# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

### YEAR: 2nd SEMESTER-III

| S. No. | COURSE NO | SUBJECT | PERIOD | | | EVALUATION SCHEME | | | | SUBJECT TOTAL | CREDIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SESSIONAL EVALUATION | | | EXAM ESE | | |
| | | | L | T | P | CT | TA | TOTAL | | | |
| **THEORY SUBJECTS** | | | | | | | | | | | |
| 1 | HMA301 | Mathematics III | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 2 | HEE-301 | Basic System Analysis | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 3 | HEE-302 | Electrical Meas.& Measuring Instruments | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 4 | HET-302 | Digital Electronics | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 5 | HET301 | Solid State Devices And Circuit | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| **PRACTICALS** | | | | | | | | | | | |
| 8 | HMA351 | Numerical Techniques Lab | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 9 | HEE-352 | Electrical Measurement Lab | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 2 |
| 10 | HET-353 | Electronics Lab – I | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 11 | HET352 | Digital Electronics Lab | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 12 | HGP-301 | General Proficiency Lab | - | - | - | - | - | 50 | - | 50 | 1 |
| | | **Total** | | | | | | | | **1000** | |

**Note:** Numbers of departmental subjects/labs in any semester may vary as per requirement keeping subject total and credit total unchanged.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

### YEAR: 2nd SEMESTER-IV

| S. No. | COURSE NO | SUBJECT | PERIOD | | | EVALUATION SCHEME | | | | SUBJECT TOTAL | CREDIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SESSIONAL EVALUATION | | | EXAM ESE | | |
| | | | L | T | P | CT | TA | TOTAL | | | |
| **THEORY SUBJECTS** | | | | | | | | | | | |
| 1 | HEE-401 | Electromechanical Energy Conversion-I | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 2 | HEE-402 | Network Analysis and Synthesis | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 3 | HEE-404 | Electrical& Electronics Engineering Materials | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 4 | HEE-403 | Microprocessors | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 5 | HET402 | Electromagnetic Field Theory | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| **PRACTICALS** | | | | | | | | | | | |
| 8 | HEE-451 | Electromechanical Energy Conversion-I Lab | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 9 | HEE-452 | Network Lab | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 10 | HEE-453 | Microprocessor Lab | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 11 | HEE-454 | Electrical Simulation Lab | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 12 | HGP-401 | General Proficiency | - | - | - | | | 50 | - | 50 | 1 |
| | | **Total** | | | | | | | | **1000** | |

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

### YEAR: 3rd SEMESTER-V

| Sl.No. | COURSE NO | SUBJECT | PERIOD | | | EVALUATION SCHEME | | | | SUBJECT TOTAL | CREDIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SESSIONAL EVALUATION | | | EXAM ESE | | |
| | | | L | T | P | CT | TA | TOTAL | | | |
| **THEORY SUBJECTS** | | | | | | | | | | | |
| 1 | HU-501 | Industrial Economics & Principle of Management | 3 | 0 | 0 | 30 | 20 | 50 | 100 | 150 | 3 |
| 2 | EC | Communication Engineering | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 3 | EEE-501 | Electromechanical Energy Conversion-II | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 4 | EEE-502 | Control System | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 5 | EEE-503 | Elements of Power System | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| **PRACTICALS** | | | | | | | | | | | |
| 8 | EEE-551 | Electromechanical Energy Conversion-II Lab | 0 | 0 | 3 | 10 | 10 | 40 | 60 | 100 | 1 |
| 9 | EEE-552 | Control System Lab | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 10 | EC | Communication Engineering Lab | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 11 | GP-501 | General Proficiency | - | - | - | - | - | 50 | 1 | 50 | 1 |
| | | **Total** | | | | | | | | **1000** | **26** |

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

## YEAR: 3rd SEMESTER-VI

| Sl.No. | COURSE NO | SUBJECT | PERIOD | | | EVALUATION SCHEME | | | | SUBJECT TOTAL | CREDIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SESSIONAL EVALUATION | | | EXAM ESE | | |
| | | | L | T | P | CT | TA | TOTAL | | | |
| **THEORY SUBJECTS** | | | | | | | | | | | |
| 1 | EEE-601 | Power System Analysis | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 2 | EEE - 602 | Conventional & Computer Aided Design of Electrical Machines | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 3 | EEE- 603 | Power Electronics | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 4 | EEE - 604 | Power Station Practice | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 5 | CS | Objected Oriented System & $C^{++}$ | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| **PRACTICALS/ SEMINAR** | | | | | | | | | | | |
| 8 | EEE-651 | Power Electronics Lab | 0 | 0 | 3 | 10 | 10 | 20 | 30 | 50 | 2 |
| 9 | CS | Objected Oriented System Lab | 0 | 0 | 2 | 10 | 10 | 20 | 30 | 50 | 1 |
| 10 | EEE - 652 | Electrical Machine Design Lab | 0 | 0 | 3 | 10 | 10 | 20 | 30 | 50 | 2 |
| 10 | EEE-653 | Seminar | 0 | 0 | 2 | - | - | 50 | - | 50 | 2 |
| 11 | GP-601 | General Proficiency | - | - | - | - | - | 50 | - | 50 | |
| | | **Total** | | | | | | | | **1000** | |

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

### YEAR: 4th SEMESTER-VII

| Sl.No. | COURSE NO | SUBJECT | PERIOD | | | EVALUATION SCHEME | | | | SUBJECT TOTAL | CREDIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SESSIONAL EVALUATION | | | EXAM ESE | | |
| | | | L | T | P | CT | TA | TOTAL | | | |
| **THEORY SUBJECTS** | | | | | | | | | | | |
| 1 | EOE - I | Open Elective-I | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 2 | EDE- I | Departmental Elective-I | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 3 | EEE - 701 | Switch Gear & Protection | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 4 | EEE-702 | Electric Drives | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 5 | EEE-703 | Power System Operation & Control | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| **PRACTICALS** | | | | | | | | | | | |
| 7 | EEE-751 | Power System Lab | 0 | 0 | 3 | 10 | 10 | 20 | 30 | 50 | 1 |
| 8 | EEE-752 | Electric Drives Lab | 0 | 0 | 3 | 10 | 10 | 20 | 30 | 50 | 1 |
| 9 | EEE-753 | Project | 0 | 0 | 3 | - | 50 | 50 | - | 50 | 2 |
| 10 | EEE-754 | Industrial Training Viva voice | 0 | 0 | 2 | - | - | 50 | - | 50 | 1 |
| 11 | GP-701 | General Proficiency | - | - | - | - | - | 50 | - | 50 | 1 |
| | | **Total** | | | | | | | | **1000** | |

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

### YEAR: 4th SEMESTER-VIII

| Sl.No. | COURSE NO | SUBJECT | PERIOD | | | EVALUATION SCHEME | | | | SUBJECT TOTAL | CREDIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SESSIONAL EVALUATION | | | EXAM ESE | | |
| | | | L | T | P | CT | TA | TOTAL | | | |
| **THEORY SUBJECTS** | | | | | | | | | | | |
| 1 | EEE - 801 | Instrumentation and Process Control | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 2 | EEE-802 | Utilization of Electrical Energy & Traction | 3 | 0 | 0 | 30 | 20 | 50 | 100 | 150 | 3 |
| 3 | EDE- II | Departmental Elective-III | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| 4 | EDE- III | Departmental Elective-III | 3 | 1 | 0 | 30 | 20 | 50 | 100 | 150 | 4 |
| **PROJECT/LAB/ SEMINAR** | | | | | | | | | | | |
| 6 | EEE -851 | Electrical Instrumentation Lab | 0 | 0 | 3 | 10 | 10 | 20 | 30 | 50 | 1 |
| 7 | EEE - 852 | Seminar/Comprehensive Viva | 0 | 0 | 2 | - | - | 50 | - | 50 | 1 |
| 8 | EEE - 853 | Project | 0 | 0 | 12 | - | 100 | 100 | 150 | 250 | 8 |
| 9 | GP-801 | General Proficiency | - | - | - | - | - | 50 | - | 50 | 1 |
| | | **Total** | | | | | | | | **1000** | |

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

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# DEPARTMENTAL ELECTIVES

**DEPARTMENTAL ELECTIVE – I**

| Course No. | Subject |
|---|---|
| EDE- I | Advanced Control System |

**ELECTIVE – II**

| Course No. | Subject |
|---|---|
| EDE- II | EHV AC & DC Transmission |

**ELECTIVE – III**

| Course No. | Subject |
|---|---|
| EDE- III | Neural Networks and fuzzy System |

**OPEN ELECTIVE-I**

| Course No. | Subject |
|---|---|
| EOE- I | Non Conventional Energy Resources |

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

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## EEE 101/EEE 201 : ELECTRICAL ENGINEERING

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**Unit I**

1. **DC Circuit Analysis and Network Theorems:**

**Circuit Concepts: Concepts of Network, Active and Passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements. R L and C as linear elements. Source Transformation.**
**Kirchhoff's Law; loop and nodal methods of analysis; star – delta transformation; Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem. (Simple Numerical Problems) 9**

**Unit II**

2. **Steady – State Analysis of Single Phase AC Circuits:**

**AC Fundamentals: Sinusoidal, Square and Triangular waveforms – average and effective values, form and peak factors, concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of series, parallel, and series – parallel RLC Circuits: Apparent, Active & Reactive Powers, Power factor, causes and problems of low power factor, power factor improvement. Resonance in Series and Parallel Circuits, Bandwidth and Quality Factor. (Simple Numerical Problems) 8**

**Unit III**

3. **Three Phase AC Circuits:**

**Three Phase System – its necessity and advantages, meaning of phase sequence and star and delta connections, balanced supply and balanced load, line and phase voltage / current relations, three phase power and its measurement. (Simple Numerical Problems) 3**

