TECHNO INDIA UNIVERSITY
WESTBENGAL

EM 4, Sector V, Salt Lake, Kolkata-700091, West Bengal, India
Phone: +91 9836544416/17/18/19, Fax: +91 33 2357 1097

4-Year Bachelor of Technology (B.Tech.) Curriculum and Syllabus for Electrical Engineering (EE)

Fourth Semester

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
Theory					
TIU-UEN-T200	Career Advancement & Skill Development	2	1	0	3
TIU-UEE-T202	Electrical Machines I	3	1	0	4
TIU-UEE-T204	Electrical Measurements & Measuring Instruments	3	1	0	4
TIU-UEE-T206	Signals & Systems	3	1	0	4
TIU-UEE-T208	Analog Electronics	3	0	0	3
TIU-UME-T210	Thermal Engineering	3	0	0	3
Practical					
TIU-UEE-L202	Electrical Machines Lab I	0	0	3	2
TIU-UEE-L204	Electrical Measurements & Measuring Instruments Lab	0	0	3	2
TIU-UEE-L206	Analog Electronics Lab	0	0	3	2
Sessional					
TIU-UES-S298	Entrepreneurship Skill Development	0	0	2	2
Total Credits					29

Detailed Syllabus

Career Advancement & Skill Development
TIU-UEN-T200
LTP: 2-1-0
Credits: 3

The detailed syllabus to be provided by the Department of Humanities

Electrical Machines I
TIU-UEE-T202

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LTP: 3-1-0
Credits: 4

General introduction to electrical machines : Faraday's laws of electromagnetic induction, Fleming's rule and Lenz's Law. Principle of operation of generators and motors. Space distribution of flux density and time variation of voltage. Flux wave in DC and AC machines. Magnetic curves and their relevance. DC Machines : Detailed construction and operating principle. Materials used for D.C. machines. Function of commutator and brush system. Induced emf in DC machine. Separate, Shunt, Series and Compound excitation. Losses and efficiency. Voltage build up of DC shunt generator. DC motoring action. Torque developed in DC motor. Armature windings, Equalisers. Armature reaction & its effects, mmf distribution,
compensating windings, Interpoles, Laminated yoke construction. Commutation, sparking, brushes, interface film. DC Generators – Characteristics with different excitation systems, voltage regulation, parallel operation. DC Motors – Characteristics and applications of Separate, Shunt, Series and Compound motors, methods of starting, speed control, equivalent circuit. Series-parallel operation of motors. Introduction to Permanent Magnet DC machines.
Testing of DC machines – Swinburne test, Hopkinson's test, Brake test. Tests specified as per standards.

1-phase Transformers : Construction and basic principle of operation. Core type and shell type. Materials used for core, winding and insulation. EMF equation. Core loss, copper loss and Leakage reactances. Harmonics in magnetizing current and magnetizing in-rush current. Generalised derivation of electrical equivalent circuit from magnetic structure. Equivalent circuit referred to primary. Phasor diagram. Parallel operation. Effects of changes of frequency and voltage on transformer performance. Dry-type and oil cooled type. Natural and forced types of cooling. Tank and radiator construction, operation. Transformer oil. Transformer accessories, eg., conservator, breather, Bucholtz relay, bushing, etc.
Power and Distribution Transformers, all-day efficiency.

Testing of transformers : Polarity of windings, OC and SC test, separation of losses, determination of equivalent circuit parameters. Regulation, efficiency, Single phase auto-transformers, principle of operation, phasor diagram. Comparison of weight, copper loss equivalent reactance with 2-winding transformer.

3-phase Transformers :As a single unit with name plate rating and as a bank of three single phase transformers; Vector groups for various connections; Per phase analysis; Qualitative explanation for origin of harmonic current and voltage and its suppression tertiary winding. Parallel operation conditions and load sharing.

Autotransformer: Basic constructional features; VA conducted magnetically and electrically. Comparative study with two winding transformer.

Recommended Textbooks

- Performance and Design of Alternating Current Machines: M.G. Say
- Performance and Design of DC machines: Clayton & Hancock.

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- Electrical Machinery : P. S. Bimbhra
- Electric Machines : I. J. Nagrath & D. P. Kothari
- Electrical Machines: A. Hussain
- Principles of Alternating Current machinery: Lawrence
- Electrical Machinery : A. E. Fitzgerald & C. Kingsley

Electrical Measurements and Measuring Instruments
TIU-UEE-T204
LTP: 3-1-0
Credits: 4

Classification of electrical measuring instruments, general feature of indicating instruments: controlling, damping, balancing torques.
Galvanometer: dynamics, sensitivity,D'Arsonval galvanometer, Ballistic galvanometer, Vibration Galvanometer,
PMMC instrument, temperature compensation, rectifier type instrument, Moving iron instrument, errors and compensations, electrodynamometer type instrument, extension of instrument range: - shunt, multiplier, Capacitive voltage divider power measurement for DC ,single and three phase AC circuit low power factor wattmeter, wattmeter connections and errors, Induction type energy meter: characteristics, errors and their compensation, current transformer(C.T.) , potential transformer (P.T.); testing and calibration of measuring instruments.
Measurement of medium resistance using Wheatstonebridge, Series and Shunt type ohmmeter.Measurement of high resistance using Meg.ohm bridge and Megger.Measurement of phase / power factor using electrodynamometer type and moving iron type instrument.
Measurement of frequency using electrical resonance type and ratio type instrument. Kelvin double bridge, measurement of surface resistivity. Measurement of inductances and capacitances, measurement of incrementalinductances, inter-bridge transformer, residuals, errors in bridges, detectors, DC potentiometer: Weston normal cell, Vernier type, Kelvin Verley slide, dual range, applications, phantom loading, AC potentiometer:- polar type and co-ordinate type, Use of Ballistic Galvanometer in magnetic testing, ac magnetic testing: Lloyd-fisher square, transducers: RTD, thermistor, thermocouple, laws of thermocouple circuits, cold junction compensation, strain gauge.

