sons, Inc., 1986.
11. Hadi Saadat, " Power System Analysis", McGraw Hill, 1999.
12. Arillagga, " Computer Methods in Power System Analysis",

-:oOo:-

B. Tech. in Power Engineering (Mechanical/ Electrical)　　　　　　　　**VII th Semester**

	L	**T**	**C**

ETPE 411　MANUFACTURING & INDUSTRIAL ENGINEERING　　　　　**3　1　4**
　　　　　(For Mechanical specialization)

Machining and Machine Tool Operations: Machining processes-turning, drilling, boring, milling, shaping planning, sawing, gear cutting thread production, broaching, grinding, lapping, honing super finishing; mechanics of cutting-Merchant's analysis, geometry of cutting tools, cutting forces, power requirements; selection of process parameters; tool materials, tool wear and tool life, cutting fluids, machinability.

Non-conventional machining processes and hybrid processes: EDM, CHM,ECM, USM, LBM, EBM, AJM, PAM and WJM; economics of machining.

Metrology and Inspection: Limits and fits, linear and angular measurements by mechanical and optical methods, comparators; design of limit gauges; interferometry; measurement of straightness, flatness, roundness, squareness and symmetry, surface finish measurement; inspection of screw threads and gears; alignment testing.

Computer Integrated Manufacturing: Basic concepts of CAD, CAM, and their integration tools.

Work Study: Method study, work measurement, time study, work sampling, job evaluation, merit rating.

Production Planning and Control: Forecasting models, aggregate production planning, master scheduling, materials requirements planning.

Inventory Control: Deterministic and probabilistic models, safety stock inventory control systems.

Operations Research: Linear programming, simplex and duplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

Suggested Text Books / References :

1.　　　Production Technology by Sh. R.K. Jain.
2.　　　Computer Aided production by Sh. Mahapatra
3.　　　Production Management Planning & Inventory Control - Narsimhan.
4.　　　Work Study by – ILO
5.　　　Operation Research : An Introduction by Sh. Taha.

-:oOo:-

B. Tech. in Power Engineering (Mechanical/ Electrical)   **VII Semester**

L	**T**	**C**

ETPE 413   COMMUNICATION ENGINEERING   3   1   4
         (For Electrical specialization)

Introduction

Signals, Functions, Mathematical basis, Fourier Analysis, Power spectral Density, Power System scenario vis-à-vis Communication engineering-its impact, Communication Systems overview.

Modulation System

Analog communication – Need for Modulation, Modulation concept, techniques-AM-Envelop &synchronous detection, DSBSC-generation and demodulation; SSB-generation and detection. Angle Modulation-concept of frequency and phase modulation, frequency deviation and modulation index, FM spectra, Carson's rule, narrowband and broadband FM, generation using Armstrong method, direct FM generation, Demodulation; PLL

Sampling and Discrete Time Modulation

Sampling Theorem, PAM, PWM, PPM.

Review of random signals and noise, SNR, Thermal and shot noise.

Digital Communication

PCM, Quantization Noise, Bandwidth, advantages/disadvantages, DPCM, Delta Modulation, Digital Modulation.

PLCC

Interfacing with power system, Concept and description of typical systems. Case studies

Microwave Communication

Concepts, Line budgets, Satellite links, VSATS, TDMA, CDMA

Optical Communication

Fiber optics basics, Transmitter/receiver, PIN/LASER/LED/APD; Fiber Optic Link, Optical systems-SDH/PDH/DWDM, OPGW

Suggested Text Book and References:

1. Lathi,"Modern Digital and Analog Communication System", Oxford University Press.
2. Keiser, Gerd: "Optical Fiber Communications", 2nd Edition, McGraw Hill(International Student Edition), 1991.
3. Couch, Leon W.: " Modern Communication Systems",Prentice Hall, India, 1998.
4. Haykins, Simon: " Communication Systems", 3rd Edition, John Wiley, Singapore, 1984.

