

## BTEE-501 SYNCHRONOUS MACHINES

<b>Internal Marks:</b>	<b>40</b>		<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>60</b>		<b>4</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>100</b>				

**GENERAL ASPECTS:** Construction and working principle of synchronous machines, Excitation systems, production of sinusoidal electromotive force (EMF), flux and magnetomotive force (MMF) phasors in syn. machines; cylindrical and salient pole rotors.

**WINDINGS:** Classification of windings, pitch factor, distribution factor. Electromagnetic Force equation.

**ALTERNATORS:** Construction, Phasor diagram of cylindrical rotor alternator, ratings, nature of armature reaction, determination of synchronous reactance; open-circuit characteristics, short-circuit characteristics, short-circuit ratio, short-circuit loss. Effect of variation of power factor on voltage. Determination of voltage regulation: EMF method, MMF. method. Zero power factor (Z.P.F).method. Alternator on infinite bus bar, operation at constant load and variable excitation, power flow through inductive impedance. Power-angle characteristics of synchronous machines:- cylindrical and salient pole. Two reaction theory of salient pole machines, power factor control.

**SYNCHRONOUS MOTORS:** Operating characteristics, power-angle characteristics, conditions for maximum power developed. V-curves and inverted V-curves, methods of starting, synchronous motors applications, synchronous condensers. Hunting and damper windings.

**PARALLEL OPERATION OF ALTERNATORS:** Conditions for proper synchronizing for single phase and three phase alternators, conditions for parallel operation, synchronizing power, current and torque, effect of increasing excitation of one of the alternators, effect of change of speed of one of the alternators, effect of unequal voltages, load sharing.

**TRANSIENTS:** Transient reactances and time constants from equivalent circuits, synchronous machine reactances and their determination, Short circuit. Oscillogram, Synchronization with the grid system, Qualitative introduction to the transient stability of the synchronous machines.

**SINGLE PHASE SYNCHRONOUS MOTORS:** Reluctance and Hysteresis motors.

### BOOKS RECOMMENDED:

6. Bimbhra P.S., *Electrical Machinery*, Khanna Publishers
7. Fitzgerald A.E., Kingsley C. and Umans S.D., *Electric Machinery*, 6<sup>th</sup> Edition, McGraw Hill
8. Langsdorff E.H., *Principles of D.C. machines*, McGraw Hill
9. Nagrath I.J. and Kothari D.P., *Electrical Machines*, 4<sup>th</sup> Edition, Tata McGraw Hill,
10. Say M G, *Alternating Current Machines*, 5<sup>th</sup> edition, Sir Isaac Pitman and Sons Ltd.

*Note: External question paper shall be set following guidelines to paper setter given at Page 61.*

## BTEE-502 ELECTRIC GENERATION AND ECONOMICS

<b>Internal Marks:</b>	<b>40</b>		<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>60</b>		<b>4</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>100</b>				

**Introduction:** Electrical energy sources, organization of power sector in India, single line diagram of thermal, hydro and nuclear power stations. Classification of power plants in base load and peak load plants

**Loads and Load curves:** Types of load (fixed voltage loads, resistive loads, Inductive motor loads, Mechanical load), effect of load on supply voltage, Maximum demand, Group diversity factor, Peak diversity factor, Types of load, chronological load curves, load-duration Curve, mass curves, load factor, capacity factor, utilization factor, base load and peak load plants, load forecasting.

**Power Plant Economics:** Capital cost of plants, annual fixed cost, operating costs and effect of load factor on cost of energy, depreciation.

**Tariffs and power factor improvement:** Objectives of tariff making, different types of tariff (domestic, commercial, agricultural and industrial loads). Need for power factor (p.f.) improvement, power factor improvement using capacitors, determination of economic power factor.

**Selection of plant:** Plant location, plant size, number and size of units in plants, economic comparison of alternatives based on annual cost, rate of return, present worth and capitalized cost methods.