Recommended Textbooks

- A Course in Electrical & Electronic Measurements & Instrumentation: A.K. Sawhney
- Electrical Measurement and Measuring Instruments: Purkait
- Electrical Measurement & Measuring Instrument : by Golding & Widdis

Signals & Systems
TIU-UEE-T206
LTP: 3-1-0
Credits: 4

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General concept of Systems: Classification. Differential equation of Systems. Definition of Linear Time invariant (LTI) Systems. Laplace Transform (LT) methods for solving linear differential equations with constant coefficients. Concept of transfer function.
Open-loop and closed-loop systems. Poles and zeros. Bode Plots. Time response ofFirst and second order systems. Time-domain specifications. Concept of damping ratio and natural frequency. Effect of addition of poles and zeros. Modeling of Dynamic Systems: Mechanical systems (including rotary systems, gears, articulated systems, Electromechanical systems, DC motors, moving coil speakers, ballistic galvanometers, Thermal systems (first order and second order models), Electric circuit analogues. Modeling of LTI systems using operational amplifiers. Simulation of differential equations with operational amplifiers. Amplitude scaling and Time Scaling. Linear Algebra. State variable representation of systems: Normalization of linear equations. Concept of state variables. Representation in standard forms. Concept of state trajectories. Time response of second order systems.
Classification of signals: Deterministic & random signals, continuous-time(CT) & discrete time (DT) signals, Power & Energy signals, causal &non-causal signals. Time-domain operations on CT signals. Mathematical descriptions of deterministic CT signals,
Singularity functions. Impulse (Dirac Delta) function and its properties. Decomposition of simple aperiodic waveforms in terms of singularity-function components. ConvolutionIntegral: analytical & graphical convolution, properties of convolution.
Review ofTrigonometric Fourier Series for CT periodic signals. Exponential Fourier Series andLine-Spectra. Gibbs phenomenon. Properties of Fourier Series. CT Fourier Transform &Integral. Generalized Fourier Transform. Parseval's theorem. Properties of FourierTransform. Power Spectral Density of periodic signals. Energy Spectral Density.
Concept of autocorrelation functions for deterministic signals. Frequency response of LTI systems: Definitions, significance, frequency responses of first-order & second-order systems. Causality: Paley-Wiener criterion, frequency response of ideal filters. Linearphase systems. Invertibility of LTI systems. Stability concepts. Introduction to discretetime signals, impulse modulation. Preliminaries of Z-transform.

Recommended Textbooks

- Signals and Systems: Oppenheim, Willsky and Nawab
- Modern Control Systems: Dorf, Bishop
- Modern Control Engineering: Ogata
- Signals and Systems: Philips and Parr

Analog Electronics
TIU-UEE-T208
LTP: 3-0-0
Credits: 3

Elementary Physics: Semiconductor Materials; Intrinsic and Extrinsic Type;Characteristics of P-N Junction. Basic Semiconductor Devices: P-N Junction Diode;Schottky Diode; Zener Diode; Bipolar Transistor; JFET; MOSFET.

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Modelling ofSemiconductor Devices: Hybrid parameters. Biasing: CE, CB and CC TransistorConfiguration; JFET and MOSFET. Feedback amplifiers: Characteristics of Negative andPositive Feedback. Transistor Power Amplifiers: Class A, AB, and ComplimentarySymmetry.
Operational Amplifiers: Characteristics; Inverting, Non-Inverting, Summing and Differentiating Amplifiers; Integrator and Differentiator; Voltage Comparator;Precision Rectifier; Sample and Hold; Study and application of integrated circuit like 741.
Waveform generators: Sine, Square, Triangular and Sawtooth. Opto-Electronics:
Elementary Physics; LED; LCD; Photo-Diodes; Photo-Transistors; LDR; 7-Segment andAlpha-Numeric Displays; Opto-Isolators and Interrupters. Oscillators: Wien bridge, Colpitts, Hartley, Phase Shift and Quadrature; VCO; Applications using Op-amp. Multivibrators: Monostable, Bistable and Astable; Implementation using 555 Timer. Special Connections: Darlington Pair; Bootstrap; Schmitt Trigger; Constant Current Sources and Sinks. Transistor Voltage Regulators: Series and Shunt Circuits; Study of integrated circuit like 7805.

Recommended Textbooks

- Electronic Devices and Circuit Theory: Boylestad
- Electronic Principles: Malvino and Bates

Thermal Engineering
TIU-UME-T210
LTP: 3-0-0
Credits: 3

The detailed syllabus to be provided by the Department of Mechanical Engineering