-:oOo:-

L   T   C

ETPE 415   CIVIL WORKS IN POWER ENGINEERING*   **2   0   1**
          (* Non-University Examination Subject)

CIVIL ENGINEERING FUNDAMENTALS:

Surveying: Importance, Types of Survey (Chain Survey, Plane Table Survey, Levelling, Triangulation etc.), Modern Survey Techniques (Total Station, Satellite Imagery, etc.), Surveying & Mapping, Surveying Instrument & Accessories, Field Survey practice.

Soil Mechanics and Soil Investigation: Types of Soil, Properties/Characteristics of Soil, Soil Classification, Objective & Methods of Soil Investigation, Field Testing, Soil Improvement Methods.

Structure: Types of Structures (RCC, Steel, etc.) and their construction, Damp proof course, Cavity walls, Masonry, Floors, Stairs, Roofs, Joineries etc., Sanitary and Water Supply, Electric Supply, Acoustics and Sound Insulation, Finishing, Seismic aspects.

Foundations: Purpose, Bearing capacity, Types of Foundations, Shallow Foundations - Spread (Isolated, Combined, Raft) Foundation and Rock Foundation, Deep Foundations - Pile Foundation and Well Foundation, Seismic aspects.

Construction Materials: Lime, Cement, Brick, Aggregate (Sand, Stone, etc.), Steel, Aluminium, Timber, Admixtures, Flooring Materials, Roofing Materials, Sanitary & Water Supply Materials, Painting / Finishing Materials.

Construction Equipment: Earth-Moving Equipment, Hauling Equipment, Hoisting Equipment, Conveying Equipment, Pneumatic Equipment, Pumping & Dewatering Equipment, Aggregate and Concrete Production Equipment, Pile Driving Equipment, Tunnelling Equipment, Drilling & Blasting Equipment, etc.

CIVIL WORKS IN GENERATING STATIONS:

a) Civil Works in Thermal Power Generating Stations – Reconnaissance Survey, Site selection, FR & DPR approval, Soil Investigation, Levelling, Preparation of Drawings & Layouts, Approach roads and other infrastructures, Layout, Construction of various structures (viz. Main plant including TG foundation, coal Bunkers, EOT Cranes, Workshop Building, Chimneys, CHP and other plants/systems), RCC & Steel structures, Area Development, Office Buildings & Residential Complex including amenities.

b) Civil Works in Hydro-electric Power Generating Stations – Hydrological data collection & study, Survey & Investivation and Preparation of DPR, Suitability of structure as per site condition, Construction of Reservoir, Dam, Diversion Tunnel, Water Conductor System (Intake, Head Race Tunnel, Desilting Basin, Surge Shaft, Pressure Shaft, Penstocks, Valve Chamber), Power House, Tail Race Tunnel.

CIVIL WORKS IN SUB-STATIONS:
    Structure, Surveying, Site Selection, Soil Investigation, Levelling, General Layout Drawing, Switchyard Foundation, Transformer Foundation, Cable Trench Design, Oil Pit, Control Room Building, DG Set Building, Fire Fighting System, Air Conditioning (AC) System, Design & Construction of Roads, Drains, Water Supply Pipe Lines, Fencing / Compound Wall, HVDC Sub-Station.

CIVIL WORKS IN TRANSMISSION SYSTEM:
    Surveying, Route Alignment & Profiling, Right of Way, Tower Spotting, Benching and Soil Classification, Soil Investigation and Soil Resistivity Measurement, Tower Types & Design, Tower Foundation Design & Classification, Special Foundation And River Crossing, Tower Erection, Hardware & Accessories Fitting Procedures, Stringing, Clearances.

CIVIL MAINTENANCE AND SAFETY:

Corrosion, Erosion, Cracks, Ageing, Foundation failure, Structure failure and other failures & problems, Preventive Maintenance, Annual Maintenance, Special repair & maintenance, Safety aspects during maintenance and construction.

Suggested Text Books & References:

1. Dr. B. C. Punmia, "Surveying", Standard Book House.
2. Dr. K. R. Arora, "Soil Mechanics & Foundation Engineering", Standard Publishers Distributors.