**Economic operation of steam plants:** Methods of loading turbo-generators, input- output curve, heat rate, incremental cost, method of Lagrangian multiplier, effect of transmission losses, co-ordination equations, and iterative procedure to solve co-ordination equations.

**Hydro-thermal co-ordination:** Advantages of combined working of Run-off River plant and steam plant, reservoir hydro plants and thermal plants, long-term operational aspects, scheduling methods.

**Pollution and environmental problems:** Energy and environment, Air pollution, Aquatic impacts, nuclear plant and hydro plant impacts.

**Cogeneration:** Definition and scope, Topping and Bottoming Cycles, Benefits, cogeneration technologies.

### BOOKS RECOMMENDED:

6. Deshpande M.V., *Power Plant Engineering*, Tata McGraw Hill (2004).
7. EI-Wakit M.M., *Power Plant Engineering*, McGraw Hill, USA
8. Rajput R.K., *Power Plant Engineering*, Luxmi Publications
9. Sharma P.C., *Power Plant Engineering*, Kataria and Sons
10. Skrotzki B.G.A. and Vapot W.A., *Power Station Engineering and Economy*, Tata McGraw-Hill
11. Arora S.C. and Dom Kundwar S., *A course in Power Plant Engineering*, Dhanpat Rai.
12. Nag, P.K., *Power Plant Engineering*, Tata McGraw Hill
13. Gupta B.R., *Generation of Electrical Energy*, S. Chand (1998).
14. Nagrath I.J. and Kothari D.P., *Power System Analysis* Tata McGraw-Hill Publication
15. Chakrabarti A., Soni, M.L. Gupta P.V. and Bhatanagar U.S., *A Textbook on Power System Engineering*, Dhanpat Rai and Co.

*Note: External question paper shall be set following guidelines to paper setter given at Page 61.*

## BTEE-503 MICROPROCESSORS

<b>Internal Marks:</b>	<b>40</b>		<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>60</b>		<b>4</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>100</b>				

**Introduction to Microprocessors:** Types of computers, Microprocessor evolution and types, Central Processing Unit (CPU) operation and terminology, idea of 8-bit, 16-bit, 32-bit and 64-bit Microprocessors from Intel, Motorola and Zilog and their comparisons.

**Introduction to 8-bit Microprocessor:** 8085 Microprocessor architecture, classification of instructions, Instruction format, and overview of the 8085 instruction set.

**Introduction to 16-bit Microprocessor:** 8086 Internal Architecture, Addressing modes, program development steps, 8086 instruction set, Assembler directives, Assembly language, program development tools.

**Programming of 8086:** Simple sequence programs, jumps, flags, conditional Jumps, IF-THEN, IF-THEN-ELSE, Multiple IF-THEN-ELSE, WHILE-DO, REPEAT-UNTIL, Instruction Timing and delay loops, strings, procedures, Macros.

**8086 System Connections, Timing, Troubleshooting:** Pin-diagram, maximum/minimum. modes, timing diagrams, use of logic analyzer to observe Bus signals, troubleshooting a simple 8086 based system

**8086 Interrupts and Applications:** 8086 Interrupts, responses and applications, 8254 software-programmable timer/counter, 8259 a priority Interrupt Controller

**Interfacing of 8086:** Programmable parallel ports and handshake, Interfacing a Microprocessor to Keyboards and alphanumeric displays, Digital to Analog (D/A) converter operation, interfacing and applications, Analog-to Digital (A/D) converter specifications and Interfacing.

### BOOKS RECOMMENDED:

1. Gaonkar, Ramesh S. *Microprocessor Architecture, Programming and Applications with the 8085*, Penram International
2. Ram B, *Fundamentals of Microprocessors and Microcomputers*, Dhanpat Rai and Sons,
3. Hall, Douglas V. *Microprocessors and interfacing: Programming and Hardware*, Tata McGraw Hill
4. Brey, Barry B. *The INTEL Microprocessors 8086/88, 80186, 286, 386, 486, Pentium Pro Processors, Architecture, Programming and Interfacing*, 4<sup>th</sup> Edition, Prentice Hall (India)
5. Ray A.K. and Bhurchandi K.M., *Advanced Microprocessors and Peripherals*, Tata McGraw Hill.

