NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 2nd YEAR (ELECTRICAL & ELECTRONICS ENGINEERING)
SEMESTER-III

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Sessional Marks	Final Marks	Total	Credits
				L	T	P				
1	PCC	ELPC302	ANALOG ELECTRONIC CIRCUITS	3	-	-	30	70	100	3
2	PCC	ELPC301	ELECTRICAL CIRCUIT ANALYSIS	3	1	-	30	70	100	4
3	PCC	ELPC303	ELECTRICAL MACHINES-1	3	-	-	30	70	100	3
4	ESC	ELES305	ENGINEERING MECHANICS	3	1	-	30	70	100	4
5	BSC	ELBS321	MATHEMATICS - III	3	1	-	30	70	100	4
6	MC		MANDATORY COURSE	2	-	-	30	70	100	0
7	PCC	ELPC353	ELECTRICAL MACHINES-I LAB	-	-	2	30	70	100	1
8	PCC	ELPC352	ANALOG ELECTRONIC CIRCUITS LAB	-	-	2	30	70	100	1
9	SEC	EESE361	ELECTRICAL AND ELECTRONICS WORKSHOP -III	-	-	4	30	70	100	2
			TOTAL				**270**	**630**	**900**	**22**

	Course Code	Course Title
Mandatory Course	MC-01 (Common to all)	Constitution of India
	MC-02 (Common to all)	Essence of Indian Traditional Knowledge

NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 2nd YEAR (ELECTRICAL & ELECTRONICS ENGINEERING)
SEMESTER-IV

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Sessional Marks	Final Marks	Total	Credits
				L	T	P				
1	PCC	ELPC401	DIGITAL ELECTRONICS	3	-	-	30	70	100	3
2	PCC	ELPC402	ELECTRICAL MACHINES-II	3	-	-	30	70	100	3
3	PCC	EEPC403	ELECTRO MAGNETIC FIELDS	3	-	-	30	70	100	3
4	PCC	ELPC404	SIGNAL & SYSTEMS	3	-	-	30	70	100	3
5	PCC	EEPC405	MEASURMENT & INSTRUMENTATION	2	-	-	30	70	100	2
6	BSC	BSC-01 (Common Subject)	BIOLOGY	2	1	-	30	70	100	3
7	PCC	ELPC451	DIGITAL ELECTRONICS LAB	-	-	2	30	70	100	1
8	PCC	ELPC452	ELECTRICAL MACHINE-II LAB	-	-	2	30	70	100	1
9	PCC	EEPC453	MEASURMENT & INSTRUMENTATION LAB	-	-	2	30	70	100	1
10	MC	MC 02 (Common Subject)	Essence of Indian Traditional Knowledge	2	-	-	30	70	100	0
11	SEC	EESE461	ELECTRICAL AND ELECTRONICS WORKSHOP –IV	-	-	4	30	70	100	2
			TOTAL				**330**	**770**	**1100**	**22**

ELPC302	Analog Electronic Circuit	3L:0T:0P	3 Credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of transistors.
2. Design and analyse various rectifier and amplifier circuits. Design sinusoidal and non-sinusoidal oscillators.
3. Understand the functioning of OP-AMP and design OP-AMP based circuits.

Unit 1: Diode circuits (4 Hours)

junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Unit 2: BJT circuits (8 Hours)

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Unit 3: MOSFET circuits (8 Hours)

MOSFET structure and I-V characteristics, MOSFET as a switch, MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Unit 4: Differential, multi-stage and operational amplifiers (8 Hours)

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Unit5: Linear applications of op-amp (8 Hours)

Idealized analysis of op-amp circuits, Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift).Analog to Digital Conversion.

Unit 6: Nonlinear applications of op-amp (6 Hours)

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators, Precision rectifier, peak detector, Monoshot.

Text/References:

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford UniversityPress, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
5. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

ELPC301	Electrical Circuit Analysis	3L:1T:0P	4 credits

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Apply network theorems for the analysis of electrical circuits.
2. Obtain the transient and steady-state response of electrical circuits.
3. Analyse circuits in the sinusoidal steady-state (single-phase and three-phase). Analyse two port circuit behaviour

Unit 1: Network Theorems (10 Hours)
Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources.Node and Mesh Analysis. Concept of duality and dual networks

Unit 2: Solution of First and Second order networks (8 Hours)
Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Unit 3: Sinusoidal steady state analysis (8 Hours)
Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Unit 4: Electrical Circuit Analysis Using Laplace Transforms (8 Hours)
Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

Unit 5: Two Port Network and Network Functions (6 Hours)
Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Text / References:

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999.

ELPC303	Electrical Machines-I	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of magnetic circuits.
2. Understand the operation of dc machines.
3. Analyse the differences in operation of different dc machine configurations.
   Analyse single phase and three phase transformers circuits.

Unit 1:Magnetic fields and magnetic circuits (6 Hours)

Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

Unit 2: Electromagnetic force and torque (9 Hours)

B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency

Unit 3: DC machines (8 Hours)

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Unit 4: DC machine - motoring and generation (7 Hours)

Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited,shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

Unit 5: Transformers (12 Hours)

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

Text / References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

ELES305	Engineering Mechanics	3L:1T:0P	4 credits

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the concepts of co-ordinate systems.
2. Analyse the three-dimensional motion.
3. Understand the concepts of rigid bodies.
4. Analyse the free-body diagrams of different arrangements. Analyse torsional motion and bending moment.

Unit 1: Introduction to vectors and tensors and co-ordinate systems (5 hours) Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indical notation; Symmetric and anti-symmetric tensors; Eigenvalues and Principal axes.

Unit 2: Three-dimensional Rotation (4 hours)
Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.

Unit 3: Kinematics of Rigid Body (6 hours)
Kinematics of rigid bodies: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two-and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.

Unit 4: Kinetics of Rigid Bodies (5 hours)
Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.

Unit 5: Free Body Diagram (1 hour)
Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.

Unit 6: General Motion (9 hours)
Examples and problems.General planar motions.General 3-D motions.Free precession, Gyroscopes, Rolling coin.

Unit 7: Bending Moment (5 hours)
Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.

Unit 8: Torsional Motion (2 hours)
Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

Unit 9: Friction (3 hours)
Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

Text / References:

1. J. L. Meriam and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley, 2011.
2. M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & Business Media, 1986.

EEBS321	Mathematics-III (Probability and Statistics)	3L:1T:0P	4 credits

Unit 1: Basic Probability (12 hours)
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Unit 2: Continuous Probability Distributions (4 hours)
Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Unit 3: Bivariate Distributions (4 hours)
Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Unit 4: Basic Statistics (8 hours)
Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Unit 5: Applied Statistics (8 hours)
Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Unit 6: Small samples (4 hours)
Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes

Text / References:

1. E. Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall, 2003.
3. S. Ross, “A First Course in Probability”, Pearson Education India, 2002.
4. W. Feller, “An Introduction to Probability Theory and its Applications”, Vol. 1, Wiley, 1968.
5. N.P. Bali and M. Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, 2010.
6. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 2000.
7. T. Veerarajan, “Engineering Mathematics”, Tata McGraw-Hill, New Delhi, 2010.

ELPC353	Electrical Machine-1 Lab	0L:0T:2P	1 Credits

List of Experiments

1. To obtain magnetization characteristics of separately excited DC Machine.
2. To obtain magnetization characteristics of self-excited DC Machine.
3. To obtain Load characteristics D.C series generator.
4. To obtain Load characteristics of D.C Shunt Generator.
5. To obtain speed torque, speed current and torque current characteristics of DC shunt motor.
6. Speed control of DC shunt motor.
7. To obtain efficiency of dc machine using Swinburne's Test.
8. To perform polarity test on transformer and also find turn ratio.
9. To perform OC & SC tests on single - phase transformer and draw equivalent circuit.
10. To perform direct load test on single - phase transformer and draw efficiency vs load curve.
11. Sumpner's test on Transformers
12. Scott Connection of Transformers
13. Parallel Operation of Two Single - Phase Transformers.

NOTE: At least ten experiments are to be performed; at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

ELPC352	Analog Electronic Circuit Lab	0L:0T:2P	1 Credits

List of Experiments

1. Study the following devices: (a) Analog & digital multimeters (b) Function/ Signal generators (c) Regulated d. c. power supplies (constant voltage and constant current operations) (d) Study of analog CRO, measurement of time period, amplitude, frequency & phase angle using Lissajous figures.
2. Plot V-I characteristic of P-N junction diode & calculate cut-in voltage, reverse Saturation current and static & dynamic resistances.
3. Plot V-I characteristic of zener diode and study of zener diode as voltage regulator. Observe the effect of load changes and determine load limits of the voltage regulator.
4. Plot frequency response curve for single stage amplifier and to determine gain bandwidth product.
5. Plot drain current - drain voltage and drain current – gate bias characteristics of field effect transistor and measure of Idss & Vp
6. Application of Diode as clipper & clamper
7. Plot gain- frequency characteristic of two stage RC coupled amplifier & calculate its bandwidth and compare it with theoretical value.
8. Plot gain- frequency characteristic of emitter follower & find out its input and output resistances.
9. Plot input and output characteristics of BJT in CB, CC and CE configurations. Find their h-parameters.
10. Study half wave rectifier and effect of filters on wave. Also calculate theoretical & practical ripple factor.
11. Study bridge rectifier and measure the effect of filter network on D.C. voltage output & ripple Factor.
12. To plot the characteristics of MOSFET.
13. To determine the following parameters of OP-AMP.a) Input Bias Current. b) Input Offset Current. c) Input Offset Voltage. d) CMRR
14. To plot the frequency response curve of an amplifier with and without feedback
15. To determine the frequency of oscillations of a given RC phase shift Oscillator.
16. Design & realize Wein -bridge oscillator using op amp 741.
17. To design & realize zero crossing detector using op amp 741

NOTE: At least ten experiments are to be performed; at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

MC-01	CONSTITUTION OF INDIA	2L:0T:0P	0 Credits

CONSTITUTION OF INDIA– BASIC FEATURES AND FUNDAMENTAL PRINCIPLES

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the “basic structure” of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of “Constitutionalism” – a modern and progressive concept historically developed by the thinkers of “liberalism” – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of “constitutionalism” in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India’s legacy of “diversity”. It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be “static” and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it “as one of the strongest court in the world”.