- Please

Turn Over

3. Dr. B. C. Punmia, "Soil Mechanics & Foundations", Laxmi Publications Pvt. Ltd.
4. S. Ramamrutham, "RCC and Steel Structures"
5. Jai Krishna & O.P. Jain, "Plain & Reinforced Concrete", Volume-I & II, Nem Chand & Bros., Roorkee,1966.
6. Dr. J. Jha and Prof. S. K. Sinha, "Construction and Foundation Engineering", Khanna Publishers.
7. Illston, J. M., "Construction Materials : Their Nature and Behaviour", E & FN Spon, 1979.
8. Dr. K. R. Arora, "Construction Materials"
9. W. Nunnally, "Construction Methods and Management", Prentice Hall Inc., 1980.
10. Rolt Hannand, "Civil Engineering Plant Hand Book", Oliver & Boyd, London.
11. "Modern Power Station Practice", British Electricity International Ltd., Central Electricity Generating Board, Pergamon Press, Oxford, 1991.
12. P.S. Nigam, "Hand Book on Hydroelectric Engineering", Nem Chand & Bros., Roorkee,1979.
13. J. Guthrie Brown (Editor),"Hydro-electric Engineering Practice", Vol.I Civil Engg., Blakie & Son Ltd. London, or CBS Publishers & Distributors, 1984.
14. R.S. Varshney, "Hydropower Structures (including Micro, Mini and Small Power Stations)", Nem Chand & Bros., Roorkee.
15. Merrit, Rickets, "Standard Hand Book of Civil Engineers", McGraw Hill.
16. Dr. B. C. Punmia and Brij Basi Lal Pande "Irrigation and Water Power Engineering", Standard Publishers Distributors.
17. CBIP Manual on "Layout of Sub-station", Technical Report No.3, 1974, Re-revised in 1996.
18. CBIP Manual on Sub-station,Chapter on "Design of Earthing Mat for HV Sub-station", Publication No.223, 1992, Re-revised in 1996.
19. CBIP Manual on "Transmission Line", Publication No.268, 1998.
20. CBIP Manual on "Design of Towers for Long Span River Crossing" , Publication No.290, 2004.
21. CBIP Manual on "Transmission Line Tower", Technical Report No.9, 1979.
22. Project Reports of Power Stations/Sub-stations/Transmission System.

-:oOo:-

B. Tech. in Power Engineering (Mechanical/ Electrical)   **VII Semester**

		P	C
ETPE 451	ROTATIONAL ON-JOB TRAINING **(MAINTENANCE – STEAM GENERATOR & ITS AUXILIARIES)** **Based on the course ETPE 405**	5	1

		P	C
ETPE 453	ROTATIONAL ON-JOB TRAINING **(MAINTENANCE – STEAM TURBINE & ITS AUXILIARIES)** **Based on the course ETPE 405**	5	1

		P	C
ETPE 455	ROTATIONAL ON-JOB TRAINING **(MAINTENANCE – POWER PLANT ELECTRICAL MACHINES & SYSTEMS)** **Based on the course ETPE 405**	5	1

		P	C
ETPE 457	THEORY OF MACHINE LAB. *(For Mechanical Specialization)* **Based on the course ETPE 407**	2	1

		P	C
ETPE 459	POWER SYSTEM LAB. *(For Electrical Specialization)* **Based on the course ETPE 409**	2	1

		C
ETPE 461	SEMINAR	1

		C
ETPE 463	PRACTICAL TRAINING AT THE END OF SIXTH SEMESTER	3

-:o0o:-

ETPE 402 LOAD DISPATCH AND REGULATORY ISSUES
L T P C
2 1 0 3

Load Dispatch

Overview of power systems communication infrastructure, RTUs, SCADA, PLCC, Communication Systems, Network Protocols.Transfer of Energy in Power Systems, VAR flows, Power System Control, Voltage Control Methods, Load Frequency control-Speed Governing Systems, AGC, frequency limits; Economic load dispatch neglecting losses, Optimum load dispatch including transmission losses, Unit commitment-constraints, spinning reserve, solution methods-Priority list method; Energy management Systems. LDCs-NLDC, SLDC, RLDC etc.