4. **Measuring Instruments:**

**Types of instruments: Construction and Working Principles of PMMC and Moving Iron type Voltmeter & Ammeters, Single Phase Dynamometer Wattmeter and Induction Type Energy Meter, use of Shunts and Multipliers. (Simple Numerical Problems on Energy Meter, Shunts and Multipliers) 4**

**Unit IV**

5. **Introduction To Power System:**

**General layout of Electrical Power system and functions of its elements, standard transmission and distribution voltages, concept of grid. 2**

6. **Magnetic Circuit:**

**Magnetic circuit concepts, analogy between Electric & Magnetic circuits, Magnetic circuits with DC and AC excitations, Magnetic leakage. B-H curve, Hysteresis and Eddy Current looses, Magnetic circuit calculations mutual Coupling. 3**

7. **Single Phase Transformer:**

**Principle of Operation, Construction, e.m.f. equation, equivalent circuit, Power losses, efficiency, introduction to auto transformer. (Simple Numerical Problems) 3**

**Unit V**

8. **Electrical Machines:**

**Principles of electro mechanical energy conversion.**

9. **DC Machines**

**Types of dc machines, e.m.f. equation of generator and torque equation of motor, characteristics and applications of dc motors. (Simple Numerical Problems)**

10. **Three Phase Induction Motor**

**Types, Principle of Operation, Slip – torque Characteristics, applications. (Simple Numerical Problems)**

11. **Single Phase Induction Motor**

**Principle of Operation and introduction to methods of starting, applications.**

12. **Three Phase Synchronous Machines**

**Principle of Operation of alternator and synchronous motor and their applications. 8**

**Text Books:**

1. **V. Del Toro, " Principles of Electrical Engineering" Prentice Hall International**
2. **I.J. Nagarath, " Basic Electrical Engineering" Tata Mc - Graw Hill**
3. **D.E. Fitzgerald & A. Grabel Higginbotham, "Basic Electrical Engineering" Mc - Graw Hill**

**Reference Books:**

1. **Edward Hughes, "Electrical Technology" Longman**
2. **T.K. Nagsarkar & M.S. Sukhija, "Basic Electrical Engineering" Oxford University Press**
3. **H. Cotton, " Advanced Electrical Technology" Wheeler Publishing**

4. W.H. Hayt & J.E. Kennely, "Engineering Circuit Analysis" Mc - Graw Hill

## EEE 151/ EEE 251: ELECTRICAL ENGINEERING LABORATORY

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|---|---|---|
| 0 | 0 | 2 |

**Note: A Minimum Ten experiments out of the following list.**

1. Verification of Kirchhoff's laws.
2. Verification of (1) Superposition Theorem (2) Thevenin's Theorem (3) Maximum Power Transfer Theorem.
3. Measurement of power and power factor in a 1 – Ø ac series inductive circuit and study improvement of power factor using capacitor.
4. Study of phenomenon of resonance in RLC series circuit and obtain the resonant frequency.
5. Measurement of power in 3 – Ø circuit by Two Wattmeter method and determination of its power factor.
6. Determination of parameter of ac 1 – Ø series RLC Circuit.
7. Determination of (1) Voltage Ratio (2) Polarity and (3) Efficiency by load test of a 1 – Ø Transformer.
8. To Study speed control of dc shunt motor using (1) Armature Voltage Control (2) Field Flux Control.
9. Determination of Efficiency of a dc shunt motor by load test.
10. To study running and speed reversal of a 3 – Ø induction motor and record its speed in both direction.
11. To measure energy by a 1 – Ø energy meter and determine error.
12. Department may add any three experiments in the above list.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

## EEE-301: BASIC SYSTEM ANALYSIS

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**UNIT I**

**Introduction to continuous time signals and systems:** Basic continuous time signals, unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics. Introduction to various types of systems.

**Analogous System:** Linear mechanical elements, force-voltage and force-current analogy, modeling of mechanical and electro-mechanical systems: Analysis of first and second order linear systems by classical method. **(9)**

**UNIT II**

**Fourier Transform Analysis :** Exponential form and Trigonometric form of Fourier series, Fourier symmetry, Fourier Integral and Fourier Transform. Transform of common functions and periodic wave forms: Applications of Fourier Transform to network analysis. **(8)**

**UNIT III**

**Laplace Transform Analysis :** Review of Laplace Transform , Laplace Transform of periodic functions, Initial and Final Value Theorems, Inverse Laplace Transform , Convolution Theorem, Superposition Integral , Application of Laplace Transform to analysis of networks, waveform synthesis and Laplace Transform of complex waveforms. **(8)**

**UNIT IV**

**State – Variable analysis :** Introduction, State Space representation of linear systems, Transfer Function and state Variables , State Transition Matrix, Solution of state equations for homogeneous and non-homogeneous systems , Applications of State-Variable technique to the analysis of linear systems **(8)**

**UNIT V**

**Z-Transform Analysis :** Concept of Z-Transform, Z-Transform of common functions, Inverse Z-Transform, Initial and Final Value theorems , Applications to solution of difference equations, Pulse Transfer Function. **(7)**

**Text Books:**


1. David K.Cheng; “Analysis of Linear System”, Narosa Publishing Co.
2. ME Van-Valkenberg; “ Network Analysis”, Prentice Hall of India
3. C.L.Wadhwa, “Network Analysis and Synthesis”, New Age International Publishers,2007.
4. Samarajit Ghosh, “Network Theory: Analysis and Synthesis” Prentice Hall of India, 2008


**Reference Books:**


5. Choudhary D.Roy, “Network & Systems”, Wiley Eastern Ltd.
6. Donald E.Scott, “Introduction to circuit Analysis” Mc. Graw Hill
7. B.P. Lathi, “Linear Systems & Signals” Oxford University Press, 2008.
8. I.J. Nagrath, S.N. Saran, R. Ranjan and S.Kumar, “Singnals and Systems, “Tata Mc. Graw Hill, 2001.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

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### EEE-302: ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS

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**3 1 0**

**UNIT I:–**

**(1) Philosophy Of Measurement:** Methods of Measurement, Measurement System**,** Classification of instrument system, Characteristics of instruments & measurement system**,** Errors in measurement & its analysis, Standards. **(3)**

**(2) Analog Measurement of Electrical Quantities :** Electrodynamic ,Thermocouple, Electrostatic & Rectifier type Ammeters & Voltmeters , Electrodynamic Wattmeter, Three Phase Wattmeter, Power in three phase system , errors & remedies in wattmeter and energy meter. **(5)**

**UNIT II:**

Instrument Transformer and their applications in the extension of instrument range, Introduction to measurement of speed , frequency and power factor. **(6)**

**UNIT III:**

**Measurement of Parameters:** Different methods of measuring low, medium and high resistances**,** measurement of inductance & capacitance with the help of AC Bridges, Q Meter. **(7)**

**UNIT IV:**

**(1) AC Potentiometer:** Polar type & Co-ordinate type AC potentiometers , application of AC Potentiometers in electrical measurement **(3)**

**(2) Magnetic Measurement:** Ballistic Galvanometer , **f**lux meter **,** determination of hysteresis loop, measurement of iron losses**.** **(4)**

**UNIT V:**

**(1) Digital Measurement of Electrical Quantities:** Concept of digital measurement, block diagram Study of digital voltmeter, frequency meter Power Analyzer and Harmonics Analyzer; Electronic Multimeter.

**(2)Cathode Ray Oscilloscope :** Basic CRO circuit (Block Diagram),Cathode ray tube (CRT) & its components **,** **a**pplication of CRO in measurement ,Lissajous Pattern.; Dual Trace & Dual Beam Oscilloscopes. **(3)**

**Text Book:**


1. E.W. Golding & F.C. Widdis, “Electrical Measurement &Measuring Instrument”, A.W. Wheeler& Co. Pvt. Ltd. India.
2. A.K. Sawhney,“Electrical & Electronic Measurement & Instrument”, Dhanpat Rai & Sons , India .


**Reference Books:**


3. Forest K. Harries,“Electrical Measurement”,Willey Eastern Pvt. Ltd. India .
4. M.B. Stout ,“Basic Electrical Measurement” Prentice hall of India,India.
5. W.D.Cooper,” Electronic Instrument & Measurement Technique “ Prentice Hall International.
6. Rajendra Prashad ,“Electrical Measurement &Measuring Instrument” Khanna Publisher.
7. J.B. Gupta, “Electrical Measurements and Measuring Instruments”, S.K. Kataria & Sons.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

### EEE-351: NUMERICAL TECHNIQUE LAB

**L T P**
**0 0 2**

Note: Minimum seven experiments out of the following list:

**MATLAB Based Experiments**

1. Solution of linear equations for under damped and over damped cases.
2. Determination of eigen values and eigenvectors of a square matrix.
3. Determination of roots of a polynomial.
4. Determination of polynomial using method of least square curve fitting.
5. Determination of polynomial fit, analyzing residuals, exponential fit and error bounds from the given data.
6. Solution of differential equations using $4^{th}$ order Runge-Kutta method.
7. Solution of differential equation using revised Euler method.
8. Solution of difference equations.
9. Determination of time response of an R-L-C circuit.
10. Department may add any three experiments in the above list.