COURSE CONTENT

1. Meaning of the constitution law and constitutionalism.
2. Historical perspective of the Constitution of India.
3. Salient features and characteristics of the Constitution of India.
4. Scheme of the fundamental rights.
5. The scheme of the Fundamental Duties and its legal status.
6. The Directive Principles of State Policy – Its importance and implementation.
7. Federal structure and distribution of legislative and financial powers between the Union and the States.
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure

10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

REFERENCES:

1. The Constitutional Law Of India 9th Edition, by Pandey. J. N.
2. The Constitution of India by P.M.Bakshi
3. Constitution Law of India by Narender Kumar
4. Bare Act by P. M. Bakshi

MC-02	Essence of Indian Knowledge Tradition	2L:0T:0P	0 credits

भारतीयविद्यासार

Course objective

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course Contents

– Basic structure of Indian Knowledge System: अष्टादशविद्या -४वेद,४उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थापत्य आदि) ६वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद) ४ उपाङ्ग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)

– Modern Science and Indian Knowledge System

– Yoga and Holistic Health care

– Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, BharatiyaVidyaBhavan, Mumbai. 5th Edition,2014
- Swami Jitatmanand, *Modern Physics and Vedant*, BharatiyaVidyaBhavan
- Swami Jitatmanand, *Holistic Science and Vedant,* BharatiyaVidyaBhavan
- Fritzof Capra, *Tao ofPhysics*
- Fritzof Capra, *The Wave oflife*
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad,Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission,Kolkata
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanamwith VyasaBhashya*, VidyanidhiPrakashan, Delhi2016
- RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, VidyanidhiPrakashan, Delhi2016
- P B Sharma (English translation), *ShodashangHridayan*

Pedagogy: Problem based learning, group discussions, collaborative mini projects.

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

ELPC401	Digital Electronics	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Be able to use PLDs to implement the given logical problem.

Unit 1: Fundamentals of Digital Systems and logic families (7Hours)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic ,one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit 2: Combinational DigitalCircuits (7Hours)

Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Unit 3: Sequential circuits and systems (7Hours)

A 1-bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, J- K, T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Unit 4: A/D and D/A Converters (7Hours)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using Voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

Unit 5: Semiconductor memories and Programmable logic devices. (7Hours) Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Text/References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

ELPC402	Electrical Machines – II	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of rotating magnetic fields.
2. Understand the operation of ac machines.
3. Analyse performance characteristics of ac machines.

Unit: Fundamentals of AC machine windings (8 Hours)

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor

Unit 2: Pulsating and revolving magnetic fields (4 Hours)

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Unit 3: Induction Machines (12 Hours)

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

Unit 4: Single-phase induction motors (6 Hours)

Constructional features double revolving field theory, equivalent circuit, and determination of parameters. Split-phase starting methods and applications

Unit 5: Synchronous machines (10 Hours)

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Text/References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

EEPC403	Electromagnetic Fields	3L:0T:0P	3 credits

Course Outcomes:

At the end of the course, students will demonstrate the ability

1. To understand the basic laws of electromagnetism.
2. To obtain the electric and magnetic fields for simple configurations under static conditions.
3. To analyse time varying electric and magnetic fields.
4. To understand Maxwell's equation in different forms and different media. To understand the propagation of EM waves.

This course shall have Lectures and Tutorials. Most of the students find difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.

Unit 1: **Review of Vector Calculus (6 hours)**

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation ,integration, vector operator del, gradient ,divergence and Curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Unit 2: Static Electric Field (6 Hours)

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Unit 3: Conductors, Dielectrics and Capacitance (6 Hours)

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Unit 4: Static Magnetic Fields (6 Hours)

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Unit 5: Magnetic Forces, Materials and Inductance (6 Hours)

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Unit 6: Time Varying Fields and Maxwell's Equations (6 Hours)

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions

Unit 7: Electromagnetic Waves (6 Hours)

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Text / References:

1. M. N. O. Sadiku, “Elements of Electromagnetics”, Oxford University Publication, 2014.
2. A. Pramanik, “Electromagnetism - Theory and applications”, PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, “Electromagnetism-Problems with solution”, Prentice Hall India, 2012.
4. G. W. Carter, “The electromagnetic field in its engineering aspects”, Longmans, 1954.
5. W. J. Duffin, “Electricity and Magnetism”, McGraw Hill Publication, 1980.
6. W. J. Duffin, “Advanced Electricity and Magnetism”, McGraw Hill, 1968.
7. G. Cullwick, “The Fundamentals of Electromagnetism”, Cambridge University Press, 1966.
8. B. D. Popovic, “Introductory Engineering Electromagnetics”, Addison-Wesley Educational Publishers, International Edition, 1971.
9. W. Hayt, “Engineering Electromagnetics”, McGraw Hill Education, 2012.

ELPC404	Signals and Systems	2L:1T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of continuous time and discrete time systems.
2. Analyse systems in complex frequency domain.
3. Understand sampling theorem and its implications.

Unit 1: Introduction to Signals and Systems (3 hours):

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Unit 2: Behavior of continuous and discrete-time LTI systems (8 hours)

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems.State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Unit 3: Fourier, Laplace and z- Transforms (10 hours)

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Unit 4: Sampling and Reconstruction (4 hours)

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text/References:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
3. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.

4. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
6. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
7. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.

EEPC405	Measurements and Instrumentation	2L:0T:0P	2 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to
1. Design and validate DC and AC bridges.
2. Analyze the dynamic response and the calibration of few instruments.
3. Learn about various measurement devices, their characteristics, their operation and their limitations.
4. Understand statistical data analysis.
5. Understand computerized data acquisition.

Unit 1: Concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity.

Unit 2:Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, C_p, C_{pk}.

Unit 3 :Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.

Unit 4 :Current and Voltage Measurements. Shunts, Potential Dividers. Instrument Transformers, Hall Sensors.

Unit 5: Measurements of R, L and C.Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.Digital Storage Oscilloscope.

Text/ Reference **Books**:

1. A course in Electrical And Electronic measurement and instrumentation : A.K. Sawhney, Dhanpat Rai Publication
2. Electrical Measurements: E.W. Golding
3 . Electronic instrumentation and measurement technique : W.D. Cooper & A.D. Helfrick
4. Measuring systems : E.O. Doeblin; TMH

ELPC451	**Digital Electronics Lab**	**0L:0T:2P**	**1 credits**

List of Experiments

1. Study of TTL gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.
2. Design & realize a given function using K-maps and verify its performance.
3. To verify the operation of multiplexer & Demultiplexer.
4. To verify the operation of comparator.
5. To verify the truth tables of S-R, J-K, T & D type flip flops.
6. To verify the operation of bi-directional shift register.
7. To design & verify the operation of 3-bit synchronous counter.
8. To design and verify the operation of synchronous UP/DOWN decade counter using J K flip-flops & drive a seven-segment display using the same.
9. To design and verify the operation of asynchronous UP/DOWN decade counter using J K flip-flops & drive a seven-segment display using the same.
10. To design & realize a sequence generator for a given sequence using J-K flip-flops.
11. Study of CMOS NAND & NOR gates and interfacing between TTL and CMOS gates.
12. Design a 4-bit shift-register and verify its operation . Verify the operation of a ring counter and a Johnson counter.

NOTE : At least ten experiments are to be performed, at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

ELPC452	Electrical Machine-II Lab	0L:0T:2P	1 credits

List of Experiments

1. To study starting methods of induction motors.
2. Determination of the effect of rotor resistance on the torque speed curve.
3. Load test on 3 - phase squirrel cage induction motor.
4. Load test on 3 - phase slip ring induction motor.
5. No load and Blocked rotor test on 3 - phase induction motor.
6. Effect of capacitor on the starting and running of single phase induction motor and method of reversing the direction of rotation.
7. Brake test on single - phase induction motor
8. Determination of Equivalent Circuit of Single - Phase Induction Motor
9. To determine voltage regulation of alternator by direct loading.
10. Determination of regulation of an alternator by emf method.
11. Determination of regulation of an alternator by ZPF method.
12. To determine Xd and Xq ofa salient pole synchronous machine by slip test.
13. To determine sub transient reactance (Xd'' and Xq'') of synchronous machine.
14. Determination of negative sequence and zero sequence reactance os a synchronous generator.
15. To perform parallel operation of alternators using dark lamp method.
16. To plot V-curve and invert V-curve of synchronous motor.

NOTE: Atleast ten experiments are to be performed; at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

EEPC453	**Measurements and Instrumentation Lab**	**0L:0T:2P**	**1 credits**

Hands-on experiments related to the course contents of EEE405 such as:

Experiments

Measurement of a batch of resistors and estimating statistical parameters.

Measurement of L using a bridge technique as well as LCR meter.
Measurement of C using a bridge technique as well as LCR meter.

Measurement of Low Resistance using Kelvin's double bridge.
Measurement of High resistance and Insulation resistance using Megger.

Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.

Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.

Usage of DSO to capture transients like a step change in R-L-C circuit.
Current Measurement using Shunt, CT, and Hall Sensor.

NOTE: At least ten experiments are to be performed; atleast seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

BSC01	BIOLOGY	2L:1T:0P	3 credits

Module 1. (2 hours)- Introduction

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2. (3 hours)- Classification

Purpose: To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module 3. (4 hours)-Genetics

Purpose: To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences” Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module 4. (4 hours)-Biomolecules

Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module 5. (4 Hours). Enzymes

Purpose: To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Module 6. (4 hours)- Information Transfer

Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7. (5 hours). Macromolecular analysis

Purpose: How to analyse biological processes at the reductionist level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8. (4 hours)- Metabolism

Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Module 9. (3 hours)- Microbiology

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

References:

1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD

NEW SCHEME OF STUDIES AND EXAMINATION

B-TECH 3rd YEAR (ELECTRICAL & ELECTRONICS ENGINEERING)
SEMESTER-V

Sr. No.	Categ Ory	Course Code	Course Title	Hours Per Week			Sessional Marks	Final Marks	Total	Credits
				L	T	P				
1	PCC	ELPC501	POWER SYSTEMS-I (Apparatus and Modelling)	3	-	-	30	70	100	3
2	PCC	EEPC503	POWER ELECTRONICS	3	-	-	30	70	100	3
3	PCC	ELPC502	CONTROL SYSTEMS	3	-	-	30	70	100	3
4	PCC	EEPC504	ANALOG & DIGITAL COMMUNICATION	3	-	-	30	70	100	3
5	PEC		PROGRAM ELECTIVE-I	3	-	-	30	70	100	3
6	OEC		OPEN ELECTIVE-I	3	-	-	30	70	100	3
7	PCC	ELPC551	POWER SYSTEMS LAB-I	-	-	2	30	70	100	1
8	PCC	EEPC553	POWER ELECTRONICS LAB	-	-	2	30	70	100	1
9	PCC	ELPC552	CONTROL SYSTEM LAB	-	-	2	30	70	100	1
10	SEC	EESE561	ELECTRICAL AND ELECTRONICS WORKSHOP –V	-	-	4	30	70	100	2
			TOTAL				**300**	**700**	**1000**	**23**

	Course Code	Course Title
Program Elective-I	EEPE511	Biomedical Electronics
	EEPE514	Nano Electronics
	ELPE512	Electrical Machine Design

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ELPC501	POWER SYSTEMS-I (Apparatus and Modelling)	3L:0T:0P	3 credits

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the concepts of powers ystems.
2. Understand the various power system components.
3. Evaluate fault currents for different types of faults.
4. Understand the protection against over-voltages and insulation coordination. Understand basic protection schemes.
5. Understand concepts of dc power transmission and renewable energy systems

Unit 1: Basic Concepts (4 hours)
Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids.
Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Power Transfer in AC circuits and Reactive Power.