Hydrothermal coordination-LR/SR Scheduling, models, scheduling problems, dynamic programming solution to scheduling problem.

unit commitment

State Estimation- basics, PS state estimation, ML weighted LSE-concepts, examples

Regulatory Issues
Transition to Deregulation- Problems in conventional systems, Blackouts-Analysis Reasons for reforms. Electricity Act 2003-IEA-1910, Electricity Supply Act 1948, Regulatory Commission Act 1998. IEA 2003.Its impact on power Generation, Transmission and Distribution, transmission Open Access, wheeling, power banking concepts. ABT basics, Energy Conservation concepts and DSM basics.

References:
1. Power Generation, Opeartion and Control, Allen J.Wood; Bruce F.Wollenberg; 2nd edition; John Wiley & Sons, 1996. (Only the relevant sections declared in class)
2. Electrical Power Systems 3rd edition, C.L.Waghwa; New Age International Publishers 2000. (Only the relevant sections declared in class)
3. Power System Operation, Robert H.Miller, McGraw Hill Book Co. 1970 (Only the relevant sections declared in class)
4. Class notes, copies of presentation material, and Journal papers.
5. Indian Electricity Act 2003, Universal Law Publishers, 2003

ETPE-404 Environmental Management, Energy Conservation and Energy Audit

L T P C
3 1 0 4

Energy Management And Energy Audit

Energy Scenario, Basics of energy and its various forms., Material and energy balance, Energy action planning, Energy monitoring and targeting. Fuels and combusion, Boilers, FBC boilers, Steam system, Furnaces, Insulation and refractory. Heat exchangers, cogeneration.Electrical Systems, Electric Motors and variable speed drive, Lighting systems, D.G. Set system, Energy efficient technology in electrical systems.Fans and blowers, Pumps and pumping systems, Compressors and compressed air systems.HVAC and refrigeration systems, cooling towers.

Application of Non-conventional and Renewable energy sources, Wastes minimization and Resource Conservation, Waste heat recovery

Environmental Management

Air Pollution

Air Pollution Standards; Effects of Air Pollutants on Materials, Vegetation and Health Origin and Fate of Pollutants (Carbon monoxide, Hazardous Air Pollutants, Lead, Nitrogen Dioxide, Photochemical Oxidants, Sulphur Oxides, Particulates) Acid Rain, Ozone depletion & Greenhouse effect.

Waste Water Treatment

Waste water Microbiology, Characteristics of Waste Water, Municipal and Industrial waste water treatment, Unit operation of Pretreatment, Primary Treatment, Unit processes of Secondary treatment, disinfections, Land treatment, Sludge treatment and disposal.

Solid Waste Management

Waste characteristics, Disposal by Sanitary landfill, thermal conversion; combustion or incineration system, Pyrolysis, Gasification, Pelletization. Waste to Energy, Resource conservation and recovery, Biological processing of Solid wastes.

Hazardous Wastes Management

Characteristics of Hazardous Waste, Management of Hazardous Waste; Chemical. Oxidation, vitrification, Hazardous wastes landfills, Radioactive waste; Detection and analysis, classification and disposal of Radioactive Wastes, Fly ash characteristics and disposal, Site remediation techniques.

Environmental Impact Assessment

Legal Framework, Purpose, EIA methodology; Baseline studies, Prediction of impacts, Evaluation of Impact and Environmental management plan, Environmental Audit.

Suggested Books

1. Energy Management , Murphy WR, Mc Kay G, Butterworth Heinamn 20091
2. Environmental Engg –A Design Approach , Sincereo, Arcadio P, PHI
3. Environmental Engineering, Water Supply, Sanitary Engineering and Pollutuion Kamala A Rao, Tata MC – Graw Hill
4. Environmental Engineering, Dean J, Horward S , Mc Grwa Hill -1985
5. Energy Management handbook, John Weiley and Sones – Wayne C. Turner

ETPE-406   Management Concepts and Techniques

L   T   P   C
2   1   0   3

Introduction to Management
Nature and Process of Management, Development of Management Thought, Managerial Function and Roles, Functional Areas of Management, Nature and Process of Planning, Decision Making, Management by Objectives.

Organising

Nature and Process of Organization, Authority Relationships, Line, Staff, Functional, Delegation and Decentralization, Departmentation, Formal and Informal Organization.