**Text/Reference Books:**

**1.** Almos Gilat, "MATLAB: An Introduction with Applications" Wiley India Ltd., 2004.

### EEE-352: ELECTRICAL MEASUREMENT LAB

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

**Note: Minimum of nine experiments from the following:**

1. Calibration of ac voltmeter and ac ammeter
2. Measurement of form factor of a rectified sine wave and determine source of error if r.m.s.value is measured by a multi-meter
3. Measurement of phase difference and frequency of a sinusoidal ac voltage using C.R.O.
4. Measurement of power and power factor of a single phase inductive load and to study effect of capacitance connected across the load on the power factor
5. Measurement of low resistance by Kelvin's double bridge
6. Measurement of voltage, current and resistance using dc potentiometer
7. Measurement of inductance by Maxwell's bridge
8. Measurement of inductance by Hay's bridge
9. Measurement of inductance by Anderson's bridge
10. Measurement of capacitance by Owen's bridge
11. Measurement of capacitance by De Sauty bridge
12. Measurement of capacitance by Schering bridge
13. Study of Frequency and differential time counter
14. Department may add any two experiments in the above list

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## B-Tech. Electrical Engineering

### EEE – 401: ELECTRO-MECHANICAL ENERGY CONVERSION –I

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**Unit – I**

**Principles of Electro-mechanical Energy Conversion -** Introduction, Flow of Energy in Electromechanical Devices, Energy in magnetic systems(defining energy & Co-energy) , Singly Excited Systems; determination of mechanical force, mechanical energy, torque equation , Doubly excited Systems; Energy stored in magnetic field, electromagnetic torque , Generated emf in machines; torque in machines with cylindrical air gap . (7)

**Unit – 2**

**D.C. Machines:-** Construction of DC Machines, Armature winding, Emf and torque equation , Armature Reaction ,Commutation , Interpoles and Compensating Windings, Performance Characteristics of D.C. generators. (9)

**Unit –3**

**D.C. Machines (Contd.):-** Performance Characteristics of D.C. motors ,Starting of D.C. motors ; 3 point and 4 point starters , Speed control of D.C. motors: Field Control , armature control and Voltage Control (Ward Lenonard method); Efficiency and Testing of D.C. machines (Hopkinson's and Swinburn's Test). (8)

**Unit –4**.

**Single Phase Transformer:** Phasor diagram, efficiency and voltage regulation, all day efficiency.

**Testing of Transformers:** O.C. and S.C. tests, Sumpner;s test, polarity test.

**Auto Transformer:** Single phase and three phase auto transformers, volt-amp, relation, efficiency, merits & demerits and applications.

**Unit –5**

**Three Phase Transformers:** Construction, three phase transformer phasor groups and their connections, open delta connection, three phase to 2 phase, 6 phase or 12 phase connections, and their applications, parallel operation and load sharing of single phase and three phase transformers, excitation phenomenon and harmonics in transformers, three winding transformers.

**Text Books:**


1 I.J. Nagrath & D.P.Kothari," Electrical Machines", Tata McGraw Hill

2 Husain Ashfaq ," Electrical Machines", Dhanpat Rai & Sons

3 A.E. Fitggerald, C.Kingsley Jr and Umans,"Electric Machinery" 6th Edition McGraw Hill, International Student Edition.

4 B.R. Gupta & Vandana Singhal, "Fundamentals of Electrical Machines, New Age International.


**Reference Books:**


5 Irving L.Kosow, "Electric Machine and Tranformers", Prentice Hall of India.

6 M.G. Say, "The Performance and Design of AC machines", Pit man & Sons.

7 Bhag S. Guru and Huseyin R. Hizirogulu, "Electric Machinery and Transformers" Oxford University Press, 2001.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

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**EEE- 402: NETWORK ANALYSIS AND SYNTHESIS**

**L T P**
**3 1 0**

**Unit – I:**

**Graph Theory** : Graph of a Network, definitions, tree, co tree , link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix Duality, Loop and Nodal methods of analysis. (7)

**Unit – II:**

**Network Theorems (Applications to ac networks):** Super-position theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Reciprocity theorem. Millman's theorem, compensation theorem, Tellegen's theorem. (8)

**Unit – III :**

**Network Functions :**

Concept of Complex frequency , Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot. (8)

**Unit – IV :**

**Two Port Networks**:

Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, Ladder and Lattice networks. T & ∏ Representation. (8)

**Unit – V :**

**(a) Network Synthesis :**

Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms.

**(b) Filters:**

Image parameters and characteristics impedance, passive and active filter fundamentals, low pass, highpass, (constant K type) filters, and introduction to active filters. (9)

**Text Books:**


1 M.E. Van Valkenburg, "Network Analysis", Prentice Hall of India
2 A.Chakrabarti, "Circuit Theory" Dhanpat Rai & Co.
3 C.L Wadhwa, "Network Analysis and Synthesis" New Age International Publishers, 2007.
4 D.Roy Choudhary, "Networks and Systems" Wiley Eastern Ltd.
5 Donald E. Scott: "An Introduction to Circuit analysis: A System Approach" McGraw Hill


**Reference Books:**


6 M.E. Van Valkenburg, "An Introduction to Modern Network Synthesis",Wiley Eastern Ltd.
7 N.C. Jagan and C. Lakshminarayana, "Newwork Analysis" B.S. Publications, 2008.
8 K.S. Suresh Kumar, "Electric Circuits and Networks" Pearson Education, 2009.
A Ramakalyan, "Linear Circuits: Analysis and Synthesis" Oxford University Press, 2005

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

**EEE-403: ELECTRICAL & ELECTRONICS ENGINEERING MATERIALS**

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**UNIT – I**

**1 Crystal Structure of Materials:**

**A.** Bonds in solids, crystal structure, co-ordination number, atomic packing factor, Miller Indices, Bragg's law and x-ray diffraction, structural Imperfections, crystal growth

**B.** Energy bands in solids, classification of materials using energy band. (6)

**UNIT – II**

**2 Conductivity of Metals:**

Electron theory of metals, factors affecting electrical resistance of materials, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect, superconductivity and super conducting materials, Properties and applications of electrical conducting and insulating materials, mechanical properties of metals (7)

**UNIT – III**

**3 Mechanism of Conduction in semiconductor materials:**

Types of semiconductors, current carriers in semiconductors, Half effect, Drift and Diffusion currents, continuity equation, P-N junction diode, junction transistor, FET & IGFET, properties of semi-conducting materials. (6)

**UNIT – IV**

**4 Magnetic Properties of Material:**

Origin of permanent magnetic dipoles in matters, Classification Diamagnetism, Paramagnetism, Ferromagnetism,AntiferromagnetismandFerrimagnetism, magnetostriction, properties of magnetic materials, soft and hard magnetic materials, permanent magnetic materials. (7)

**Text Books :**


1 A.J. Dekker,"Electrical Engineering Materials" Prentice Hall of India

2 R.K. Rajput," Electrical Engg. Materials," Laxmi Publications.

3 C.S. Indulkar & S.Triruvagdan "An Introduction to Electrical Engg. Materials, S.Chand & Co.


**References :**


4 Solymar, "Electrical Properties of Materials" Oxford University Press.

5. Ian P. Hones," Material Science for Electrical and Electronic Engineering," Oxford University Press.

8 G.P. Chhalotra & B.K. Bhat, "Electrical Engineering Materials" Khanna Publishers.

9 T. K. Basak, "Electrical Engineering Materials" New age International.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

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### EEE-404: MICROPROCESSORS

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**3 1 0**

**UNIT-I:**

**Introduction to Digital Computer and Microprocessor:**

**Digital Computers:** General architecture and brief description of elements, instruction execution, instruction format, and instruction set, addressing modes, programming system, higher lever languages.

**Buses and CPU Timings:** Bus size and signals, machine cycle timing diagram, instruction timing, processor timing.

**Microprocessor and Microprocessor Development Systems:** Evolution of Microprocessor, Microprocessor architecture and its operations, memory, inputs-outputs (I/Os), data transfer schemes interfacing devices, architecture advancements of microprocessors, typical microprocessor development system.

**UNIT-II:**

**8-bit Microprocessors.**

**8085 microprocessor:** pin configuration, internal architecture.

Timing & Signals: control and status, interrupt: ALU, machine cycles,

**Instruction Set of 8085:**

**Addressing Modes:** Register addressing, direct addressing; register indirect addressing, immediate addressing, and implicit addressing.

Instruction format, op-codes, mnemonics, no. of bytes, RTL, variants, no. of machine cycles and T states, addressing modes.

**Instruction Classification:** Data transfer, arithmetic operations, logical operations, branching operation, machine control; Writing assembly Language programs, Assember directives.

**UNIT-III:**

**16-bit Microprocessors:**

**Architecture:**

Architecture of INTEL 8086 (Bus Interface Unit, Execution unit), register organization, memory addressing, memory segmentation,

Operating Modes

**Instruction Set of 8086**

Addressing Modes**:** Instruction format:

Discussion on instruction Set: Groups: data transfer, arithmetic , logic string, branch control transfer, processor control.

**Interrupts:** Hardware and software interrupts, responses and types.

**UNIT-IV**

**Fundamental of Programming:** development of algorithms, flowcharts in terms of structures,(series, parallel, if-then-else etc.)

**Assembler Level Programming:** memory space allocation (mother board and user program)

Assembler level programs (ASMs)

**UNIT-IV**

**Peripheral Interfacing:**
I/O programming: Programmed I/O, Interrupt Driven I/O, DMA I/O interface: serial and parallel communication, memory I/O mapped I/Os. Peripheral Devices: 8237 DMA controller, 8255-Programmable peripheral interface, 8253/8254 Programmable timer/counter.
8259 programmable Interrupt Controller.

**Text Books:**

1. Gaonkar, Ramesh S, "Microprocessor Architecture, programming and applications with the 8085" Pen ram International Publishing 5th Ed.
2. Uffenbeck, John, "Microcomputers and Microprocessors" PHI/ 3rd Edition.
3. Ray, A.K. & Burchandi, K.M., "Advanced Microprocessors and Peripherals: Architecture, Programaming and Interfacing" Tata Mc. Graw Hill.
4. Krishna Kant, "Microprocessors and Microcontrollers" PHI Learning.