*Note: External question paper shall be set following guidelines to paper setter given at Page 61.*

## BTEE-504 POWER ELECTRONICS

**Internal Marks: 40**  
**External Marks: 60**  
**Total Marks: 100**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

**Thyristors and their characteristics:** Introduction to Thyristor family, V-I characteristics of silicon-controlled rectifier (SCR), gate turn-off thyristor (GTO), Bidirectional diode for alternating current (DIAC) and Bidirectional, Triode for Alternating Current (TRIAC). Principle of operation of silicon-controlled rectifier (SCR). Two transistor analogy. Turn on methods of a thyristor Switching characteristics of thyristors during turn-on and turn-off. Gate characteristics. Firing of thyristors. Gate triggering circuits. Series and parallel operation of silicon-controlled rectifiers (SCR) and their triggering circuits. Thyristor specifications; such as latching current and holding current, critical rate of rise of off-state voltage (dv/dt) and critical rate of rise of on-state current (di/dt) etc. Protection of SCR from over voltage and over current. Snubber circuits. Power dissipation.

**Thyristor commutation techniques:** Self commutation by resonating the load (Class A), Self commutation by LC circuit (class B), Complementary commutation (class C), Auxiliary commutation (class D), External pulse commutation (class E), AC Line commutation (class F).

**Phase controlled techniques:** Introduction to phase angle control. Single phase half wave controlled rectifiers. Single phase half controlled and full controlled bridge rectifiers. Three phase full controlled bridge rectifiers. Effect of resistive, inductive and resistive cum inductive loads. Basic circuit and principle of operation of Dual Converter, circulating current mode and non-circulating current mode of operation. Applications of rectifiers and dual converters to speed control of DC motor drives.

**Choppers:** Introduction of chopper, Basic chopper classification, Basic chopper operations. Control strategies, Chopper configuration, voltage commutated chopper, Current commutated chopper, Load commutated chopper.

**Cycloconverters:** Basic principle of operation, Single phase to. single phase cycloconverter. Three phase half wave cycloconverter. Advantages disadvantages of cycloconverters.

**Inverters:** Introduction & Classification of inverter. Operating principle, Single phase half bridge voltage source inverters, Single phase full bridge inverter. Modified McMurray half-bridge and full-bridge inverter. Three-phase bridge inverter. Voltage control (Pulse-width modulation (PWM) control etc.) and reduction of harmonics in the inverter output voltage. Series inverter.

**Symbols and V-I characteristics** of Silicon Unilateral Switch (SUS), Silicon Controlled Switch (SCS), Silicon Bilateral Switch (SBS), Unijunction Transistor (UJT), Programmable Unijunction Transistor (PUT), Light-activated silicon-controlled rectifier (LASCR), Reverse conducting Thyristors (RCT), Static Induction Thyristor (SITH), N- Metal Oxide Semiconductor Controlled Thyristor (N-MCT), Field Controlled Thyristors (FCT).

### BOOKS RECOMMENDED:

1. Bimbhra, P.S., *Power Electronics*, Khanna Publishers.
2. Singh M.D. and Khanchandani K.B., *Power Electronics*, Tata Mc Graw Hill Publishing company limited.
3. Rashid M.H., *Power Electronics*, Circuits Devices and Applications, Prentice Hall (India)
4. Sen, P.C., *Power Electronics*, Tata McGraw Hill Publishing Company limited.
5. Bhattacharya S.K. and Chatterji, S. *Industrial Electronics and Control*, by New Age international Publications(P) Ltd, New Delhi.

**Note:** External question paper shall be set following guidelines to paper setter given at Page 61.

## BTEE-505 NUMERICAL AND STATISTICAL METHODS

<b>Internal Marks:</b>	<b>40</b>		<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>60</b>		<b>4</b>	<b>1</b>	<b>0</b>
<b>Total Marks:</b>	<b>100</b>				

**Floating-Point Numbers:** Floating-point representation, Rounding, Chopping, Error analysis, Condition and instability.