Motivation
Significance and Theories of Motivation, Maslow's Hierarchy Model, Herzberg's Motivation-Hygiene Model,

Leadership

Significance of Leadership and Styles of Leadership.

Communication

Significance of Communication, Concept, Channels, Process and Barriers to Communication, Effective Communication.

Management Control

Nature and Process of Control, Requirements of a Good Control System, Control by Exception.

Change Management

Concepts of Change, Resistance to Change, Management of Change, Changing Environment and Management Challenges.

Recommended Books:

1. B.P.Singh & T.N.Chhabra – "Management Concepts and Practices", Dhanpat Rai and Company
2. Koontz and O'Donnel : "Essentials of Management"
3. Peter F.Drucker, "Management Jobs, Tasks, Responsibilities, Practices", Allied Publishers (P) Ltd., New Delhi, 1978.
4. Stoner. James A.F., "Management", New Delhi, Prentice Hall of India, 1991.
5. Davis, Keith, Newstrom, "Human Behaviour at Work", New Delhi, Tata McGraw Hill Publishing Co. Ltd.,

ETPE-408   Mechanical Vibration (for mechanical specialization)

L   T   P   C
2   1   0   3

Fundamentals of Vibration
Introduction, Definitions, Vector method of representing harmonic motions, complex method of representing harmonic vibrations, work done by a harmonic force on a harmonic motion, Fourier series and harmonic analysis.

Undamped Free vibrations of single degree of freedom systems.
Introduction, Derivation of Differential equation, Solution of differential equation, Tortional Vibrations, Equivalent stiffness of spring combinations (Springs in series, springs in parallel) Energy method.

Damped Free Vibration of Single degree of freedom systems.
Introduction, different types of Dampings, Free vibrations with viscous damping (over-damped system, critically-damped system, under damped system).

Forced vibrations of single Degree of Freedom Systems.
Introduction, Force vibrations with constant harmonic excitation (steady state vibrations), Forced vibrations with rotating and reciprocating unbalance. Forced vibration due to excitation of the support (Absolute amplitude, Relative amplitude) Energy dissipated by damping.

Two Degree of Freedom System
Introduction, Principal Modes of Vibration, Other cases of simple two degrees of freedom systems (Two masses fixed on tightly stretched string).

Critical speed of shafts
Introduction, Critical speed of a light shaft having a single disc without damping. Critical speed of a light shaft having a single Disc with damping (Critical speeds of a shaft having multiple discs.

References:

1.   G.K. Grover   Roorkee Press Roorkee
2.   N.S. V. Kameswara Rao   S. Chand & company Ltd. 7361,
                                     Ram Nagar, New Del;hi-55
3.   R.S. Khurmi   S. Chand & company Ltd., 7361,
                                     Ram Nagar, New Delhi-44.
4.   Dr. Sadhu Singh   Khanna Publication

ETPE   410   DESIGN OF ELECTRICAL MACHINES   L   T   P   C
(for electrical specialization)   2   1   0   3

Introduction

Review of material used in construction of electrical machines. Classification of insulating materials depending upon permissible temperature rise properties of transformer oil. Standard specifications, C.M.R. and short time rating of machines. Heating and cooling characteristics.

Transformer Design

Specific loading, equation for voltage per turn for power and distribution transformers output equation.

Principle of electric and magnetic circuit design method of cooling and cooling circuit design. Estimation of performance characteristics from the design data.

DC Machines

Fundamental of design concepts in D.C.. MACHINES. Main dimension.

Induction Motors

Induction Motor: Main dimensions, output equation, loading constants, estimation of axial lengths, air gap diameter, winding design.

Air gap length, slot combination for stator and rotor of I.M. cage rotor and wound rotor design.

Calculation of no load current and other performance on characteristics for design data.

Synchronous Machine

Air gap length methods of obtaining sinusoidal o/p voltage, field coil design for salient pole machine and for turbo generator rotor, ventilation of syunchronous generator cooling air circuits, closed ventilation/quantity of cooling medium hydrogen and water cooling media.