Unit 2: Power System Components (15 hours)
Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.
Loads: Types, Voltage and Frequency Dependence of loads, Per Unit System and Per Unit Calculations

Unit 3: Over-voltages and Insulation Requirements (4 hours)
Protection against Over-voltages, Insulation Coordination.

Unit 4: Fault Analysis and Protection Systems (10 hours)
Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding
Switchgear: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection.
Protection schemes (Over-current, directional, distance protection, differential protection) and their application.

Unit5: Introduction to DC Transmission and Renewable energy systems (9 hours)
HVDC transmission: types of links; Introduction to solar PV systems

Text/References:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education,1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education,1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc.,1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education,2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

ELPC551	Power Systems-I Lab	0L:0T:2P	1 credits

Hands-on experiments related to the course contents of ELPC-501. Visits to power system installations (generation stations, EHV substations etc.) are suggested.

EEPC503	**Power Electronics**	**3L:0T:0P**	**3 credits**

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the differences between signal level and power level devices.
2. Analyse controlled rectifier circuits.
3. Analyse the operation of DC-DC choppers.
4. Analyse the operation of voltage source inverters.

Unit 1: Power switching devices (8Hours)

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Unit 2: Thyristor rectifiers (7Hours)

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Unit 3: DC-DC buck converter (5Hours)

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Unit 4: DC-DC boost converter (5Hours)

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Unit 5: Single-phase voltage source inverter (10Hours)

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Unit 6: Three-phase voltage source inverter (8Hours)

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

Text/References:

1. M. H. Rashid, "*Power electronics: circuits, devices, and applications*", Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
4. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

EEPC553	**Power Electronics Lab**	**0L:0T:2P**	**1 credits**

Hands-on experiments related to the course contents of **ELPC503**

ELPC 502	Control Systems	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will be able to

1. Understand the modeling of linear-time-invariant systems using transfer function and state- space representations.
2. Design specifications for second order systems based on time response.
3. Interpret the Concept of stability and its assessment for linear-time invariant systems using various methods.
4. Design controllers in time and frequency domain.
5. Explain the basic concept of optimal and non linear control systems.

Unit 1: Introduction to control problem (8 hours)

Industrial Control examples, Mathematical models of physical systems, Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback, Transfer Function of control system, impulse response and its relation with transfer function of linear systems. Transfer function from Block diagram reduction technique and signal flow graph, Mason's gain formula.

Unit 2: Time Response Analysis (6 hours)

Standard test signals, Time response of first and second order systems for standard test inputs, Application of initial and final value theorem, Design specifications for second-order systems based on the time-response. Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique, Construction of Root-loci

Unit 3: Frequency-response analysis (6 hours)

Relationship between time and frequency response, Polar plots, Bode plots, Nyquist stability criterion, Relative stability using Nyquist criterion – gain and phase margin, Closed-loop frequency response.

Unit 4: Introduction to Controller Design (10 hours)

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems, Root-loci method of feedback controller design, Design specifications in frequency-domain, Frequency-domain methods of design, Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs, Analog and Digital implementation of controllers.

Unit 5: State Variable Analysis of Linear Dynamic Systems (4 hours)

State variables, State variable representation of system, dynamic equations, merits for higher order differential equations and solution, Concept of controllability and observability and techniques to test them

Unit 6: Introduction to Optimal Control and Nonlinear Control (5 hours)

Performance Indices, Regulator problem, Tracking Problem., Nonlinear system–Basic concepts and analysis

Text/References:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.

2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

3. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.

I. J. Nagrath and M.Gopal, "Control Systems Engineering", New Age International, 2009

ELPC552	**Control Systems Lab**	**0L:0T:2P**	**3 credits**

Hands-on/Computer experiments related to the course contents of ELPC502

EEPC504	Analog and Digital Communication	3L:0T:0P	3 credits

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.
Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasise, Threshold effect in angle modulation.
Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM),Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.
Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying. Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques.
Synchronization and Carrier Recovery for Digital modulation.

Text/Reference Books:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behavior of a communication system in presence of noise
3. Investigate pulsed modulation system and analyze their system performance
4. Analyze different digital modulation schemes and can compute the bit error performance

EEPE511	Biomedical Electronics	3L:0T:0P	3 credits

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the application of the electronic systems in biological and medical applications.
2. Understand the practical limitations on the electronic components while handling biosubstances.
3. Understand and analyze the biological processes like other electronic processes.

Detail Syllabus:

Brief introduction to human physiology. Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases. Bio-electrodes and biopotential amplifiers for ECG, EMG, EEG, etc.

Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrasonic,X-ray and nuclear imaging. Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped. Safety aspects.

Text/Reference Books:

1. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
2. J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
3. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

EEPE514	Nano Electronics	3L:0T:0P	3 credits

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig- Penny Model. Brillouin Zones.

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.), Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Text/ Reference Books:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

ELPE512	Electrical Machine Design	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will be able to

1. Understand the construction and performance characteristics of electrical machines.
2. Analyze the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
3. Estimate the overall dimensions and operating characteristics of AC/DC machines
4. Explain the concept of computer aided design CAD and optimal design of electrical machines

Unit 1: Introduction

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

Unit 2: Transformers

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

Unit 3: Induction Motors

Sizing of an induction motor, main dimensions, output equation, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

Unit 4: Synchronous Machines

Sizing of a synchronous machine, main dimensions, output equation, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design, cooling of turbo alternators.

Unit-5: DC Machines

Sizing of a direct current machine, main dimensions, output equation, selection of number of poles, core length, armature diameter, Length of air gap, Choice of armature winding, number of armature coils, number of armature slots, slot dimensions, Armature voltage drop, depth of armature core, design of field system, Design of Commutator

Unit 6: **Computer aided Design (CAD):**

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to **c**omplex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Text / References:

1. A. K. Sawhney, “A Course in Electrical Machine Design”, Dhanpat Rai and Sons,1970.
2. M.G. Say, “Theory & Performance & Design of A.C. Machines”, ELBS London.
3. S. K. Sen, “Principles of Electrical Machine Design with computer programmes”, Oxford and IBH Publishing,2006.
4. K. L. Narang, “A Text Book of Electrical Engineering Drawings”, SatyaPrakashan,1969.
5. A. Shanmugasundaram, G. Gangadharan and R. Palani, “Electrical Machine Design Data Book”, New Age International,1979.
6. K. M. V. Murthy, “Computer Aided Design of Electrical Machines”, B.S. Publications,2008.
7. Electrical machines and equipment design exercise examples using Ansoft’s Maxwell 2D machine design package...

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD

NEW SCHEME OF STUDIES AND EXAMINATION

B-TECH 3rd YEAR (ELECTRICAL & ELECTRONICS ENGINEERING)

SEMESTER-VI

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Sessional Marks	Final Marks	Total	Credits
				L	T	P				
1	PCC	EEPC601	DIGITAL SYSTEM DESIGN	3	-	-	30	70	100	3
2	PCC	ELPE613	DIGITAL SIGNAL PROCESSING	3	-	-	30	70	100	3
3	PCC	ELPC503*	MICROPROCESSORS	3	-	-	30	70	100	3
4	PEC		PROGRAM ELECTIVE-II	3	-	-	30	70	100	3
5	PEC		PROGRAM ELECTIVE-III	3	-	-	30	70	100	3
6	OEC		OPEN ELECTIVE-II	3	-	-	30	70	100	3
7	PCC	ELPC553*	MICROPROCESSOR LAB	-	-	2	30	70	100	1
8	PCC	EEPC652	DIGITAL SIGNAL PROCESSING LAB	-	-	2	30	70	100	1
9	PCC	EEPC651	DIGITAL SYSTEM DESIGN LAB	-	-	2	30	70	100	1
10	SEC	EESE661	ELECTRICAL AND ELECTRONICS WORKSHOP –VI	-	-	4	30	70	100	2
			TOTAL				**300**	**700**	**1000**	**23**

	Course Code	Course Title
Program Elective-II	ELPE611	Electrical Drives
	EEPE612	Embedded System Design
	EEPE613	Microwave Theory and Techniques

	Course Code	Course Title
Program Elective-III	ELPE614	Wind and Solar Energy System
	ELPE615	Computational Electromagnetics
	ELPE616	Digital Control System

* Common with 5th semester Electrical Engineering

EEPC601	Digital System Design	3L:0T:0P	3 credits

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractions, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU
Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices

VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Text/Reference Books:

1. R.P. Jain, " Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL" , Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, " Digital Electronics- An introduction to theory and practice", PHI, 2nd edition ,2006.
4. D.V. Hall, " Digital Circuits and Systems", Tata McGraw Hill, 1989
5. Charles Roth, " Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

Course outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation

EEPC651	Digital System Design Lab	0L:0T:2P	1 credits

Hands-on experiments related to the course contents **EEPC601.**

ELPE613	Digital Signal Processing	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
2. Analyse discrete-time systems using z-transform.
3. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms. Design digital filters for various applications.
4. Apply digital signal processing for the analysis of real-life signals.

Unit 1: Discrete-time signals and systems (6 hours)

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Samplingand reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

Unit 2: Z-transform (6 hours)

z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of z-transform for causal signals, Interpretation of stability in z- domain, Inverse z-transforms.

Unit 3: Discrete Fourier Transform (10 hours)

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Connvolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Unit 4:Designof Digital filters (12 hours)

Designof FIR Digital filters: Windowmethod,Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations;Low-pass, Band-pass, Band-stop and High-pass filters.Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation.Introduction to multi-rate signalprocessing.