**Non-Linear Equations:** Bisection, Fixed-point iteration and Newton-Raphson methods, Order of convergence.

**Linear Systems and Eigen-Values:** Gauss-elimination method (using Pivoting strategies) and Gauss-Seidel Iteration method. Rayleigh's power method for Eigen-values and Eigen-vectors

**Interpolation:** Lagrange's formula with error, divided difference, Newton's divided difference formula

**Numerical Integration:** Newton-Cote's quadrature formula (with error) and Gauss-Legendre quadrature formula.

**Differential Equations:** Solution of initial value problem using Taylor Series, Euler's and Runge-Kutta (up to fourth order) methods Statistical Methods

**Random Variables:** Definition, Probability distribution, Distribution functions, probability distribution function (pdf) and cumulative distribution function (cdf), Expectation and Variance.

**Special Probability Distributions:** Binomial, Poisson, Geometric, Uniform, Normal and Exponential distributions.

**Sampling Distributions:** Population and samples, Concept of sampling distributions, Sampling distribution of mean, Chi-square, t and F distributions (pdf only). Tests of Hypotheses: Basic ideas, Important tests based on normal, Chi-square, t and F distribution.

**Curve Fitting:** Method of least squares, Fitting of simple curves using this method, Regression and Correlation: (Two variables case only)

### BOOKS RECOMMENDED:

1. Jain M.K., Iyengar, S.R.K., and Jain R.K., *Numerical Methods for Scientific and Engineering Computation*, New Age International (2008) 5<sup>th</sup> ed.
2. Conte, S.D and Carl D. Boor, *Elementary Numerical Analysis: An Algorithmic approach*, Tata McGraw Hill, New York (2005).
3. Johnson, R., Miller, I. and Friends, J., *Probability and Statistics for Engineers*, Pearson Education(2005) 7<sup>th</sup> ed.
4. Gerald C.F and Wheatley P.O., *Applied Numerical Analysis*, Pearson Education (2008) 7<sup>th</sup> ed.
5. Mathew, J.H., *Numerical Methods for Mathematics, Science and Engineering*, Prentice Hall Inc.J (2002).
6. Meyer, P.L., *Introductory Probability and Statistical Applications*, Oxford (1970) 2<sup>nd</sup> ed.
7. Walpole, Ronald E., Myers, Raymond H., Myers, Sharon L. and, Keying Ye, *Probability and Statistics for Engineers and Scientists*, Pearson Education (2007) 8<sup>th</sup> ed
8. Sastry S.S., *Introductory Methods of Numerical Analysis*, Prentice Hall (India), (2002), 3rd ed.

**Note:** External question paper shall be set following guidelines to paper setter given at Page 61.

## BTEE-506 Laboratory-VII (Electrical Machines-II)

<b>Internal Marks:</b>	<b>30</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>20</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Total Marks:</b>	<b>50</b>			

**Note:** Atleast TEN experiments are to be performed in a semester. list of experiments is given below:

### List of Experiments:

1. To perform load-test on three-phase Induction motor and to plot torque versus speed characteristics.
2. To perform no-load and blocked-rotor tests on three-phase Induction motor to obtain equivalent circuit. Parameters and to draw circle diagram.
3. To study the speed control of three-phase Induction motor by Kramer's Concept.
4. To study the speed control of three-phase Induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor.
5. To study star- delta starters physically and
  - a) to draw electrical connection diagram
  - b) to start the three-phase Induction motor using it.
  - c) to reverse the direction of three-phase Induction motor
6. To start a three-phase slip –ring induction motor by inserting different levels of resistance in the rotor ckt. And to plot torque –speed characteristics.
7. To perform no-load and blocked-rotor test on single-phase Induction motor and to determine the parameters of equivalent ckt. Drawn on the basis of double revolving field theory.
8. To perform load –test on single-phase. Induction motor and plot torque –speed characteristics.
9. To perform no load and short circuit. Test on three-phase alternator and draw open and short circuit characteristics.
10. To find voltage regulation of an alternator by zero power factor (ZPF.) method.
11. To study effect of variation of field current upon the stator current and power factor with synchronous motor running at no load and draw Voltage and inverted Voltage curves of motor.
12. To measure negative sequence and zero sequence reactance of Synchronous Machines.
13. Parallel operation of three phase alternators using
  - Dark lamp method
  - Two-Bright and one dark lamp method
14. To study synchroscope physically and parallel operation of three-phase alternators using synchroscope.
15. Starting of synchronous motors using
  - Auxiliary motor
  - Using Damper windings