Reference Books

1. Performance and Design of A.C. machines by M.G. Say

2. Electrical machine Design by A.K. Sawhney, Dhanpatrai and sons, Delhi.

ETPE-412 ENERGY MANAGEMENT (for Mechanical Specialization)

L T P C

3 1 0 4

Enegry An Overview:
Introduction, Primary and Secondary Energy, Commercial Energy and Non commercial Energy, Renewable and Non Renewable energy, Global Primary Energy Reserves, Energy Needs of Growing Economy, Long Term Energy Scenario – India, Energy Pricing in India, Energy Sector Reforms, Energy and Environment, Energy Security, Energy Conservation and its Importance, Energy Strategy for the Future, The Energy Conservation Act, 2001 and its Features.

Basics Of Energy And Its Various Forms:
Definition, Various Forms of Energy, Electrical Energy and Thermal Energy Details, Units and Conversions.

Energy Management And Application:
Definition & Objectives of Energy Management, Principles of Energy Management, Energy Management Skills, Energy Management Strategy, Understanding and Energy Performance, Matching Energy Usage to Requirement, Maximising System Efficiency, Fuel and Energy substitution.

Material And Energy Balance:
Introduction to Material and Energy Balance, The Sankey Diagram and its Use, Method for Preparing Process Flow Chart, Facility as ab Energy System.

Energy Action Planning

Key Elements, Force Field Analysis, Energy Policy, Organizing: Location of Energy Manager, Top Management Support, Energy Manager: Responsibilities and Duties to be Assigned Under The Energy Conservation Act, 2001, Accountability, Motivation of Employees, Requirements for Energy Action Planning, information Systems, Marketing and Communicating, Planning and Training.

Financial Management

Introduction, Investment Need, Appraisal and Criteria, Financial Analysis, Financial Analysis Techniques, Risk and Sensitivity Analysis Factors, Financing Options.

Energy Monitoring And Targeting

Definition, Elements of Monitoring & Targeting system, A Rationale for Monitoring, Targeting and Reporting, Data and Information Analysis, Relating Energy Consumption and Production, CUSUM, Case Study.

REFERENCES:

1. Encyclopaedia of Energy – McGraw Hill Publication
2. Energy Management handbook, John Weiley and Sones – Wayne C. Turner.
3. Guide to Energy Management, Cape Hart, Turner and Kennedy.
4. NPC Energy Audit Manuals
5. General Aspects of Energy management & Energy Audit – BEE Publication.
6. Financial Management , Tata McGraw Hill – Prasanna Chandra.

ETPE 428　　　HVDC TECHNOLOGY　　　　　　　L T　P C

(for electrical specialization)　　　　3　1　0 4

Fundamental design aspects of EHV AC transmission lines and their power carrying capabilities.

EHV AC Transmission lines analysis – nominal and equivalent circuits. Problems related with long lines.

Reactive Power Management of Power System. Reactive power problems associated it EHV systems. Reactive power devices – their operation and control.

Series compensation of EHV AC system, different equipment and scheme details.

Fundamental aspects of HVDC systems and their comparison with EHV AC Systems. Different types of HVDC of HVDC Schemes and their fundamental details.

HVDC Equipment and their rating, construction and characteristics.

Power Converter circ associated with HVDC systems, Design aspects of 12- pulse converters. Simple design problems of HVDC Systems.

Power flow control in HVDC systems – different controllers and their operational characteristics.

Harmonic Filters – HVDC current and voltage filters. Different types of filters. Simple design problems of single tuned harmonic current filters.

Fundamental aspects of HVDC circuit breaking.

Suggested Books

1.　　EHV AC & HVDC Transmission Engineering & practice – By S. Rao.
2.　　EHV AC Transmission - By Begamudre
3.　　HVDC Power Transmission Systems – By K.R. Paadiyar (New Publishers)

Practical /Laboratories at the end of 8th semesters

	L	T	P	C
ETPE 452 ENVIRONMENTAL & ENERGY AUDIT LAB			2	1

	L	T	P	C
ETPE 454 MATLAB			4	1

Project / Viva Voce

	L	T	P	C
ETPE 498 PROJECT / VIVA VOCE			8	8

-:o0o:-