Unit 5: Applications of Digital Signal Processing (6 hours)

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Text/Reference Books:

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992.
5. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.

EEPC652	Digital Signal Processing Lab	0L:0T:2P	1 credits

Hands-on experiments related to the course contents **EEPC602**

ELPC503*	Microprocessors	3L:0T:0P	3 credits

Course Outcomes: At the end of the course the student will be able to:

CO1	Understand the basic architecture of 8086 microprocessor.
CO2	Write assembly language programs to perform a given task.
CO3	Write interrupt service routines for all interrupt types
CO4	Interface memory and I/O devices to 8086 using peripheral devices
CO5	Write microcontroller programs and interface devices

Detailed syllabus

UNIT-I Introduction: Evolution of Microprocessors, Internal Architecture of 8085/8086, BIU and EU, Registers in of 8085/8086, Memory segmentation

UNIT-II Instruction sets and Addressing modes: Addressing modes-register related, Addressing modes-memory related, Instruction formats, Instruction set of 8086-functional groups, Assembler Directives, assembly language programming.

UNIT-III Pin and timing diagrams of 8086: Pin diagram of 8086 in minimum mode & Maximum mode configuration, Timing diagram of typical read write instructions.

UNIT-IV Interrupts- Steps in interrupt process, Interrupt structure in 8086, Internal and external interrupts-interrupt service routines.

UNIT-V Interfacing the microprocessor- Interfacing of I/O devices, Interfacing I/O-programmable peripheral interface-8255, Interfacing of multi digit seven segment display, Interfacing timer-Programmable interval timer-8254.

UNIT-VI Serial interface and data converters-USART 8251, Serial interface standards-RS 232 C and RS -485, Interfacing of ADCs and DACs,

UNIT-VII Microcontrollers- Introduction to Microcontroller, 8051 Microcontroller, memory and I/ O organization, Applications of Microcontroller.

Reading:

1. Douglas V. Hall : Microprocessors and Interfacing, TMH-Revised Second Edition, 2005
2. A.K. Ray & Burchandi: Advanced Microprocessors and Peripherals, TMH, 2003.

Ajay V. Deshmukh: Microcontrollers –Theory and Applications, TMH, 2009.

ELPC553*	Microprocessors Laboratory	0L:0T:2P	1 credits

Hands-on experiments related to the course contents of ELPC503

* Common with 5th semester Electrical Engineering

ELPE611	Electrical Drives	3L:0T:0P	3 credits

Course Outcomes:
At the end of this course, students will demonstrate the ability to

1. Understand the characteristicsof dc motors and induction motors.
2. Understand the principles of speed-control of dc motors and induction motors.
3. Understand the power electronic converters used for dc motor and induction motor speed control.

Unit 1: DC motor characteristics (5 hours)
Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation.

Unit 2: Chopper fed DC drive (5 hours)
Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.

Unit 3: Multi-quadrant DC drive (6 hours)
Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.

Unit 4: Closed-loop control of DC Drive (6 hours)
Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design.

Unit 5: Induction motor characteristics (6 hours)
Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.

Unit 6: Scalar control or constant V/f control of induction motor (6 hours)
Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

Unit 7: Control of slip ring induction motor (6 hours)
Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery.

Text / References:

1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall, 2001.
3. G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002.
4. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.

EEPE612	Embedded System Design	3L:0T:0P	3 credits

UNIT 1: Concept of Embedded Systems Design: Embedded system overview, design challenges, processor technology, design technology, and Examples of Embedded System.

UNIT 2: Custom single-purpose processors: Hardware, Basic combinational logic design, Sequential logic design, custom single purpose processor design.

UNIT 3: General purpose processors: Software, Basic architecture, operation, programmer's view, development environment, ASIC processors.

UNIT 4: Microprocessors memories: Memory write ability and storage permanence, common memory types, memory hierarchy and cache, Advanced RAM.

UNIT 5: **Standard single**: purpose processors, peripherals, Timers, counters, watchdog timers, UART, PWM, RTC, LCD controllers, keypad controllers, ADCs, Stepper motor controllers.

UNIT 6: Microprocessor Interfacing: Communication basics, I/O addressing, Interrupts, DMA, arbitration.

Text/Reference Books:

1. Frank Vahid , "Embedded System Design" Wiley India Edition, 2001.
2. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole,
3. 2000.
4. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
5. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
6. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
7. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

Course Outcomes: On successful completion of this course, the students should be able to:

• Understand design concept and approach of embedded systems using advanced controllers.

• Understand hardware design features and memories of embedded systems.

• Understand software design features of embedded systems.

• Understand processor peripherals and their interfacing with microprocessors

EEPE613	Microwave Theory and Techniques	3L:0T:0P	3 credits

Introduction to Microwaves-History of Microwaves, Microwave Frequency bands;Applications of Microwaves: Civil and Military, Medical, EMI/ EMC.

Mathematical Model of Microwave Transmission-Concept of Mode, Features ofTEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

Analysis of RF and Microwave Transmission Lines- Coaxial line, Rectangularwaveguide, Circular waveguide, Strip line, Micro strip line.

Microwave Network Analysis- Equivalent voltages and currents for non-TEMlines, Network parameters for microwave circuits, Scattering Parameters.

Passive and Active Microwave Devices- Microwave passive components:Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes, Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.

Microwave Design Principles- Impedance transformation, Impedance Matching,Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave Antennas-Antenna parameters, Antenna for ground based systems, Antennas for airborne and satellite borne systems, Planar Antennas.

Microwave Measurements- Power, Frequency and impedance measurement atmicrowave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. Measurement of Microwave antenna parameters.

Microwave Systems- Radar, Terrestrial and Satellite Communication, Radio Aidsto Navigation, RFID, GPS. Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RFMEMS for microwave components, Microwave Imaging.

Text/Reference Books:

1. R.E. Collins, Microwave Circuits, McGraw Hill
2. K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand various microwave system components their properties.
2. Appreciate that during analysis/ synthesis of microwave systems, the different mathematical treatment is required compared to general circuit analysis.
3. Design microwave systems for different practical application.

ELPE614	Wind and Solar Energy Systems	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Understand the basic physics of wind and solar power generation.
3. Understand the power electronic interfaces for wind and solar generation.
4. Understand the issues related to the grid-integration of solar and wind energy systems.

Unit 1: Physics of Wind Power: (5 Hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power- cumulative distribution functions.

Unit 2: Wind generator topologies: (12 Hours)

Review of modern wind turbine technologies,Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit 3: The Solar Resource: (3 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Unit 4: Solar photovoltaic: (8 Hours)

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms.Converter Control.

Unit 5: Network Integration Issues: (8 Hours)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Unit 6: Solar thermal power generation: (3 Hours)

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text / References:

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems**”,** John Wiley and Sons, 2004.
3. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

ELPE615	**Computational Electromagnetics**	**3L:0T:0P**	**3 credits**

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the basic concepts of electromagnetics.
2. Understand computational techniques for computing fields.
3. Apply the techniques to simple real-life problems.

Unit 1: Introduction (6 hours)

Conventional design methodology, Computer aided design aspects – Advantages. Review of basic fundamentals of Electrostatics and Electromagnetics. Development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic.

Unit 2: Analytical Methods (6 hours)

Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

Unit 3: Finite Difference Method (FDM) (7 hours)

Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence.

Unit 4: Finite Element Method (FEM) (7 hours)

Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

Unit 5: Special Topics(7 hours)

{Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)}, hybrid methods, coupled circuit - field computations, electromagnetic - thermal and electromagnetic - structural coupled computations, solution of equations, method of moments, Poisson's fields.

Unit 6: Applications (7 hours)

Low frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators.CAD packages.

Text/Reference Books

1. P. P. Silvester and R. L. Ferrari "Finite Element for Electrical Engineers", Cambridge University press, 1996.
2. M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press, 2001.

ELPE616	**Digital Control Systems**	**3L:0T:0P**	**3 credits**

Course Outcomes:
At the end of this course, students will demonstrate the ability to

1. Obtain discrete representation of LTI systems.
2. Analyse stability of open loop and closed loop discrete-time systems.
3. Design and analyse digital controllers.
4. Design state feedback and output feedback controllers.

Unit 1: Discrete System Representation and Analysis (12 hours)
Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit, Effects of Sampling and Quantization. Choice of sampling frequency.ZOH equivalent.
Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

Unit 2: Stability of Discrete Time System (6 hours)
Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

Unit 3: State Space Approach for discrete time systems (10 hours)
State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

Unit 4: Design of Digital Control System and Discrete output feedback control (8 hours)
Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator. Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

Text Books :

1. K. Ogata, “Digital Control Engineering”, Prentice Hall, Englewood Cliffs,1995.
2. M. Gopal, “Digital Control Engineering”, Wiley Eastern,1988.
3. G. F. Franklin, J. D. Powell and M. L. Workman, “Digital Control of Dynamic Systems”, Addison-Wesley,1998.
4. B.C. Kuo, “Digital Control System”, Holt, Rinehart and Winston,1980.

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 4th YEAR (ELECTRICAL & ELECTRONICS ENGINEERING)
SEMESTER-VII/VIII

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Sessional Marks	Final Marks	Total	Credits
				L	T	P				
1	PEC		PROGRAM ELECTIVE-IV	3	-	-	30	70	100	3
2	PEC		PROGRAM ELECTIVE-V	3	-	-	30	70	100	3
3	PEC		PROGRAM ELECTIVE-VI	3	-	-	30	70	100	3
4	OEC		OPEN ELECTIVE-III	3	-	-	30	70	100	3
5	OEC		OPEN ELECTIVE-IV	3	-	-	30	70	100	3
6	HSMC		SLOT FOR HSMC	3			30	70	100	3
7	PROJ/SEC	EESE762	MAJOR PROJECT	-	-	4	30	70	100	2
8	SEC	EESE761	ELECTRICAL AND ELECTRONICS WORKSHOP –VII	-	-	4	30	70	100	2
			TOTAL				**240**	**560**	**800**	**22**

	Course Code	Course Title
Program Elective-IV	ELPE711	Power System Protection
	ELPE712	HVDC Transmission System
	ELPE713	Power Quality& FACTS

	Course Code	Course Title
Program Elective-V	ELPE714	High Voltage Engineering
	ELPE716	Control System Design
	ELPE717	Power System Dynamics and Control

	Course Code	Course Title
Program Elective-VI	EEPE722	Mobile Communication and Networks
	EEPE723	Antenna & Propagation
	EEPE724	Fiber Optic Communication

	Course Code	Course Title
Humanities & Social Sciences Including Management Courses	HSMC-03 (Common to all)	Organizational Behaviour
	HSMC-04 (Common to all)	Finance & Accounting
	HSMC-05 (Common to all)	Operations Research

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 4th YEAR (ELECTRICAL & ELECTRONICS ENGINEERING)
SEMESTER-VII/VIII

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Sessional Marks	Final Marks	Total	Credits
				L	T	P				
1	PROJ/SEC	EESE861	Industrial Training	8 Hrs per Day			300	200	500	8

A) Procedure For Annual Examination And Marks		
Project Evaluation	50 Marks	Total 200 Marks
Project Seminar	50 Marks	
Project Viva	100 Marks	
B) Continuous Assessment Marks		
Assessment By Institute Faculty	100 Marks.	Total 300 Marks
Assessment By Industrial Guide	100 Marks.	
Conduct Marks	100 Marks.	
		Total 500 Marks

NOTE: All affiliated colleges can opt for industrial training either in 7th or 8th semester, as per their convenience under intimation to the University.