**Reference Books:**

5. Brey, Barry B. "INTEL Microprocessors" Prentice Hall ( India)
6. ADitya P Mathur, "Introduction to Microprocessor" Tata Mc Graw Hill
7. M. Rafiquzzaman, "Microprocessors- Theory and applications" PHI
8. B. Ram, "Advanced Microprocessor & Interfacing" Tata McGraw Hill
9. Renu Singh & B.P.Singh, "Microprocessor and Interfacing and applications" New Age International
10. Hall D.V., "Microprocessors Interfacing" Tata Mc Graw Hill
11. Liu and Gibson G.A., "Microcomputer Systems: The 8086/8088 Family" Prentice Hall (India)

**EEE-451: ELECTROMECHANICAL ENERGY CONVERSION- I LAB**

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**Note : Minimum eight experiments are to be performed from the following list :**

1 To obtain magnetization characteristics of a d.c. shunt generator
2 To obtain load characteristics of a d.c. shunt generator and compound generator (a) Cumulatively compounded (b) Differentially compounded
3 To obtain efficiency of a dc shunt machine using Swinburn's test
4 To perform Hopkinson's test and determine losses and efficiency of DC machine
5 To obtain speed-torque characteristics of a dc shunt motor
6 To obtain speed control of dc shunt motor using (a) armature resistance control (b) field control
7 To obtain speed control of dc separately excited motor using Conventional Ward-Leonard/ Static Ward –Leonard method.
8 To study polarity and ratio test of single phase and 3-phase transformers
9 To obtain equivalent circuit, efficiency and voltage regulation of a single phase transformer using C.C. and S.C. tests.
10 To obtain efficiency and voltage regulation of a single phase transformer by Sumpner's test.

11. To obtain 3-phase to 2-phase conversion by Scott connection.
12. To determine excitation phenomenon (B.H. loop) of single phase transformer using C.R.O

**EEE-452: NETWORK LABORATORY**

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**Note: Minimum eight experiments are to be performed from the following list.**

1. Verification of principle of superposition with dc and ac sources.
2. Verification of Thevenin, Norton and Maximum power transfer theorems in ac circuits
3. Verification of Tellegin's theorem for two networks of the same topology
4. Determination of transient response of current in RL and RC circuits with step voltage input
5. Determination of transient response of current in RLC circuit with step voltage input for underdamp, critically damp and overdamp cases
6. Determination of frequency response of current in RLC circuit with sinusoidal ac input
7. Determination of z and h parameters (dc only) for a network and computation of Y and ABCD parameters
8. Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values
9. Determination of image impedance and characteristic impedance of T and ∏ networks, using O.C. and S.C. tests Write Demo for the following (in Ms-Power point)
10. Verification of parameter properties in inter-connected two port networks : series, parallel and cascade also study loading effect in cascade.
11. Determination of frequency response of a Twin – T notch filter.
12. To determine attenuation characteristics of a low pass / high pass active filters.

**EEE-454: ELECTRICAL SIMULATION LAB**

**(List of Experiments (PSPICE based)**

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**Note: Select any 10 out of the following:**

1. Study of various commands of PSPICE.
2. To determine node voltages and branch currents in a resistive network.
3. To obtain Thevenin's equivalent circuit of a resistive network.
4. To obtain transient response of a series R-L-C circuit for step voltage input.
5. To obtain transient response of a parallel R-L-C circuit for step current input.
6. To obtain transient response of a series R-L-C circuit for alternating square voltage waveform.
7. To obtain frequency response of a series R-L-C circuit for sinusoidal voltage input.
8. To determine line and load currents in a three phase delta circuit connected to a 3-phase balanced ac supply.

9. To plot magnitude, phase and step response of a network function.
10. To determine z,y,g,h and transmission parameters of a two part network.

11. To obtain transient response of output voltage in a single phase half wave rectifier circuit using capacitance filter.
12. To obtain output characteristics of CE NPN transistor.
13. To obtain frequency response of a R-C coupled CE amplifier.
14. To obtain frequency response of an op-Amp integrator circuit.
15. To verify truth tables of NOT, ANDor OR gates implemented by NAND gates by plotting their digital input and output signals.

**Reference Books:**

1. Irvine, Calif, "PSPICE Manual" Microsim Corporation, 1992.
2. Paul W. Tuinenga, "SPICE : A guide to circuit Simulation and Analysis Using PSPICE", Prentice Hall, 1992.
3. M.H. Rashid, "SPICE for Circuits and Electronics Using PSPICE" Prentice Hall of India, 2000.

## EEE-453: MICROPROCESSOR LABORATORY

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**A. Study Experiments**

1. To study 8085 based microprocessor system
2. To study 8086 and 8086A based microprocessor system
3. To study Pentium Processor

**B. Programming based Experiments (any four)**

4. To develop and run a program for finding out the largest/smallest number from a given set of numbers.
5. To develop and run a program for arranging in ascending/descending order of a set of numbers
6. To perform multiplication/division of given numbers
7. To perform conversion of temperature from $^0$F to $^0$C and vice-versa
8. To perform computation of square root of a given number
9. To perform floating point mathematical operations (addition, subtraction, multiplication and division)

**C. Interfacing based Experiments (any four)**

10. To obtain interfacing of RAM chip to 8085/8086 based system
11. To obtain interfacing of keyboard controller
12. To obtain interfacing of DMA controller
13. To obtain interfacing of PPI
14. To obtain interfacing of UART/USART
15. To perform microprocessor based stepper motor operation through 8085 kit
16. To perform microprocessor based traffic light control
17. To perform microprocessor based temperature control of hot water.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

### EEE-501: ELECTRO-MECHANICAL ENERGY CONVERSION - II

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**UNIT-I**

**Synchronous Machine I**

Constructional features, Armature winding, EMF Equation, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier's Triangle Method, Parallel Operation of synchronous generators, operation on infinite bus, synchronizing power and torque co-efficient

**UNIT-II**

**Synchronous Machine II:**

Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics

**Synchronous Motor:**

Starting methods, Effect of varying field current at different loads, V- Curves, Hunting & damping, synchronous condenser

**UNIT-III:**

**Three phase Induction Machine – I**

Constructional features, Rotating magnetic field, Principle of operation Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator & its applications.

**UNIT-IV**

**Three phase Induction Machine- II**

Starting, Deep bar and double cage rotors, Cogging & Crawling, Speed Control (with and without emf injection in rotor circuit.)

**UNIT-V**

**Single phase Induction Motor:**

Double revolving field theory, Equivalent circuit, No load and blocked rotor tests,
Starting methods, repulsion motor

**AC Commutator Motors:**

Universal motor, Single phase a.c. series compensated motor, stepper motors

**Text Books:**


1. D.P.Kothari & I.J.Nagrath, "Electric Machines", Tata Mc Graw Hill
2. Ashfaq Hussain"Electric Machines" Dhanpat Rai & Company
3. Fitzerald,A.E.,Kingsley and S.D.Umans"Electric Machinery", MC Graw Hill.


**Reference Books:**


4. P.S.Bimbhra, "Electrical Machinery", Khanna Publisher
5. P.S. Bimbhra, " Generalized Theory of Electrical Machines", Khanna Publishers
6. M.G.Say, "Alternating Current Machines",Pitman & Sons

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

**EEE-502: CONTROL SYSTEM**

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**Unit-I**

**The Control System:**

Open loop & closed control; servomechanism, Physical examples. Transfer functions, Block diagram algebra, Signal flow graph, Mason's gain formula Reduction of parameter variation and effects of disturbance by using negative feedback

**Unit-II**

**Time Response analysis:**

Standard test signals, time response of first and second order systems, time response specifications, steady state errors and error constants

Design specifications of second order systems: Derivative error, derivative output, integral error and PID compensations, design considerations for higher order systems, performance indices

**Unit-III**

**Control System Components:**

Constructional and working concept of ac servomotor, synchros and stepper motor

**Stability and Algebraic Criteria** concept of stability and necessary conditions, Routh-Hurwitz criteria and limitations.

**Root Locus Technique:**

The root locus concepts, construction of root loci

**Unit-IV**

**Frequency response Analysis:** Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots

**Stability in Frequency Domain:**

Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, constant M&N circles

**Unit-V**

**Introduction to Design:**

The design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in time domain and frequency domain.

**Review of state variable technique:**

Review of state variable technique, conversion of state variable model to transfer function model and vice-versa, diagonalization, Controllability and observability and their testing.

**Text Books:**


1. Nagrath & Gopal, "Control System Engineering", 4th Edition, New age International.
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India.
3. B.C. Kuo & Farid Golnaraghi, "Automatic Control System" Wiley IndiaLtd, 2008.
4. D.Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.


**Reference Books:**


5. Norman S. Mise, Control System Engineering 4th edition, Wiley Publishing Co.
6. Ajit K Mandal, "Introduction to Control Engineering" New Age International, 2006.

7. R.T. Stefani, B.Shahian, C.J.Savant and G.H. Hostetter, "Design of Feedback Control Systems" Oxford University Press.
8. N.C. Jagan, " Control Systems", B.S. Publications,2007.

## EEE-503: ELEMENTS OF POWER SYSTEM

| L | T | P |
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**Unit-I**

**Power System Components:**

Single line Diagram of Power system,

Brief description of power system Elements: Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator

**Supply System**

Different kinds of supply system and their comparison, choice of transmission voltage

**Transmission Lines:**

Configurations, types of conductors, resistance of line, skin effect, Kelvin's law.Proximity effect

**Unit-II**

**Over Head Transmission Lines**

Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines,

Representation and performance of short, medium and long transmission lines, Ferranti effect. Surge impedance loading

**Unit-III**

**Corona and Interference:**

Phenomenon of corona, corona formation, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona and interference.

Electrostatic and electromagnetic interference with communication lines

**Overhead line Insulators:**

Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency

**Unit-IV**

**Mechanical Design of transmission line:**

Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers

**Insulated cables:**

Type of cables and their construction, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables

**Unit-V**

**Neutral grounding:**

Necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices

**Electrical Design of Transmission Line:**
Design consideration of EHV transmission lines, choice of voltage, number of circuits, conductor configuration, insulation design, selection of ground wires.