## BTEE-507 Laboratory-VIII (Numerical Analysis )

<b>Internal Marks:</b>	<b>30</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>20</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Total Marks:</b>	<b>50</b>			

**Note:** Atleast TEN experiments are to be performed in a semester. list of experiments is given below:

### List of Experiments:

To Develop algorithms/programs in C or C++ or FORTRAN-77/90/95 or MatLab language for the following methods

1. Lagrange's formula with error, divided difference for interpolation,
2. Newton's divided difference method for interpolation and extrapolation.
3. Bisection method for finding a real root of an equation.
4. Newton Raphson method for finding a real root of an equation.
5. Iteration method for finding a real root of an equation.
6. Gauss elimination method for solving simultaneous linear algebraic equations.
7. Gauss Jordan method for solving simultaneous linear algebraic equations.
8. Simpson's 1/3rd rule for numerical integration.
9. Newton's forward interpolation formula.
10. Lagrange's method for interpolation.
11. Euler's method for solving ordinary differential equations.
12. Runge-Kutta (up to fourth order) method for solving ordinary differential equations.
13. Curve fitting (linear and polynomial)

## BTEE-508 Laboratory-IX (Electrical: Estimation and Costing)

<b>Internal Marks:</b>	<b>30</b>		<b>L</b>	<b>T</b>	<b>P</b>
<b>External Marks:</b>	<b>20</b>		<b>0</b>	<b>0</b>	<b>2</b>
<b>Total Marks:</b>	<b>50</b>				

**Note:** Atleast TEN experiments are to be performed in a semester. list of experiments is given below:

### List of Experiments:

1. To study Indian electricity rules
2. To carryout wiring diagram of residential building, Educational institute and Industry. Giving selection of appropriate wiring, list materials and accessories for given project.
3. To study the design consideration of Panel Boards.
4. To study the design consideration of various electrical systems:
  - a. 3 phase four wire distribution systems
  - b. Earthing
5. To estimate the cost of a domestic installation (Residential building, laboratory room or Drawing hall etc) with concept of illumination design. TERI (The Energy Research Institute) recommendations on lighting schemes
6. To estimate the cost of industrial installation (Work shop, agriculture, flour mill etc).
7. To estimate the cost of overhead service connection (Single phase and three phase).
8. To estimate the cost of underground service connection (single phase and three phase).
9. To estimate the cost of overhead, 440 V, 3-phase, 4 wire or 3 wire distribution line.
10. To estimate the cost of underground, distribution line.
11. To estimate the cost of any one electrical appliance.
12. To estimate the cost of repairs and maintenance of any one domestic appliance.
13. To study various types of light sources and lighting schemes.
14. To make wiring diagrams of motor control circuits for starting of
  - a. 3 phase induction motor
  - b. Wound Motor
  - c. Synchronous motor

### RECOMMENDED BOOKS

1. Raina K.B. and Bhattacharya S.K., *Electrical Design, Estimating and Costing*, Tata McGraw Hill, New Delhi
2. Gupta J.B., *A course in Electrical Installation, Estimating and Costing*, SK Kataria and Sons, N.Delhi
3. Sharma B.R. and Rai H.M., *Electrical Estimating and Costing*
4. Uppal S.L., *Electrical Wiring, Estimating and Costing*
5. Singh Surjeet, *Estimating and Costing*, Dhanpat Rai and Co., New Delhi