ELPE711	Power System Protection	3L:0T:0P	3 credits

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the different components of a protection system.
2. Evaluate fault current due to different types of fault in a network.
3. Understand the protection schemes for different power system components. Understand the basic principles of digital protection.
4. Understand system protection schemes, and the use of wide-area measurements.

Unit 1: **Introduction and Components of a Protection System (6 hours)**
Principles of Power System Protection, Fuse (Introduction, types and Applications), Relays – operating principle, types, zone of protection and applications, Instrument transformers and modelling, Circuit Breakers- arcing phenomenon, types, characteristics, ratings and applications, surge diverters, absorbers and grounding

Unit 2: Faults and Over-Current Protection (6 hours)
Review of Fault Analysis, Sequence Networks, Introduction to Over current Protection and over current relay co-ordination.

Unit 3: **Equipment Protection Schemes (8 hours)**
Directional, Distance, Differential protection, Transformer and Generator protection, Bus bar Protection, Bus Bar arrangement schemes

Unit4: **Digital Protection (8 hours)**
Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.

Unit 5:**Modeling and Simulation of Protection Schemes (4 hours)**
Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

Unit 6: **System Protection (6 hours)**
Effect of Power Swings on Distance Relaying, Under-frequency, under- voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide- Area Measurement Systems (WAMS).Application of WAMS for improving protection systems.

Text/References

1. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.
2. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.
3. A.G. Phadke and J.S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.
4. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer,2008.
5. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis,2006.

ELPE712	HVDC Transmission Systems	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the advantages of dc transmission over actransmission.
2. Understand the operation of Line Commutated Converters and Voltage SourceConverters.
3. Understand the control strategies used in HVdc transmissionsystem.
4. Understand the improvement of power system stability using anHVdcsystem.

Unit 1:DC Transmission Technology (4 hours)

Comparison of AC and dc Transmission (Economics, Technical Performance and Reliability).Application of DC Transmission. Types of HVDC Systems. Components of aHVdc system. Line Commutated Converter and Voltage Source Converter based systems.

Unit2: Analysis of Line Commutated and Voltage Source Converters (10 hours)

Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links.

Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using aVSC.

Unit 3:Control of HVdc Converters: (10 hours)

Principles of Link Control in aLCCHVdc system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVdc system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

Unit 4:Components of HVdc systems: (8 hours)

Smoothing Reactors, Reactive Power Sources and Filters in LCC HVdc systems DC line: Corona Effects. Insulators, Transient Over-voltages.dc line faults in LCC systems. dc line faults in VSC systems. dc breakers. Mono polar Operation. Ground Electrodes.

Unit5:Stability Enhancement using HVDC Control (4 hours)

Basic Concepts : Power System Angular, Voltage and Frequency Stability.

Power Modulation: basic principles – synchronous and asynchronous links, Voltage Stability Problem in AC/dc systems.

Unit 6:MTDC Links (4 hours)

Multi-Terminal and Multi-Infeed Systems. Series and Parallel MTdc systems using LCCs. MTdc systems using VSCs. Modern Trends in HVDC Technology. Introduction to Modular Multi-level Converters.

Text/References:

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers,2011.
2. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd.,1983.
3. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience,1971.

ELPE713	Power Quality and FACTS	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
2. Understand the working principles of FACTS devices and their operating characteristics.
3. Understand the basic concepts of powerquality.
4. Understand the working principles of devices to improve power quality.

Unit 1: Transmission Lines and Series/Shunt Reactive Power Compensation (4 hours) Basics of AC Transmission Analysis of uncompensated AC transmission lines Passive Reactive Power Compensation Shunt and series compensation at the mid-point of an AC line Comparison of Series and Shunt Compensation.

Unit 2: Thyristor-based Flexible AC Transmission Controllers (FACTS) (6 hours)

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC, Fault Current Limiter.

Unit 3: Voltage Source Converter based (FACTS) controllers (8 hours)

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse- Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

Unit 4: Application of FACTS (4 hours)

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC, Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

Unit 5: Power Quality Problems in Distribution Systems (4 hours)

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations, Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

Unit 6: DSTATCOM (8 hours)

Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters, Synchronous Reference Frame Extraction of Reference Currents

,Current Control Techniques in for DSTATCOM.

Unit 7: Dynamic Voltage Restorer and Unified Power Quality Conditioner (6 hours)

Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.

Text/References

1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press,1999.
2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New AgeInternational (P) Ltd. 2007.
3. T.J.E.Miller,"ReactivePower Control inElectricSystems",JohnWileyandSons,NewYork,1983.
4. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education,2012.
5. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications,1991

ELPE714	High Voltage Engineering	3L:0T:0P	3 credits

Course outcomes:

At the end of the course, the student will demonstrate

1. Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
2. Knowledge of generation and measurement of D. C., A.C., & Impulse voltages. Knowledge of tests on H. V. equipment and on insulating materials, as per thestandards.
3. Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.

Unit 1: Breakdown in Gases (8 Hours)

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge

Unit 2: Breakdown in liquid and solid Insulating materials (7 Hours)

Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

Unit 3: Generation of High Voltages (7 Hours)

Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

Unit 4: Measurements of High Voltages and Currents (7 Hours)

Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

Unit 5: Lightning and Switching Over-voltages (7 Hours)

Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over- voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

Unit 6: High Voltage Testing of Electrical Apparatus and High Voltage Laboratories (7 Hours)

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

Text/Reference Books

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
4. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
5. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.
6. Various IS standards for HV Laboratory Techniques and Testing

ELPE716	Control Systems Design	3L:0T:0P	3 credits

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand various design specifications.
2. Designcontrollerstosatisfythedesireddesignspecificationsusingsimplecontroller structures(P,PI,PID, compensators).
3. Design controllers using the state-space approach.

Unit 1: Design Specifications (6 hours)
Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

Unit 2: Design of Classical Control System in the time domain (8 hours)
Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

Unit 3: Design of Classical Control System in frequency domain (8 hours) Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.

Unit 4: Design of PID controllers (6 hours)
Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

Unit5: Control System Design in state space (8 hours)
Review of state space representation. Concept of controllability &observability, effect of pole zero cancellation on the controllability &observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. SeparationPrinciple.

Unit 6: Nonlinearities and its effect on system performance (3 hours)
Various types of non-linearities.Effect of various non-linearities on system performance. Singular points. Phase plot analysis.

Text and Reference Books :

1. N. Nise, "Control system Engineering", John Wiley,2000.
2. I. J. Nagrath and M. Gopal, "Control system engineering", Wiley,2000.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern,1988.
4. K. Ogata, "Modern Control Engineering", Prentice Hall,2010.
5. B. C. Kuo, "Automatic Control system", Prentice Hall,1995.
6. J. J. D'Azzo and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill,1995.

1. R. T. Stefani and G. H. Hostetter, "Design of feedback Control Systems",Saunders College Pub,1994

ELPE717	Power System Dynamics and Control	3L:0T:0P	3 credits

Course Outcomes:
At the end of this course, students will demonstrate the ability to

- Understand the problem of power system stability and its impact on the system.
- Analyse linear dynamical systems and use of numerical integration methods.
- Model different power system components for the study of stability.
- Understand the methods to improve stability.

Module 1: Introduction to Power System Operations (4 hours)
Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

Module 2 : Analysis of Linear Dynamical System and Numerical Methods (6 hours) Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System, Analysis using Numerical Integration Techniques, Issues in Modeling: Slow and Fast Transients, Stiff System

Module 3 : Modeling of Synchronous Machines and Associated Controllers (12 hours) Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

Module 4 : Modeling of other Power System Components (6 hours)
Modeling of Loads. Load Models - induction machine model. HVDC and FACTS controllers, Wind Energy Systems.

Module 5 : Stability Analysis (12 hours)
Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multi- machine systems – Intra- plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor droop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools: Transient Stability Programs, Small Signal Analysis Programs.

Module 6 : Enhancing System Stability (5 hours)
Planning Measures. Stabilizing Controllers (Power System Stabilizers).Operational Measures-Preventive Control. Emergency Control.

Text/Reference Books

1. K.R. Padiyar, “ Power System Dynamics, Stability and Control”, B. S. Publications,2002.
2. P. Kundur, “ Power System Stability and Control”, McGraw Hill,1995.
3. P. Sauer and M. A. Pai, “ Power System Dynamics and Stability” , Prentice Hall,1997..

EEPE 722	Mobile Communication and Networks	3L:0T:0P	3 credits

Cellular concepts- Cell structure, frequency reuse, cell splitting, channelassignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

Signal propagation-Propagation mechanism- reflection, refraction, diffraction andscattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading-Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

Capacity of flat and frequency selective channels. Antennas- Antennas for mobileterminal- monopole antennas, PIFA, base station antennas and arrays.

Multiple access schemes-FDMA, TDMA, CDMA and SDMA. Modulationschemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

Receiver structure- Diversity receivers- selection and MRC receivers, RAKEreceiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.

MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff.Performance measures- Outage, average snr, average symbol/bit error rate. System examples-GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Text/Reference Books:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the working principles of the mobile communication systems.
2. Understand the relation between the user features and underlying technology.

Analyze mobile communication systems for improved performance

EEPE 723	Antennas and Propagation	3L:0T:0P	3 credits

Fundamental Concepts- Physical concept of radiation, Radiation pattern, near-andfar-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, linearelements near conductors, dipoles for mobile communication, small circular loop.

Aperture and Reflector Antennas- Huygens' principle, radiation from rectangularand circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas.

Broadband Antennas- Log-periodic and Yagi-Uda antennas, frequencyindependent antennas, broadcast antennas.