**EHV AC and HVDC Transmission:**
Introduction to EHV AC and HVDC transmission and their comparison, use of bundle conductors, kinds of DC links, and incorporation of HVDC into AC system

**Text Books**

1. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill,
2. C. L. Wadhwa, "Electrical Power Systems" New age international Ltd. Third Edition
3. Asfaq Hussain, "'Power System", CBS Publishers and Distributors,
*4.B. R. Gupta, "Power System Analysis and Design" Third Edition, S. Chand & Co.*
*5.M. V. Deshpande, "Electrical Power System Design" Tata Mc Graw Hill.*

***Reference Books***

6. M. V. Deshpandey, "Elements of Power System Design", Tata McGraw Hill,
7. Soni, Gupta & Bhatnagar, "A Course in Electrical Power", Dhanpat Rai & Sons,
8. S. L. Uppal, "Electric Power", Khanna Publishers
S.N.Singh, " Electric Power Generation, Transmission& distribution." PHI Learning

## EEE – 801: INSTRUMENTATION AND PROCESS CONTROL

**L T P**
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**Unit-I:**
**Transducer – I:**
Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, Potentiometers, Strain guages, Resistance thermometer, Thermistors, Thermocouples, LVDT,RVDT

**Unit-II**
**Transducer – II :**
Capacitive, Piezoelectric Hall effect and opto electronic transducers.
Measurement of Motion, Force pressure, temperature, flow and liquid level.

**Unit-III:**
**Telemetry :**
General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data
**Acquisition System:**
Analog data acquisition system, Digital data acquisition system, Modern digital data acquisition system.

**Unit-IV:**
**Display Devices and Recorders:**

Display devices, storage oscilloscope, spectrum analyzer, strip chart & x-y recorders, magnetic tape & digital tape recorders.

**Recent Developments:**

Computer aided measurements, fibre optic transducers, microsessors, smart sensors, smart transmitters.

**Unit-V:**

**Process Control :**

Principle, elements of process control system, process characteristics, proportional (P), integral (I), Derivative (D), PI, PD and PID control modes. Electronic, Pneumatic & digital controllers.

**Text Books:**

1. A.K.Sawhney, "Advanced Measurements & Instrumentation", Dhanpat Rai & Sons
2. B.C. Nakra & K.Chaudhry, "Instrumentation, Measurement and Analysis", Tata Mc Graw Hill 2nd Edition.
3. Curtis Johns, "Process Control Instrumentation Technology", Prentice Hall

**Reference Books:**

4. E.O. Decblin, "Measurement System – Application & design", Mc Graw Hill.
5. W.D. Cooper and A.P. Beltried, "Electronics Instrumentation and Measurement Techniques" Prentice Hall International
6. Rajendra Prasad,"Electronic Measurement and Instrumentation Khanna Publisher
7. M.M.S. Anand, "Electronic Instruments and Instrumentation Technology" PHI Learning.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

## EEE- 551: ELECTRO-MECHANICAL ENERGY CONVERSION – II LABORATORY

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**Note: The minimum 8 experiments are to be performed from the following, out of which there should be at least two software based experiments.**

1. To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a three phase induction motor and draw:
3. Torque -speed characteristics
4. Power factor-line current characteristics
5. To perform no load and blocked rotor tests on a single phase induction motor and determine equivalent circuit.
6. To study speed control of three phase induction motor byKeeping V/f ratio constant
7. To study speed control of three phase induction motor by varying supply voltage.
8. To perform open circuit and short circuit tests on a three phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by (i) EMF method (ii) MMF method.
9. To determine V-curves and inverted V-curves of a three phase synchronous motor.
10. To determine Xd and Xq of a three phase salient pole synchronous machine using the slip test and draw the power-angle curve.
11. To study synchronization of an alternator with the infinite bus by using:
12. dark lamp method (ii) two bright and one dark lamp method

**Software based experiments (Develop Computer Program in 'C' language or use MATLAB or other commercial software)**

13. To determine speed-torque characteristics of three phase slip ring induction motor and study the effect of including resistance, or capacitance in the rotor circuit.
14. To determine speed-torque characteristics of single phase induction motor and study the effect of voltage variation.
15. To determine speed-torque characteristics of a three phase induction motor by (i) keeping v/f ratio constant (ii) increasing frequency at the rated voltage.
16. Draw O.C. and S.C. characteristics of a three phase alternator from the experimental data and determine voltage regulation at full load, and unity, 0.8 lagging and leading power factors.
17. To determine steady state performance of a three phase induction motor using equivalent circuit.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

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### EEE – 552: CONTROL SYSTEM LABORATORY

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**Note: The minimum of 10 experiments are to be performed from the following, out of which at least three should be software based.**

1. To determine response of first order and second order systems for step input for various values of constant 'K' using linear simulator unit and compare theoretical and practical results.
2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To study and calibrate temperature using resistance temperature detector (RTD)
4. To design Lag, Lead and Lag-Lead compensators using Bode plot.
5. To study DC position control system
6. To study synchro-transmitter and receiver and obtain output V/S input characteristics
7. To determine speed-torque characteristics of an ac servomotor.
8. To study performance of servo voltage stabilizer at various loads using load bank.
9. To study behaviour of separately excited dc motor in open loop and closed loop conditions at various loads.
10. To study PID Controller for simulation proves like transportation lag.

**Software based experiments** (Use MATLAB, LABVIEW software etc.)

11. To determine time domain response of a second order system for step input and obtain performance parameters.
12. To convert transfer function of a system into state space form and vice-versa.
13. To plot root locus diagram of an open loop transfer function and determine range of gain 'k' fir stability.
14. To plot a Bode diagram of an open loop transfer function.
15. To draw a Nyquist plot of an open loop transfer functions and examine the stability of the closed loop system.

**Reference Books**:


1. K.Ogata,"Modern Control Engineering" Prentice Hall of India.
2. Norman S.Nise, "Control System Engineering", John Wiley & Sons.
3. M.Gopal, "Control Systems: Principles & Design" Tata Mc Graw Hill.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

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### EEE – 851: INSTRUMENTATION LAB.

**L T P**

**0 0 2**

**Note: Minimum ten experiments should be performed from the following**

1. Measurement of displacement using LVDT.
2. Measurement of displacement using strain gauge based displacement transducer.
3. Measurement of displacement using magnetic pickup.
4. Measurement of load using strain gauge based load cell.
5. Measurement of water level using strain gauge based water level transducer
6. Measurement of flow rate by anemometer
7. Measurement of temperature by RTD.
8. Measurement of temperature by thermocouple
9. Study of P,PI and PID controllers
10. Study of storage oscilloscope and determination of transient response of RLC circuit.
11. Determination of characteristics of a solid state sensor/fibre-optic sensor
12. Design and test a signal conditioning circuit for any transducer
13. Study of data acquisition system using "**lab view**" software and test all signal points
14. Measurement of sine, triangular ,square wave signal of function generator and verify its frequency at 100 Hz tap point using "**labview**" software.
15. Measurement of voltage and current signal of programmable power supply using **Lab view** GPIB interface.

**Note :- Three more software based experiments may be added in place of experiments nos. 13 to 15.at the institute level.**

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

### EEE-601: POWER SYSTEM ANALYSIS

| L | T | P |
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**Unit-I**

**Representation of Power System Components**:

Synchronous machines, Transformers,Transmission lines, One line diagram, Impedance and reactance diagram, per unit System

**Symmetrical components**:

Symmetrical Components of unbalanced phasors, power in terms of symmetrical components, sequence impedances and sequence networks.

**Symmetrical fault analysis**:

Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions

**Unit-II**

**Unsymmetrical faults**:

Analysis of single line to ground fault, line-to-line fault and Double Line to ground fault on an unloaded generators and power system network with and without fault impedance.

Formation of $Z_{bus}$ using singular transformation and algorithm, computer method for short circuit calculations

**Unit-III**

**Load Flows**:

Introduction, bus classifications, nodal admittance matrix ($Y_{BUS}$), development of load flow equations, load flow solution using Gauss Siedel and Newton-Raphson method, approximation to N-R method, line flow equations and fast decoupled method

**Unit-IV**

**Power System Stability**:

Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion and step-by-step method. Factors affecting steady state and transient stability and methods of improvement

**Unit-V**

**Traveling Waves**:

Wave equation for uniform Transmission lines, velocity of propagation, surge impedance, reflection and transmission of traveling waves under different line loadings. Bewlay's lattice diagram, protection of equipments and line against traveling waves

**Text Books:**


1. W.D. Stevenson, Jr. " Elements of Power System Analysis", Mc Graw Hill.
2. C.L. Wadhwa, "Electrical Power System", New Age International.
3. Chakraborthy, Soni,Gupta & Bhatnagar, "Power System Engineering", Dhanpat Rai & Co.
4. T.K Nagsarkar & M.S. Sukhija, "Power System Analysis" Oxford University Press,2007.


**Reference Books**:

5. L. P. Singh; "Advanced Power System Analysis & Dynamics", New Age International
6. Hadi Sadat; "Power System Analysis", Tata McGraw Hill.
7. D.Das, " Electrical Power Systems" New Age International, 2006.
8. J.D. Glover, M.S. Sharma & T.J.Overbye, "Power System Analysis and Design" Thomson, 2008.
9. P.S.R. Murthy " Power System Analysis" B.S. Publications,2007.

**EEE-602: POWER ELECTRONICS** **L T P**
**3 1 0**

**Unit-I**

**Power semiconductor Devices:**

Power semiconductor devices their symbols and static characteristics
Characteristics and specifications of switches, types of power electronic circuits
Operation, steady state & switch characteristics & switching limits of Power Transistor
Operation and steady state characteristics of Power MOSFET and IGBT
**Thyristor** – Operation V- I characteristics, two transistor model, methods of turn-on
Operation of GTO, MCT and TRIAC

**Unit-II**

**Power Semiconductor Devices(Contd)**

Protection of devices.
Series and parallel operation of thyristors
Commutation techniques of thyristor

**DC-DC Converters:**

Principles of step-down chopper, step down chopper with R-L load Principle of step-up chopper, and operation with RL load, classification of choppers

**Unit-III**

**Phase Controlled Converters**

Single phase half wave controlled rectifier with resistive and inductive loads, effect of freewheeling diode.
Single phase fully controlled and half controlled bridge converters.
Performance Parameters
Three phase half wave converters
Three phase fully controlled and half controlled bridge converters, Effect of source impedance
Single phase and three phase dual converters

**Unit-IV**

**AC Voltage Controllers**

Principle of On-Off and phase controls
Single phase ac voltage controller with resistive and inductive loads
Three phase ac voltage controllers (various configurations and comparison only)
Single phase transformer taps changer.
Cyclo Converters

Basic principle of operation, single phase to single phase, three phase to single phase and three phase to three phase cyclo converters, output voltage equation

**Unit-V**

**Inverters**

Single phase series resonant inverter
Single phase bridge inverters
Three phase bridge inverters
Voltage control of inverters
Harmonics reduction techniques
Single phase and three phase current source inverters

**Text Books:**

1. M.H. Rashid,"Power Electronics: Circuits, Devices & Applications", Prentice Hall of India Ltd. 3rd Edition,2004.
2. M.D. Singh and K.B.Khanchandani, "Power Electronics"Tata MC Graw Hill, 2005
3. V.R. Moorthy, " Power Electronics : Devices, Circuits and Industrial Applications" Oxford University Press,2007.

**Reference Books:**

4. M.S. Jamil Asghar, "Power Electronics" Prentice Hall of India Ltd., 2004
5. Chakrabarti & Rai, "Fundamentals of Power Electronics &Drives"Dhanpat Rai & Sons.
6. Ned Mohan, T.M.Undeland and W.P.Robbins, "Power Electronics:Converters, Applications and Design", Wiley India Ltd,2008.
7. S.N.Singh, "A Text Book of Power Electronics" Dhanpat Rai & Sons

## EEE-651 : POWER ELECTRONICS LABORATORY

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**Note: The minimum of 10 experiments is to be performed out of which at least three should be software based.**

1. To study V-I characteristics of SCR and measure latching and holding currents.
2. To study UJT trigger circuit for half wave and full wave control.
3. To study single-phase half wave controlled rectified with (i) resistive load (ii) inductive load with and without free wheeling diode.
4. To study single phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and inductive loads.
5. To study three-phase fully/half controlled bridge rectifier with resistive and inductive loads.
6. To study single-phase ac voltage regulator with resistive and inductive loads.
7. To study single phase cyclo-converter
8. To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor
9. To study operation of IGBT/MOSFET chopper circuit

10. To study MOSFET/IGBT based single-phase series-resonant inverter.
11. To study MOSFET/IGBT based single-phase bridge inverter.

**Software based experiments(PSPICE/MATLAB)**

12. To obtain simulation of SCR and GTO thyristor.
13. To obtain simulation of Power Transistor and IGBT.
14. To obtain simulation of single phase fully controlled bridge rectifier and draw load voltage and load current waveform for inductive load.
15. To obtain simulation of single phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load.
16. To obtain simulation of step down dc chopper with L-C output filter for inductive load and determine steady-state values of output voltage ripples in out put voltage and load current.

**Text/Reference Books:**

1. M.H.Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd Edition, prentice Hall of India.
2. D.W. Hart, "Introduction to power Electronics" prentice hall Inc. 1997.
3. Randal Shaffer, "Fundamentals of Power Electronics with MATLAB" Firewall Media, 2007.

**YEAR- IV**

## EEE – 701: SWITCHGEAR AND PROTECTION

| L | T | P |
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**Unit I:**

**Introduction to Protection System:**

Introduction to protection system and its elements, functions of protective relaying, protective zones, primary and backup protection, desirable qualities of protective relaying, basic terminology.

**Relays:**

Electromagnetic, attracted and induction type relays, thermal relay, gas actuated relay, design considerations of electromagnetic relay.

**Unit-II:**

**Relay Application and Characteristics:**

Amplitude and phase comparators, over current relays, directional relays, distance relays, differential relay

**Static Relays:**

Comparison with electromagnetic relay, classification and their description, over current relays, directional relay, distance relays, differential relay.

**Unit-III**

**Protection of Transmission Line:**

Over current protection, distance protection, pilot wire protection, carrier current protection, protection of bus, auto re-closing,

**Unit-IV:**

**Circuit Breaking:**

Properties of arc, arc extinction theories, re-striking voltage transient, current chopping, resistance switching, capacitive current interruption, short line interruption, circuit breaker ratings.

**Testing Of Circuit Breaker:**

Classification, testing station and equipments, testing procedure, direct and indirect testing

**Unit-V**

**Apparatus Protection:**

Protection of Transformer, generator and motor.

**Circuit Breaker:**

Operating modes, selection of circuit breakers, constructional features and operation of Bulk Oil, Minimum Oil, Air Blast, SF6, Vacuum and d. c. circuit breakers.

**Text Books:**

1. S. S. Rao, "Switchgear and Protection", Khanna Publishers.
2. B. Ravindranath and M. Chander, Power system Protection and Switchgear, iley Eastern Ltd.

**Reference Books:**

3. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", Tata Mc. Graw Hill
4. Y. G. Paithankar and S R Bhide, "Fundamentals of Power System Protection", Prentice Hall of India.
5. T.S.M Rao,"Power System Protection: Static Relays with Microprocessor Applications" Tata Macgraw Hill".
6. A.R. Van C. Warringtaon , " Protective Relays- Their Theory and Practice, Vol. I & II" Jhon Willey & Sons.

## EEE –702: ELECTRIC DRIVES

| L | T | P |
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**Unit-I:**

**Fundamentals of Electric Drive:**

Electric Drives and its parts, advantages of electric drives
Classification of electric drives
Speed-torque conventions and multi-quadrant operations
Constant torque and constant power operation
Types of load
Load torque: components, nature and classification

**Unit-II:**

**Dynamics of Electric Drive:**

Dynamics of motor-load combination; Steady state stability of Electric Drive; Transient stability of electric Drive

**Selection of Motor Power rating:**

Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty.Load equalization

**Unit-III:**

**Electric Braking:**

Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors

**Dynamics During Starting and Braking:**

Calculation of acceleration time and energy loss during starting of dc shunt and three phase induction motors, methods of reducing energy loss during starting.

Energy relations during braking, dynamics during braking

**Unit-IV:**

**Power Electronic Control of DC Drives:**

Single phase and three phase controlled converter fed separately excited dc motor drives (continuous conduction only), dual converter fed separately excited dc motor drive, rectifier control of dc series motor.

Supply harmonics, power factor and ripples in motor current

Chopper control of separately excited dc motor and dc series motor.

**Unit-V:**

**Power Electronic Control of AC Drives: Three Phase induction Motor Drive:**

Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo - converter based) static rotor resistance and slip power recovery control schemes.

**Three Phase Synchronous motor:**

Self controlled scheme

**Special Drives:**

Switched Reluctance motor, Brushless dc motor. Selection of motor for particular applications

**Text Books:**

1. G.K. Dubey, “Fundamentals of Electric Drives”, Narosa publishing House.
2. S.K.Pillai, “A First Course on Electric Drives”, New Age International.

**Reference Books:**

3. M.Chilkin, “Electric Drives”,Mir Publishers, Moscow.
4. Mohammed A. El-Sharkawi, “Fundamentals of Electric Drives”, Thomson Asia, Pvt. Ltd. Singapore.
5. N.K. De and Prashant K.Sen, “Electric Drives”, Prentice Hall of India Ltd.
6. V.Subrahmanyam, “Electric Drives: Concepts and Applications”, Tata McGraw Hill.

## EEE – 751: POWER SYSTEM LAB

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

**Note: - At least 10 experiments should be performed out of which 3 should be simulation based.**

**(A) Hardware Based:**

1. To determine direct axis reactance ($x_d$) and quadrature axis reactance ($x_q$) of a salient pole alternator.
2. To determine negative and zero sequence reactances of an alternator.
3. To determine sub transient direct axis reactance ($x_d$) and sub transient quadrature axis reactance ($x_q$) of an alternator
4. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation
5. To study the IDMT over current relay and determine the time current characteristics
6. To study percentage differential relay
7. To study Impedance, MHO and Reactance type distance relays
8. To determine location of fault in a cable using cable fault locator
9. To study ferranty effect and voltage distribution in H.V. long transmission line using transmission line model.
10. To study operation of oil testing set.