Micro strip Antennas- Basic characteristics of micro strip antennas, feedingmethods, methods of analysis, design of rectangular and circular patch antennas.

Antenna Arrays- Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

Basic Concepts of Smart Antennas- Concept and benefits of smart antennas, fixedweight beam forming basics, Adaptive beam forming.

Different modes of Radio Wave propagation used in current practice.

Text/Reference Books:

1. J.D. Kraus, Antennas, McGraw Hill, 1988.
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
3. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw ill, 1984.
5. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
6. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005
7. R.E. Crompton, Adaptive Antennas, John Wiley

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the properties and various types of antennas.
2. Analyze the properties of different types of antennas and their design.
3. Operate antenna design software tools and come up with the design of the antenna of required specifications.

EEPE724	Fiber Optic Communication	3L:0T:0P	3 credits

Introduction to vector nature of light, propagation of light, propagation of light ina cylindrical dielectric rod, Ray model, wave model.

Different types of optical fibers, Modal analysis of a step index fiber.
Signaldegradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detectorresponsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.

Optical switches - coupled mode analysis of directional couplers, electro-opticswitches. Optical

amplifiers - EDFA, Raman amplifier.

WDM and DWDM systems. Principles of WDM networks.

Nonlinear effects in fiber optic links. Concept of self-phase modulation, groupvelocity dispersion and solition based communication.

Text/Reference Books

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
3. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997
7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
2. Understand the properties of the optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors
4. Analyze system performance of optical communication systems
5. Design optical networks and understand non-linear effects in optical fibers

HSMC-03	Organizational Behaviour	3L:0T:0P	3 credits

Course Objectives:

The objective of this course is to expose the students to basic concepts of management and provide insights necessary to understand behavioural processes at individual, team and organizational level.

MODULE-1

Introduction to management: concept, nature; evolution of management thoughts –traditional, behavioural, system, contingency and quality viewpoints; Managerial levels, skills and roles in an organization; Functions of Management: Planning, Organizing, Directing, Controlling, Problem solving and Decision making; Management control; managerial ethics and social responsibility; Management Information System (MIS).

MODULE-2

Fundamentals of Organizational Behavior: Concept, evolution, importance and relationship with other Fields; Contemporary challenges of OB; Individual Processes and Behavior – differences, Personality concept, determinant, theories and applications; Values, Attitudes and Emotions, Perception- concept, process and applications, Learning and Reinforcement; Motivation: concept, theories and applications; Stress management.

MODULE-3

Interpersonal Processes- Work teams and groups- Definition of Group, Stages of group development, Group cohesiveness, Types of groups, Group processes and Decision Making; Team Building; Conflict- concept, sources, types, management of conflict; Power and Political Behavior; Leadership: concept, function and styles.

MODULE-4

Organizational Processes and structure: organizational design: various organizational structures and their effect on human behavior; Organizational climate; Organizational culture; Organizational change: Concept, Nature, Resistance to Change, Change Management, Implementing Change and Organizational Development

Course Outcomes:

1. The students learn how to influence the human behaviour.
2. Students will be able to understand behavioural dynamics in organizations.
3. Students will be able to apply managerial concepts in practical life.
4. Students will be able to understand organizational culture and change.

REFERENCES:

1. Robbins, S.P. and Decenzo, D.A. Fundamentals of Management, Pearson Education Asia, New Delhi.

2. Stoner, J et. al, Management, New Delhi, PHI, New Delhi
3. SatyaRaju, Management – Text & Cases, PHI, New Delhi
4. Kavita Singh, OrganisationalBehaviour: Text and cases. New Delhi: Pearson Education.
5. Pareek, Udai, Understanding OrganisationalBehaviour, Oxford University Press, New Delhi
6. Robbins, S.P. & Judge, T.A., OrganisationalBehaviour, Prentice Hall of India, New Delhi

HSMC-04	Finance and Accounting	3L:0T:0P	3 credits

Course Objectives:

The purpose of the course is to understand nature of accounting and its interaction with other accounting and their comparison. It also focuses what kind of information the manager need, from where these can be obtained and how this information can be used to carry out important managerial decision.

MODULE-1:
Meaning nature and scope of different types of accounting and their comparison.Accounting principles and Indian accounting standards, IFRS, Preparation of final accounts of company with basic adjustments.Reading and understanding of Annual report.

MODULE-2:
Analysis and interpretation of financial statements – meaning, importance and techniques, ratio analysis; fund flow analysis; cash flow analysis (AS-3)

MODULE-3:
Classification of costs, preparation of cost sheet, inventory valuation, overview of standard costing and variance analysis; material variance and labour variance.

MODULE-4:
Budgetary control- meaning, need, objectives, essentials of budgeting, different types of budgets cash budget, flexible budget zero base budget; marginal costing, BEP analysis, decision making for optimum sales mix, exploring new markets, make/Buy decisions, expand/ contract, accepting and rejecting decisions

Course Outcomes:

1. This course will impart knowledge to the students regarding preparation of financial statements their analysis.
2. The students will be able to understand applications of cost accounting and cost control techniques like standard costing etc.
3. The course will help them to take better managerial decisions.
4. Students will be able to know about budget control techniques.

REFERENCES:

1. Singhal, A.K. and Ghosh Roy, H.J., Accounting for Managers, JBC Publishers and Distributors, New Delhi
2. Pandey, I.M., Management Accounting, Vikas Publishing House, New Delhi
3. Horngren, Sundem and Stratton, Introduction to Management Accounting, Pearson Education, New Delhi.

4. Jain, S.P and Narang, K.L., Advanced Cost Accounting, Kalyani Publishers, Ludhiana.
5. Khan, M.Y. and Jain, P.K., Management Accounting, TMH, New Delhi

HSMC-05	Operations Research	3L:0T:0P	3 credits

Course Objectives:

1. To introduce the student with Different types of OR Models and Linear Programming Model
2. To introduce the students about Dual Sensitive Method and Sensitive Analysis.
3. To introduce the concept of Assignment Problem.
4. To introduce the students with Network Model
5. To introduce the concept of Dynamic Programming and Queuing Model.

MODULE-1:

The origin of OR, Phases of an O.R. study, Impact of OR, Formulation of Linear-programming model, Graphical solution.Converting the linear programming problem to standard form, Simplex method.

MODULE-2:

Big-M method, Two-phase method, Degeneracy, Alternate optima, unbounded and infeasible solution.

MODULE-3:

Definition of the dual problem, prima-dual relationship, Dual Simplex method, Post optimal and sensitivity analysis.

MODULE-4:

Assignment problem and its mathematical formulation, solution of assignment problem (Hyngarian method), Transportation problem and its mathematical formulation.Initial basic feasible solution of transportation problem by North-West corner rule. Lowest-Cost Entry method and Vogel's Approximation method, Optimal solution of transportation problem.

MODULE-5:

Network models, Minimal spanning tree algorithm, Shortest-route problem (Floyd's Algorithm and Dijkstras algorithm), Maximal flow problem, Introduction to CPM & PERT.

MODULE-6:

Introduction to Dynamic Programming, General inventory Model, Static Economic Order Quantity (EOQ) Models.

MODULE-7:

Elements of a Queuing model, Pure Birth & Death model, Generalized Poisson Queuing, Specialized Poisson Queues.

Course Outcomes:

After completion of the course student will be able to:

1. Understand different types of OR Model and solve Linear programming problems.
2. Understand dual simplex problem and sensitive analysis.
3. Solve Assignment problem.
4. Understand Dynamic Programming and Queuing Model.

REFERENCES:

1. Operations Research by Hamdy A Taha
2. Introduction to Operations Research by Hiller and Dieherman, TMH

Optimization Theory and Applicatio

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION

LIST OF OPEN ELECTIVE COURSES

[ELECTRICAL AND ELECTRONICS ENGINEERING]

Sr. No	Code No.	Subject	Credits
1.	ELOE-101	Electronic Devices	3
2.	ELOE-102	Data Structures and Algorithms	3
3.	ELOE-104	Computer Networks	3
4.	ELOE-106	Power Plant Engineering	3
5.	ELOE-107	Strength of Materials	3
6.	ELOE-108	Automobile Engineering	3
7.	ELOE-109	Manufacturing Processes	3
8.	ELOE-110	Environmental Engineering	3
9.	ELOE-111	Operating System	3
10.	ELOE-112	Total Quality Management	3
11.	ELOE-113	Mechatronic System	3
12.	ELOE-114	Scientific Computing	3
13.	ELOE-115	Engineering Economics, Estimation & Costing	3
14.	ELOE-116	Cyber Law and Security	3
15.	ELOE-117	Intelligent Systems	3
16.	ELOE-119	Adaptive Signal Processing	3
17.	ELOE-120	Digital Image & Video Processing	3
18.	ELOE-121	Artificial Intelligence	3
19.	ELOE-122	Programming in Python	3
20.	ELOE-123	Machine Leaning	3

ELOE-101	Electronic Devices	3L:0T:0P	3 credits

Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors

Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-Vcharacteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model,MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell;

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Text /Reference Books:

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson,2014.
2. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley &Sons, 2006.
4. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor Physics
2. Understand and utilize the mathematical models of semiconductor junctions andMOS transistors for circuits and systems.

ELOE-102	Data Structure and Algorithm	3L:0T:0P	3 credits

Objectives of the course:
1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

Detailed contents:

Module 1:

Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.

Module 2:

Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Module 3:

Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Module 4:

Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. **Graph:** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Suggested books:

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

Suggested reference books:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.

Course outcomes
1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
5. Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

ELOE-104	Computer Network	3L:0T:0P	3 credits

Introduction to computer networks and the Internet: Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic ail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.

Switching in networks: Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing. Transport layer: Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call.

Transport layer: Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call.

Congestion Control and Resource Allocation: Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.

Network layer: Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing

Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, Switches.

Text Reference books:

1. J.F. Kurose and K. W. Ross, “ Computer Networking – A top down approach featuring the Internet”, Pearson Education, 5th Edition
2. L. Peterson and B. Davie, “ Computer Networks – A Systems Approach” Elsevier Morgan Kaufmann Publisher, 5th Edition.
3. T. Viswanathan, “Telecommunication Switching System and Networks”, Prentice Hall
4. S. Keshav, “ An Engineering Approach to Computer Networking” , Pearson Education
5. B. A. Forouzan, “ Data Communications and Networking”, Tata McGraw Hill, 4th Edition
6. Andrew Tanenbaum, “ Computer networks”, Prentice Hall
7. D. Comer, “ Computer Networks and Internet/TCP-IP”, Prentice Hall
8. William Stallings, “ Data and computer communications” , Prentice Hall

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand the concepts of networking thoroughly.
2. Design a network for a particular application.
3. Analyze the performance of the network

ELOE-106	**Power Plant Engineering**	**3L:0T:0P**	**3 credits**

Objectives:
To provide an overview of power plants and the associated energy conversion issues

Contents:
Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam andheating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Course Outcomes:
Upon completion of the course, the students can understand the principles of operation for different power plants and their economics.

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

ELOE-107	Strength of Materials	3L:0T:0P	3 credits

Objectives:

- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
- To calculate the elastic deformation occurring in various simple geometries for different types of loading

Contents :

Deformation in solids- Hooke‟s law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr‟s circle. **(8)**

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. **(8)**

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell‟s reciprocal theorems.**(8)**

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs. (**8)**

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure **(8)**

Course Outcomes:

After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components

The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGrawHill Publishing Co. Ltd., New Delhi 2005.

ELOE-108	**Automobile Engineering**	**3L:0T:0P**	**3 credits**

To understand the construction and working principle of various parts of an automobile

Contents:

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials, variable valve timing (VVT). Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, Over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells

Course Outcomes:
Upon completion of this course, students will understand the function of each automobile component and also have a clear idea about the overall vehicle performance.

Text books:

1. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.
3. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
4. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

ELOE-109	Manufacturing Process	3L:0T:0P	5 Credits

Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods

Contents:

Conventional Manufacturing processes:

Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. **(5)**

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.**(4)**

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.**(8)**

Additive manufacturing: Rapid prototyping and rapid tooling**(3)**

Joining/fastening processes: Physics of welding, brazing and soldering;design considerations in welding,Solid and liquid state joining processes;Adhesive bonding. **(4)**

Unconventional Machining Processes:

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters **(5)**

Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant &maskant, process parameters, MRR and surface finish. **(8)**

Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining **(3)**

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products

Text Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014

2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems

3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

ELOE-110	Environmental Engineering	2L:2T:0P	3 credits

Module 1: *Water:* -Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.
Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes

Module 2: *Sewage*- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans,Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

Module 3: *Air* - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations
Module 4: *Noise*- Basic concept, measurement and various control methods.

Module5:*Solid waste management*-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

Module 6: *Building Plumbing*-Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used.

Module 7: Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.

Practical Work: List of Experiments

1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic etc.
3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness
4. Analysis of ions: copper, chloride and sulfate
5. Optimum coagulant dose
6. Chemical Oxygen Demand (COD)
7. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)
8. Break point Chlorination
9. Bacteriological quality measurement: MPN,
10. Ambient Air quality monitoring (TSP, RSPM, SOx, NOx)
11. Ambient noise measurement

Text/Reference Books:

1. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
2. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
3. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. *Environmental Engineering*, Mc-Graw - Hill International Editions, New York 1985.

ELOE-111	Operating Systems	3L:0T:4P	5 Credits

Objectives of the course

To learn the fundamentals of Operating Systems.

1. To learn the mechanisms of OS to handle processes and threads and their communication
2. To learn the mechanisms involved in memory management in contemporary OS
3. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
4. To know the components and management aspects of concurrency management

Detailed contents

Module 1:
Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

Module 2:
Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Module 3:
Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson‟s Solution, TheProducer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader‟s & Writer Problem, Dinning Philosopher Problem etc.

Module 4:
Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker‟s algorithm, Deadlock detection and Recovery.

Module 5:
Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation –Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

Module 6:
I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free- space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

Suggested books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

Suggested reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

Course Outcomes

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.
3. For a given specification of memory organization developthe techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.
4. Design and implement file management system.
5. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers

ELOE-112	**Total Quality Management**	**3L:0T:0P**	**3 credits**

Objectives:
To facilitate the understanding of total quality management principles and processes

Contents:
Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation,; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Course Outcomes:
Upon completion of this course, the students will be able to use the tools and techniques of TQM in manufacturing and service sectors.

Text Books:

1. Besterfield D.H. et al., Total qualityManagement, 3rd ed., Pearson Education Asia, 2006.
2. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.

Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

ELOE-113	Mechatronic Systems	3L:0T:0P	3 credits

Description:

(i) To understand the structure of microprocessors and their applications in mechanical devices

(ii) To understand the principle of automatic control and real time motion control systems, with the help of electrical drives and actuators

(iii) To understand the use of micro-sensors and their applications in various fields

Course Contents:

Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface;
Sensors and transducers: classification, Development in Transducer technology, Opto-electronics-Shaft encoders, CD Sensors, Vision System, etc.;

Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems;

Smart materials: Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.;

Micromechatronic systems: Microsensors, Microactuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.

Course Outcomes:

Upon completion of this course, students will get an overview of mechatronics applications and the use of micro-sensors and microprocessors.

Text Books:

1) Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)
2) Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
3) A Textbook of Mechatronics ,R.K.Rajput, S. Chand & Company Private Limited
4) Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

ELOE-114	Scientific computing	3L:0T:0P	3 credits

Introduction: Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis, Stability and Accuracy
Computer Arithmetic: Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating-Point Arithmetic, Cancellation

System of liner equations: Linear Systems, Solving Linear Systems, Gaussian elimination,Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems

Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting

Eigenvalues and singular values:Eigenvalues and Eigenvectors, Methods for Computing All Eigenvalues, Jacobi Method, Methods for Computing Selected Eigenvalues, Singular Values Decomposition, Application of SVD

Nonlinear equations: Fixed Point Iteration, Newton‟s Method, Inverse Interpolation Method
Optimization: One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares

Interpolation: Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation

Numerical Integration And Differentiation: Quadrature Rule, Newton-Cotes Rule, Gaussian Quadrature Rule, Finite Difference Approximation,

Initial Value Problems for ODES, Euler‟s Method, Taylor Series Method, Runga-Kutta Method, Extrapolation Methods, Boundary Value Problems For ODES, Finite Difference Methods, Finite Element Method, Eigenvalue Problems

Partial Differential Equations,Time Dependent Problems, Time Independent Problems, Solution for Sparse Linear Systems, Iterative Methods

Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication, Wavelets, Random Numbers And Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences

Text/ Reference Books:

1. Heath Michael T., “ Scientific Computing: An Introductory Survey” , McGraw-Hill, 2nd Ed., 2002
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, “Numerical Recipes: The Art of Scientific Computing”, Cambridge University Press, 3rd Ed., 2007
3. Xin-she Yang (Ed.)., “ Introduction To Computational Mathematics” , World Scientific Publishing Co., 2nd Ed., 2008
4. Kiryanov D. and Kiryanova E., “ Computational Science”, Infinity Science Press, 1st Ed., 2006

5. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, " Scientific Computing With MATLAB And Octave", Springer, 3rd Ed., 2010

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the significance of computing methods, their strengths and application areas.
2. Perform the computations on various data using appropriate computation tools.

ELOE-115	**Engineering Economics, Estimation, & Costing**	**3L:0T:0P**	**3 credits**

Module 1:Basic Principles and Methodology of Economics. Demand/Supply – elasticity – Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro- economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes (3 lectures)

Module 2: Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve. (2 lectures)

Module 3: Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method. (3 lectures)

Module 4: Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors. (2 lectures)

Module 5:*Estimation /* Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying (7 lectures)

Module 6: Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures. (3 lectures)

Module 7: Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity. (3 lectures)

Module 8: Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes,
R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids-
Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits;
Bid conditions, alternative specifications; Alternative Bids. Bid process management (6 lectures)

Module 9: Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights. (1 lecture)

Text/Reference Books:

1. Mankiw Gregory N. (2002), *Principles of Economics,* Thompson Asia
2. V. Mote, S. Paul, G. Gupta(2004), *Managerial Economics,* Tata McGraw Hill
3. Misra, S.K. and Puri (2009), *Indian Economy,* Himalaya

4. Pareek Saroj (2003), *Textbook of Business Economics,* Sunrise Publishers
5. M Chakravarty, Estimating, Costing Specifications & Valuation
6. Joy P K, Handbook of Construction Management, Macmillan
7. B.S. Patil, Building & Engineering Contracts
8. Relevant Indian Standard Specifications.
9. World Bank Approved Contract Documents.
10. FIDIC Contract Conditions.
11. Acts Related to Minimum Wages, Workmen‟s Compensation, Contract, and Arbitration
12. Typical PWD Rate Analysis documents.
13. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations,2016
14. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016

On completion of the course, the students will:

- Have an idea of Economics in general, Economics of India particularly for public sector agencies and private sector businesses
- Be able to perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.
- Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.
- Be able to understand the technical specifications for various works to be performed for a project and how they impact the cost of a structure.
- Be able to quantify the worth of a structure by evaluating quantities of constituents, derive their cost rates and build up the overall cost of the structure.
- Be able to understand how competitive bidding works and how to submit a competitive bid proposal.

ELOE-116	Cyber Laws and Security	3L:0T:0P	3 credits

UNIT I History of Information Systems and its Importance, basics, Changing Nature of Information Systems, Need of Distributed Information Systems, Role of Internet and Web Services, Information System Threats and attacks, Classification of Threats and Assessing Damages Security in Mobile and Wireless Computing- Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations, Laptops Security Basic Principles of Information Security, Confidentiality, Integrity Availability and other terms in Information Security, Information Classification and their Roles.