**Simulation Based Experiments (using MATLAB or any other software)**

11. To determine transmission line performance.
12. To obtain steady state, transient and sub-transient short circuit currents in an alternator
13. To obtain formation of Y-bus and perform load flow analysis
14. To perform symmetrical fault analysis in a power system
15. To perform unsymmetrical fault analysis in a power system

**Text Books:-**

1. Hasdi Sadat, “Power System Analysis” Tata Mc.Graw Hill.
2. T. K. Nagsarskar & M.S. Sukhija,’ Power System Analysis’ Oxford Universitry Press.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

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### EEE – 752: ELECTRIC DRIVES LAB

| L | T | P |
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**Note: - Minimum 10 experiments are to be performed from the following out of which at least three should be simulation based.**

**(A) Hardware Based Experiments:**

1. To study speed control of separately excited dc motor by varying armature voltage using single-phase fully controlled bridge converter.
2. To study speed control of separately excited dc motor by varying armature voltage using single phase half controlled bridge converter.
3. To study speed control of separately excited dc motor using single phase dual converter (Static Ward-Leonard Control)
4. To study speed control of separately excited dc motor using MOSFET/IGBT chopper
5. To study closed loop control of separately excited dc motor
6. To study speed control of single phase induction motor using single phase ac voltage controller.
7. To study speed control of three phase induction motor using three phase ac voltage controller
8. To study speed control of three phase induction motor using three phase current source inverter
9. To study speed control of three phase induction motor using three phase voltage source inverter
10. To study speed control of three phase slip ring induction motor using static rotor resistance control using rectifier and chopper
11. To study speed control of three phase slip ring induction motor using static scherbius slip power recovery control scheme

**Simulation Based Experiments (using MATLAB or any other software)**

12. To study starting transient response of separately excited dc motor
13. To study speed control of separately excited dc motor using single phase fully / half controlled bridge converter in discontinuous and continuous current modes.
14. To study speed control of separately excited dc motor using chopper control in motoring and braking modes.
15. To study starting transient response of three phase induction motor
16. To study speed control of three phase induction motor using (a) constant/V/F control (b) Constant Voltage and frequency control.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

### EEE -753: PROJECT

**L T P**

**0 0 3**

Project shall be assigned to students at the start of VII$^{th}$ semester. There should not usually be more than 3 students in batch. The project should be based on latest technology as far as possible and it may be hardware or/and software based. The assessment of performance of students should be made at least twice in the semester. Students should be encouraged to present their progress of project using overhead projector or LCD projector.

### EEE – 754 PRACTICAL & INDUSTRIAL TRAINING PRESENTATION

**L T P**

**0 0 2**

Students will go practical & Industrial training of four weeks in any industry or reputed organization after the VI$^{th}$ semester examination in summer. They will also prepare an exhaustive technical report of the training which will be duly signed by the officer under whom training was taken in the industry/organization. They will have to present about the training before a committee consisting of faculty members constituted by the concerned Head of the Department.

### EEE – 802: UTILIZATION OF ELECTRICAL ENERGY AND TRACTION

**L T P**

**3 1 0**

**Unit-I:**

**Electric Heating:**

Advantages and methods of electric heating

Resistance heating

Electric arc heating

Induction heating

Dielectric heating

**Unit-II:**

**Electric Welding:**

Electric Arc Welding

Electric Resistance welding

Electronic welding control

**Electrolyte Process:**

Principles of electro deposition, Laws of electrolysis, applications of electrolysis

**Unit-III**

**Illumination:**

Various definitions, Laws of illumination, requirements of good lighting

Design of in door lighting and outdoor lighting systems

**Refrigeration and Air Conditioning:**

Refrigeration systems, domestic refrigerator, water cooler

Types of air conditioning, Window air conditioner

**Unit-IV:**

**Electric Traction - I**

Types of electric traction, systems of track electrification

Traction mechanics- types of services, speed time curve and its simplification, average and schedule speeds

Tractive effort, specific energy consumption, mechanics of train movement, coefficient of adhesion and its influence

**Unit-V:**

**Electric Traction – II**

Salient features of traction drives

Series – parallel control of dc traction drives (bridge transition) and energy saving

Power Electronic control of dc and ac traction drives

Diesel electric traction.

**Text Books:**

1. H.Partab,"Art and Science of Electrical Energy" Dhanpat Rai & Sons.
2. G.K.Dubey,"Fundamentals of Electric Drives" Narosa Publishing House

**Reference Books:**

3. H. Partab, " Modern Electric Traction" Dhanpat Rai & Sons.
4. C.L. Wadhwa, " Generation, Distribution and Utilization of Electrical Energy" New Age International Publications.

## EEE – 853: PROJECT

**L T P**
**0 0 12**

Students should devote themselves to expedite progress of the project as soon as VIIIth semester starts. They are supposed to finish project work latest by middle of April and submit project report by the end of the April month. The assessment of performance of students should be made at least twice in the

semester. The students should present project using overheads project or power point presentation using in the end semester project examination

## EEE – 021: HIGH VOLTAGE ENGINEERING

| L | T | P |
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**UNIT-I**

**Break Down In Gases:**

Ionization processes, Townsend's criterion, breakdown in electronegative gases, time lags for breakdown, streamer theory, Paschen's law, break down in non-uniform field, breakdown in vacuum.

**Break Down In Liquid Dielectrics:**

Classification of liquid dielectric, characteristic of liquid dielectric, breakdown in pure liquid and commercial liquid.

**Break Down In Solid Dielectrics:**

Intrinsic breakdown, electromechanical breakdown, breakdown of solid, dielectric in practice, breakdown in composite dielectrics.

**UNIT-II**

**Generation of High Voltages and Currents:**

Generation of high direct current voltages, generation of high alternating voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

**UNIT-III**

**Measurement of High Voltages and Currents:**

Measurement of high direct current voltages, measurement of high alternating and impulse voltages, measurement of high direct, alternating and impulse currents, Cathode Ray Oscillographs for impulse voltage and current measurements.

**UNIT-IV**

**Non-Destructive Testing:**

Measurement of direct current resistively, measurement of dielectric constant and loss factor, partial discharge measurements

**High Voltage Testing:**

Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, testing of transformers, testing of surge arresters, radio interference measurements.

**Text Book:**

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering, Tata Mc-Graw Hill.

**Reference Books:**

2. E. Kuffel and W. S. Zacngal, High Voltage Engineering", Pergamon Press.
3. M. P. Chaurasia , "High Voltage Engineering", Khanna Publishers
4. R. S. Jha, "High Voltage Engineering", Dhanpat Rai & sons
5. C. L. Wadhwa, "High Voltage Engineering", Wiley Eastern Ltd.
6. M. Khalifa,' High Voltage Engineering Theory and Practice,' Marcel Dekker.
7. Subir Ray,' An Introduction to High Voltage Engineering' Prentice Hall of India

## EEE -602: CONVENTIONAL & CAD OF ELECTRICAL MACHINES

**L T P**

**3 1 0**

**UNIT-I**

**Basic Considerations:**

Basic concept of design, limitation in design, standardization, modern trends in design and manufacturing techniques,
Classification of insulating materials.
Calculation of total mmf and magnetizing current.
Transformer Design:
Output equation design of core, yoke and windings, overall dimensions,
Computation of no load current to voltage regulation, efficiency and cooling system designs

**UNIT-II**

Design of rotating machines – I:
Output equations of rotating machines, specific electric and magnetic loadings, factors affecting size of rotating machines, separation of main dimensions, selection of frame size.
Core and armature design of dc and 3-phase ac machines

**UNIT-III**

Design of rotating machines – II:
Rotor design of three phase induction motors.
Design of field system of DC machine and synchronous machines.
Estimation of performance from design data

**UNIT-IV**

Computer Aided Design
Philosophy of computer aided design, advantages and limitations.
Computer aided design approaches analysis, synthesis and hybrid methods.
Concept of optimization and its general procedure.

Flow charts and 'c' based computer programs for the design of transformer, dc machine, three phase induction and synchronous machines.

**Text Books:**


1. K. Sawhney, "A Course in Electrical Machine Design" Dhanpat Rai & Sons.
2. K.G. Upadhyay," Conventional and Computer Aided Design of Electrical Machines" Galgotia Publications.

**Reference Books:**

3. M.G. Say, "The Performance and Design of AC Machines" Pitman & Sons.
4. A.E. Clayton and N.N. Hancock, "The Performance and Design of D.C.Machines" Pitman & Sons.
5. S.K. Sen, "Principle of Electrical Machine Design with Computer Programming" Oxford and IBM Publications.


## EEE –703: POWER SYSTEM OPERATION AND CONTROL

| L | T | P |
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**UNIT-I**

**Introduction :**

Structure of power systems,
Power system control center and real time computer control, SCADA system
Level decomposition in power system
Power system security
Various operational stages of power system
Power system voltage stability

**UNIT-II**

**Economic Operation :**

Concept and problems of unit commitment
Input-output characteristics of thermal and hydro-plants
System constraints
Optimal operation of thermal units without and with transmission losses, Penalty factor, incremental transmission loss, transmission loss formula (without derivation)
Hydrothermal scheduling long and short terms
Concept of optimal power flow

**UNIT-III**

**Load Frequency Control :**

Concept of load frequency control,
Load frequency control of single area system:
Turbine speed governing system and modeling, block diagram representation of single area system, steady state analysis, dynamic response, control area concept, P-I control, load frequency control and economic dispatch control.
Load frequency control of two area system:
Tie line power modeling, block diagram representation of two area system, static and dynamic response

**UNIT-IV**

**Automatic Voltage Control :**

Schematic diagram and block diagram representation, different types of Excitation systems & their controllers.

**Voltage and Reactive Power control :**

Concept of voltage control, methods of voltage control-control by tap changing transformer.
Shunt Compensation, series compensation, phase angle compensation

**UNIT-V**

**State Estimation**:

Detection and identification, Linear and non-linear models.

**Flexible AC Transmission Systems:**

Concept and objectives
FACTs controllers: Structures & Characteristics of following FACTs Controllers.

**Text Books:**
1. D.P. Kothari & I.J. Nagrath, "Modern Power System Analysis" Tata Mc Graw Hill, 3rd Edition.
2. P.S.R. Murty, "Operation and control in Power Systems" B.S. Publications.
3. N. G. Hingorani & L. Gyugyi, " Understanding FACTs" Concepts and Technology of Flexible AC Transmission Systems"
4. J. Wood & B.F. Wollenburg, " Power Generation, Operation and Control " John Wiley & Sons.