UNIT II Security Threats to E Commerce, Virtual Organization, Business Transactions on Web, E Governance and EDI, Concepts in Electronics payment systems, E Cash, Credit/Debit Cards. Physical Security- Needs, Disaster and Controls, Basic Tenets of Physical Security and Physical Entry Controls, Access Control- Biometrics, Factors in Biometrics Systems, Benefits, Criteria for selection of biometrics, Design Issues in Biometric Systems, Interoperability Issues, Economic and Social Aspects, Legal Challenges

UNIT III Model of Cryptographic Systems, Issues in Documents Security, System of Keys, Public Key Cryptography, Digital Signature, Requirement of Digital Signature System, Finger Prints, Firewalls, Design and Implementation Issues, Policies Network Security- Basic Concepts, Dimensions, Perimeter for Network Protection, Network Attacks, Need of Intrusion Monitoring and Detection, Intrusion Detection Virtual Private Networks- Need, Use of Tunneling with VPN, Authentication Mechanisms, Types of VPNs and their Usage, Security Concerns in VPN

UNIT IV Security metrics- Classification and their benefits Information Security & Law, IPR, Patent Law, Copyright Law, Legal Issues in Data mIning Security, Building Security into Software Life Cycle Ethics- Ethical Issues, Issues in Data and Software Privacy Cyber Crime Types & overview of Cyber Crimes

References:

1. Godbole,― Information Systems Security‖, Willey
2. Merkov, Breithaupt, ― Information Security‖, Pearson Education
3. Yadav, ―Foundations of Information Technology‖, New Age, Delhi
4. Schou, Shoemaker, ― Information Assurance for the Enterprise‖, Tata McGraw Hill
5. Sood,―Cyber Laws Simplified‖, Mc Graw Hill
6. Furnell, ―Computer Insecurity‖, Springer 7. IT Act 2000

ELOE-117	Intelligent Systems	3L:0T:0P	3 credits

UNIT I Fundamental Issues in IS : Definition of AI , History ,Domains AI ,AI problems & State space ,Some examples problems representations like Travelling Salespersons, Syntax analysis Problem. Basic issues to solve AI problems, Underlying assumptions, AI techniques, Level of model, Criteria for success, Control strategies, DFS, BFS

UNIT II Heuristic Search Techniques: Generate & Test, Hill Climbing (simple &stipest), Best first search, A*, AO*, Constraint Satisfaction.

UNIT III Knowledge Representation Issues: Syntax & Semantic for Propositional logic, Syntax & Semantic for FOPL, Properties for WFF„s, Resolution Basics : conversion to clausal form ,Resolution of proposition logic, Resolution algorithms for predicates, Problems with FOPL ,Semantic nets ,Frames ,Scripts

UNIT IVReasoning Under Uncertainty: An introduction, Default reasoning & Closed world assumptions, Model & Temporal logic ,Fuzzy logic, Basian Probabilistic inference Dempster Shafer theory ,Heuristic reasoning methods

UNIT V Planning & Learning : Planning, Planning in Situational calculus ,Representation for planning ,Partial order palnning, Partial order palnning algorithm, Learning by Examples, Learning by Analogy, Explanation based learning, Neurals nets, Genetics algorithms

UNIT VIMinimax: Game playing strategy, Natural language processing ,Overview of linguistics , Grammer& Language, Transformation Grammer, Basic Parsing Techniques, Expert System, Architecture of Rule based Expert system ,Non Rule based Expert system.

References:

1. Artificial Intelligence by Elain Rich & Kevin Knight, Tata McGraw Hills Pub.
2. Principals of AI by Nills .J.Nilsson, Pearson Education Pub. 177
3. Artificial Intelligence by DAN. W.Petterson. Printice Hall of India
4. Artificial Intelligence by Petrick Henry Winston,
5. Artificial Intelligence by Russel and Norvig, Pearson Education Pub.

ELOE-119	Adaptive Signal Processing	3L:0T:0P	3 credits

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complexvalued The LMS algorithm (real, complex), convergence analysis, weight errorcorrelation matrix, excess mean square error and mis-adjustment

Variants of the LMS algorithm: the sign LMS family, normalized LMSalgorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering.

Signal space concepts - introduction to finite dimensional vectorspace theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram- Schmidt orthogonalization, concepts of orthogonal projection,orthogonal decomposition of vector spaces.

Vector space of random variables, correlation as inner product, forward andbackward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

Introduction to recursive least squares (RLS), vector space formulation of RLSestimation, seudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Text/Reference Books:

1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2. C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the non-linear control and the need and significance of changing the control parameters w.r.t. real-time situation.
2. Mathematically represent the „adaptability requirement".
3. Understand the mathematical treatment for the modeling and design of the signal processing systems.

ELOE-120	Digital Image & Video Processing	3L:0T:0P	3 credits

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Image Enhancements and Filtering-Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

Image Segmentation- Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation.

Wavelets and Multi-resolution image processing- Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

Image Compression-Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression- predictive and transform coding; Discrete Cosine Transform; Still image compression standards – JPEG and JPEG-2000.

Fundamentals of Video Coding- Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation- Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation – motion-based; Video object detection and tracking.

Text/Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004
3. Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Mathematically represent the various types of images and analyze them.
2. Process these images for the enhancement of certain properties or for optimized use of the resources.
3. Develop algorithms for image compression and coding

ELOE 121	ARTIFICIAL INTELLIGENCE	3L-0T-0P	3 Credits

Detailed Syllabus:

I. Artificial Neural Networks:

Introduction, Models of Neuron Network-Architectures –Knowledge representation, Artificial Intelligence and Neural networks–Learning process-Error correction learning, Hebbian learning –Competitive learning-Boltzmann learning, supervised learning Unsupervised learning–Reinforcement learning-Learning tasks.

II. ANN Paradigms:

Multi-layer perceptron using Back propagation Algorithm (BPA), Self –Organizing Map (SOM), Radial Basis Function Network-Functional Link Network (FLN), Hopfield Network.

III. Fuzzy Logic:

Introduction –Fuzzy versus crisp, Fuzzy sets-Membership function –Basic Fuzzy set operations, Properties of Fuzzy sets –Fuzzy cartesion Product, Operations on Fuzzy relations –Fuzzy logic –Fuzzy Quantifiers, Fuzzy Inference-Fuzzy Rule based system, Defuzzification methods

IV. Genetic Algorithms:

Introduction-Encoding –Fitness Function-Reproduction operators, Genetic Modeling –Genetic operators-Cross over-Single site cross over, Two point cross over –Multi point cross over-Uniform cross over, Matrix cross over-Cross over Rate-Inversion & Deletion, Mutation operator –Mutation –Mutation Rate-Bit-wise operators, Generational cycleconvergence of Genetic Algorithm.

V. Applications of AI Techniques:

Load forecasting, Load flow studies, Economic load dispatch, Load frequency control, Single area system and two area system, Small Signal Stability (Dynamic stability), Reactive power control , Speed control of DC and AC Motors.

Reading:

1. S.Rajasekaran and G.A.V.Pai Neural Networks, Fuzzy Logic & Genetic Algorithms, PHI, New Delhi, 2003.

2. Rober J. Schalkoff, Artificial Neural Networks, Tata McGraw Hill Edition, 2011

3. P.D.Wasserman; Neural Computing Theory & Practice, Van Nostrand Reinhold, New York, 1989.

4. Bart Kosko; Neural Network & Fuzzy System, Prentice Hall,1992

5. D.E.Goldberg, Genetic Algorithms, Addison-Wesley 1999.

ELOE 122	PROGRAMMING IN PYTHON	3L-0T-0P	3 Credits

UNIT 1: Introduction To Python & Data Types

Installation and Working with Python, Understanding Python variables, Python basic Operators, Understanding python blocks, Declaring and using Numeric data types: int, float, complex, Using string data type and string operations,

Defining list and list slicing, Use of Tuple data type

UNIT 2: Python Program Flow Control, String, List And Dictionary Manipulations

Conditional blocks using if, else and elif, simple for loops in python, For loop using ranges, string, list and dictionaries, Use of while loops in python, Loop manipulation using pass, continue, break and else Programming using Python conditional and loops block, Understanding string in build methods, List manipulation using in build methods, Dictionary manipulation, Programming using string, list and dictionary in build functions

UNIT 3: Python Functions, Modules, Packages & Python File Operation

Organizing python codes using functions, Organizing python projects into modules Importing own module as well as external modules Understanding Packages, Powerful Lamda function in python, Programming using functions, modules and external packages , reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek, Programming using file operations

UNIT 4 : Python Object Oriented Programming & Exception handling :

Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class in live projects, Inheritance , overlapping and overloading operators, Adding and retrieving dynamic attributes of classes, Programming using Oops support, Avoiding code break using exception handling, Safe guarding file operation using exception handling, Handling and helping developer with error code, Programming using Exception handling

UNIT 5 : Data Manipulation using Python

SQL Database connection using python, Creating and searching tables, Reading and storing config information on database, Programming using database connections , **The Basics of NumPy:** NumPy Array Basics , Boolean Selection, Helpful Methods and Shortcuts , Vectorization , Multi-Dimensional Arrays, Querying Slicing, Combining, and Splitting Arrays, P**andas DataFrame Basics:** Reading Files, Plotting, and Basic Methods , More Plotting, Joins, Basic DateTime Indexing, and Writing to Files, Adding & Reseting Columns, Mapping with Functions , More Mapping, Filling NaN values, Plotting, Correlations, and Histograms , More Plotting, Rolling Calculations, Basic DateTime Indexing, Analysis Concepts, Filling NaN Values, Cumulative Sums and Value Counts , Data Maintenance, Adding/ Removing Columns and Rows , Basic Grouping, Concepts of Aggregate Functions.

Suggested Readings :

1. Head First Python , A brain friendly guide – Paul Barry , O reilly, 2nd Edition.
2. A byte of Python- C.H. Swaroop
3. Python Cookbook by David Beazley and Brian K. Jones
4. Introduction to Machine Learning with Python Paperback – by Andreas C. Mueller

ELOE 123	MACHINE LEARNING	3L-0T-0P	3 Credits

UNIT-I

Introduction: Learning, Types of Machine Learning.
Some Basic Statistics: Averages, Variance and Covariance, Gaussian distribution, Bayes theorem.
Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm.
Learning with Trees: Constructing Decision Trees, CART, Classification Example

UNIT-II

Time Series : AR, MA, ARMA, ARIMA , ARMAX for predictions using time dependent data.

Linear Discriminants: Linear Separability, Linear Regression ,

Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis

SUPPORT Vector Machines: Optimal Separation, Kernels

The Bias-Variance Tradeoff.

UNIT-III

Bayesian learning: Introduction, Bayes Optimal Classifier, Naive Bayes Classifier, Bayesian networks, Approximate Inference, Making Bayesian Networks, Hidden Markov Models, The Forward Algorithm,

Neural Networks : The Perceptron, Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back Propagation

UNIT-IV

Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison

Evolutionary Learning: Genetic Algorithms, Genetic Operators, Genetic Programming

Ensemble learning: Boosting, Bagging

UNIT-V

Case studies : Use of Data sets , Data Pre-processing and application of the suitable algorithms .

Suggested Reading:

1. Tom M. Mitchell, Machine Learning, Mc Graw Hill, 1997
2. Stephen Marsland, Machine Learning - An Algorithmic Perspective, CRC Press, 2009
3. Margaret H Dunham, Data Mining, Pearson Edition., 2003.
4. Galit Shmueli, Nitin R Patel, Peter C Bruce, Data Mining for Business Intelligence, Wiley India Edition, 2007
5. Rajjan Shinghal, Pattern Recognition, Oxford University Press, 2006.