**Reference Books:**
5. O.I. Elgerd, "Electric Energy System Theory" Tata McGraw Hill.
6. P. Kundur, " Power System Stability and Control Mc Graw Hill.
7. M.H. Rashid, "Power Electronics: Circuits, devices and Applications" Prentice Hall of India,3rd Edition.
8. T. K. Nagsarkar & M.S.Sukhiza,' Power System Analysis' Oxford University Press.

## EOE I : Non Conventional Energy Resources:

**L T P**
**3 1 0**

Power Crisis, future energy demand, role of Private sectors in energy management,

**MHD generation:** Working principle, open and closed cycles, MHD systems, advantages, parameters governing power output.

**Solar power plant:** Conversion of solar heat to electricity, Solar energy collectors, Photovoltaic cell, power generation, future prospects of solar energy use.

**Wind Energy**: Windmills, power output with combined operation of wind turbine generation and isolated generating system, technical choices& economic size.

**Geothermal Energy:** Earth energy, heat extraction, vapor turbine cycle, difficulties & disadvantages,

**Tidal energy:** Tidal phenomenon, tidal barrage, tidal power Schemes.

**Ocean Thermal Energy:** Introduction, energy conversion, problems.

### EDE-III: NEURAL NETWORKS AND FUZZY SYSTEM

**LTP**
**31 0**

**Unit-I**

**Neural Networks-1(Introduction & Architecture)**

Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions,

Neural network architecture: single layer and multilayer feed forward networks, recurrent networks.Various learning techniques; perception and convergence rule,

Auto-associative and hetro-associative memory

**Unit-II**

**Neural Networks-II (Back propogation networks)**

Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications.

**Unit-III**

**Fuzzy Logic-I (Introduction)**

Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

**Unit-IV**

**Fuzzy Logic –II (Fuzzy Membership, Rules)**

Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications.

**Unit-V**

**Fuzzy Neural Networks:**

L-R Type fuzzy numbers, fuzzy neutron, fuzzy back propogation(BP), architecture, learning in fuzzy BP, inference by fuzzy BP, applications.

**Text Books:**


1. Kumar Satish, “Neural Networks” Tata Mc Graw Hill
2. S. Rajsekaran & G.A. Vijayalakshmi Pai, “Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications” Prentice Hall of India.


**Reference Books:**


3. Siman Haykin,”Neural Netowrks”Prentice Hall of India
4. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India.

# Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

## B-Tech. Electrical Engineering

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### EDE - II: EHV AC & DC TRANSMISSION

**L T P**
**3 1 0**

**UNIT-I**

**Introduction :**

Need of EHV transmission, standard transmission voltage, comparison of EHV ac & dc transmission systems and their applications & limitations, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, mechanical considerations of transmission lines, modern trends in EHV AC and DC transmission

**UNIT-II**

**EHV AC Transmission :**

Corona loss formulas, corona current, audible noise – generation and characteristics corona pulses their generation and properties, radio interference (RI) effects, over voltage due to switching, ferroresonance, reduction of switching surges on EHV system, principle of half wave transmission.

**UNIT-III**

**Extra High Voltage Testing:**

Characteristics and generation of impulse voltage, generation of high Ac and Dc voltages, measurement of high voltage by spheregaps and potential dividers.

**Consideration for Design of EHV Lines:**

Design factors under steady state limits, EHV line insulation design based upon transient over voltages.

Effects of pollution on performance of EHV lines.

**UNIT-IV**

**EHV DC Transmission – I:**

Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters.

Principle of dc link control, converter controls characteristics, firing angle control, current and excitation angle control, power control, starting and stopping of dc link.

**UNIT-V**

**EHV DC Transmission – II:**

Converter faults, protection against over currents and over voltages, smoothing reactors, generation of harmonics, ac and dc filters,

Multi Terminal DC systems (MTDC): Types, control, protection and applications.

**Text Books :**


1. R. D. Begamudre, “Extra High Voltage AC Transmission Engineering” Wiley Eastern.
2. K. R. Padiyar, “HVDC Power Transmission Systems: Technology and System Reactions” New Age International.
3. J. Arrillaga,“ High Voltage Direct current Transmission” IFFE Power Engineering Series 6, Peter Peregrinus Ltd, London.
4. M. S. Naidu & V. Kamaraju, “High Voltage Engineering” Tata Mc Graw Hill.


**Reference Books:**


5. M. H. Rashid , “ Power Electronics : Circuits, Devices and Applications” Prentice Hall of India.
6. S. Rao, “EHV AC and HVDC Transmission Engineering and Practice” Khanna Publisher.

7. "EPRI, Transmission Line Reference Book, 345 KV and above" Electric Power Research Institute. Palo Alto, California, 1982.

## EEE 604: POWER STATION PRACTICE

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**UNIT-I**

**Introduction:** Electric energy demand and growth in India, electric energy sources.

**Thermal Power Plant**:

Site selection, general layout and operation of plant, detailed description and use of different parts.

**Hydro Electric Plants**:

Classifications, location and site selection, detailed description of various components, general layout and operation of Plants, brief description of impulse, reaction, Kaplan and Francis turbines, advantages & disadvantages, hydro-potential in India

**UNIT-II**

**Nuclear Power Plant**:

Location, site selection, general layout and operation of plant. Brief description of different types of reactors Moderator material, fissile materials, control of nuclear reactors, disposal of nuclear waste material, shielding.

**Gas Turbine Plant**:

Operational principle of gas turbine plant & its efficiency, fuels, open and closed-cycle plants, regeneration, inter-cooling and reheating, role and applications.

**Diesel Plants**:

Diesel plant layout, components & their functions, its performance, role and applications

**UNIT-III**

**Sub-stations Layout**:

Types of substations, bus-bar arrangements, typical layout of substation.

**Power Plant Economics and Tariffs:**

Load curve, load duration curve, different factors related to plants and consumers, Cost of electrical energy, depreciation, generation cost, effect of Load factor on unit cost. Fixed and operating cost of different plants, role of load diversity in power system economy. Objectives and forms of Tariff; Causes and effects of low power factor, advantages of power factor improvement, different methods for power factor improvements.

**UNIT-IV**

**Economic Operation of Power Systems**:

Characteristics of steam and hydro-plants,

Constraints in operation, Economic load scheduling of thermal plants Neglecting and considering transmission Losses, Penalty factor, loss coefficients, Incremental transmission loss.

Hydrothermal Scheduling

**UNIT-V**

**Non Conventional Energy Sources**:

Power Crisis, future energy demand, role of Private sectors in energy management,

**MHD generation:** Working principle, open and closed cycles, MHD systems, advantages, parameters governing power output.

**Solar power plant:** Conversion of solar heat to electricity, Solar energy collectors, Photovoltaic cell, power generation, future prospects of solar energy use.

**Wind Energy**: Windmills, power output with combined operation of wind turbine generation and isolated generating system, technical choices& economic size.

**Geothermal Energy:** Earth energy, heat extraction, vapor turbine cycle, difficulties & disadvantages,

**Tidal energy:** Tidal phenomenon, tidal barrage, tidal power Schemes.

**Ocean Thermal Energy:** Introduction, energy conversion, problems.

**Text Books:**


1. B.R. Gupta,"Generation of Electrical Energy", S. Chand Publication.
2. Soni, Gupta & Bhatnagar, "A text book on Power System Engg.", Dhanpat Rai & Co.
3. P.S.R. Murthy, "Operation and control of Power System" BS Publications, Hyderabad.


**Reference Books:**


4. W. D. Stevenson, "Elements of Power System Analysis", McGraw Hill.
5. S. L. Uppal, "Electrical Power", Khanna Publishers.


## EDE – I : ADVANCED CONTROL SYSTEM

| L | T | P |
|---|---|---|
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**Unit-I**

**State Space Analysis of Continuous System:**

Review of state variable representation of continuous system, conversion of state variable models to transfer function and vice-versa, solution of state equations and state transition matrix, controllability and obsrvability, design of state observer and controller

**Unit-II**

**Analysis of Discrete System:**

Discrete system and discrete time signals, state variable model and transfer function model of discrete system, conversion of state variable model to transfer function model and vice-versa, modeling of sample-hold circuit, solution of state difference equations, steady state accuracy, stability on the z-plane and Jury stability criterion, bilinear transformation, Routh-Hurwitz criterion on rth planes

**Unit-III**

**Stability:**

Lyapunov's stability theorems for continuous and discrete systems, methods for generating Lyapunov function for continuous and discrete system, Popov's criterion.

**Non linear System:**

Types of non linearities, phenomena related to non - linear systems.

Analysis of non linear systems-Linearization method, second order non-linear system on the phase plane, types of phase portraits, singular points, system analysis by phase-plane method, describing function and its application to system analysis.

**Unit-IV**

**Optimal Control:**

Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization.Pontryagin's Minimum Maximum Principle, Linear Quadratic Problem-Hamilton Jacobi equation, Riccati equation and its solution.

**Unit-V**

**Adaptive Control:**

Introduction, modal reference adaptive control systems, controller structure, self tuning regulators.

Introduction to neural network, fuzzy logic and genetic algorithms

**Text Books:**


1. M.Gopal, "Digital Control and State variable Methods", Tata Mc Graw Hill
2. Ajit K.Madal, "Introduction to Control Engineering: Modelling, Analysis and Design"
3. New Age International.
4. D.Landau, "Adaptive Control", Marcel Dekker Inc.
5. S.Rajasekaran & G.A.Vjayalakshmi Pai, "Neural Networks,Fuzzy Logic and Genetic
6. Alogorithms: Synthesis and Applications" Prentice Hall of India.


**Reference Book:**


7. Donald E. Kiv, "Optimal Control Theory: An Introduction" Prentice Hall
8. B.C. Kuo, "Digital Control Systems" Sounders College Publishing
9. C.H.Houpis and G.B.Lamont,"Digital Control Systems:Theory,Hardware,Software"Mc Graw Hill.