COURSE DESCRIPTION

BACHELOR OF TECHNOLOGY

(ELECTRICAL ENGINEERING)

Effective from 2018-19

COLLEGE OF TECHNOLOGY AND ENGINEERING

MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

UDAIPUR (RAJASTHAN)

VISION OF ELECTRICAL ENGINEERING DEPARTMENT

The Electrical Engineering Department was established with a vision of making it a centre for imparting technical education of high standards and conducting research at the cutting edge of technology to meet the current and future challenges of technological development.

MISSION OF ELECTRICAL ENGINEERING DEPARTMENT

- To offer high quality graduate and post graduate programs in Electrical Engineering.
- To prepare students for professional career or higher studies.
- The department promotes excellence in teaching, research, collaborative activities and positive contributions to society

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO I:
Our graduates will be productive in the professional practice of electrical engineering, related fields and higher education.

PEO II:
They will obtain employment appropriate to their background, interests, and education and will advance in their career.

PEO III:
Have the mathematical and scientific knowledge to analyze and solve emerging real world problems related to power system, control systems, power electronics, measurement and instrumentation system.

PEO IV:
They possess the necessary communication, organization and teamwork skills for bridge the divide between advanced technology and end users in the practice of electrical engineering.

PEO V:
Exhibit professionalism, ethical attitude, sense of responsibility in their profession and adapt to current trends by engaging in lifelong learning or in service to society.

PROGRAMME OUTCOME

- An ability to apply knowledge of engineering, mathematics, science appropriate to the discipline.
- An ability to analyze a problem, and identify and formulate the Engineering requirements appropriate to its solution.
- An ability to design, implement, and evaluate an Electrical Engineering system to meet desired needs with appropriate consideration for public health and safety, societal and environmental considerations.
- An ability to design and conduct experiments, as well as to analyze and interpret data.
- An ability to use current techniques, skills, and modern tools necessary for Electrical Engineering practice.
- An ability to analyze the local and global impact of computing on individuals, organizations, and society.
- Knowledge of contemporary issues for and an ability to engage in continuing professional development.

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- An understanding of professional, ethical, legal, security and social issues and responsibilities and an ability to communicate effectively with a range of audiences
- An ability to function effectively individually and on teams, including diverse and multidisciplinary, to accomplish a common goal.

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COURSE CONTENT

FIRST YEAR B.TECH. (I SEMESTER)

BS 111 MATHEMATICS – I

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

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

CO1	Expand function in Taylor's and Maclaurin's series
CO2	Trace the Cartesian and Polar curves
CO3	The student will be able to apply the partial differentiation to compute the minima and maxima of functions of two variables.
CO4	The student will be able compute areas and volumes by integration.
CO5	Solve linear differential equations of higher order and homogenous differential equations with constant coefficients.

Unit-I

Differential Calculus : Taylor's and Maclaurin's expansions. Asymptotes and Curvature (Cartesian Coordinates only). Curve tracing (Cartesian and standard Polar Curves-Cardioids, Lemniscates of Bernoulli, Limacon, Equiangular Spiral).

Unit-II

Differential Calculus : Partial Differentiation, Euler's Theorem on Homogeneous Functions. Maxima & Minima of Two Independent Variables. Lagrange's Method of Multipliers. Jacobians.

Unit-III

Integral Calculus : Double Integral, Areas & Volumes by Double Integration. Change of Order of Integration. Triple integrals. Beta Function and Gamma Function (Simple Properties), Relation between Beta and Gamma functions.

Unit-IV

Differential Equations : Linear Differential Equations of Higher Order with constant coefficients. Homogeneous Linear Differential Equations with constant coefficient.

Text Books/References

1. Guar, Y.N. and Koul, C.l. (2013) Engineering Mathematics, Vols. I & II, Jaipur Publishing House, Jaipur.
2. Babu Ram (2011) Engineering Mathematics-I, Pearson Education, India.
3. B.V. Ramana (2012) Higher Engineering Mathematics, Tata McGraw Hill, India.
4. J.L. Bansal and H.S. Dhami (2012) Differential Equations, Vols. I & II, Jaipur Publishing House, Jaipur.

5. M.Ray and Chaturvedi: A Text Book of Differential Equations, Student Friend & Co. Publisher, Agra.
6. Rao V. Dukkipati (2012) Engineering Mathematics, New Age International (P) Ltd., New Delhi.

ME 113 MECHANICAL ENGINEERING

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

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

CO1	A fundamental understanding of the laws of thermodynamics and their application to a wide range of systems with work and heat interactions.
CO2	Concept of entropy and irreversibility of a process and application of thermodynamic relationships to solve practical problems.
CO3	Gas and vapour power cycles and the efficiencies.
CO4	Properties of steam and its application in power generation.
CO5	Construction and working of various boilers and IC engines.

Unit-I

Thermodynamics: Thermodynamic properties, closed and open systems, flow and non-flow processes, gas laws, laws of thermodynamics, internal energy. Application of First Law in heating and expansion of gases in non-flow processes only.

Second law of thermodynamics: Kelvin-Planck and Claussius statements. Reversible processes, Carnot cycle, Carnot theorem. Reverse Carnot cycle. Entropy, physical concept of entropy.

Unit-II

Properties of Steam: Difference between gas and vapour, change of phase during constant pressure process. Generation of Steam, triple point and critical point. Internal energy and entropy of steam. Use of steam tables and Mollier chart, heating and expansion of vapour in non-flow processes.

Unit-III

Vapour Power Cycles: Introduction to Carnot Cycle. Rankine cycle and modified Rankine cycle.

Steam Generators: Classification of steam boilers. Cochran, Lancashire, Locomotive and Babcock-Wilcox boilers. Boiler mountings and accessories.

Steam Engines: Introduction to simple and compound steam engines.

Unit-IV

Gas Power Cycles: Introduction. Air Standard efficiency, other engine efficiencies and terms. Otto, Diesel and Dual cycles. Calculation of efficiency, mean effective pressure and their comparison.

Internal Combustion Engines: Introduction, Classification, terminology and description of IC Engines. Four stroke and two stroke petrol, gas and diesel engines. Comparison of petrol and diesel engines. Simple carburettor.

Text Books/References

1. M.L. Mathur and F.S. Mehta. Thermal Engineering, (Vol. I, SI Edition), Jain Brothers, New Delhi.
2. R.K. Purohit : Foundation of Mechanical Engineering; Scientific Publishers (INDIA), Jodhpur.
3. P.K. Nag : Engineering Thermodynamics, TMH.

ME 114 WORKSHOP PRACTICE

Cr. Hrs. 1 (0 + 1)

	L	T	P
Credit	**0**	**0**	**1**
Hours	**0**	**0**	**3**

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

CO1	Practical performance in carpentry shop.
CO2	Smithy Shop, Simple exercises involving basic operations like bending, drawing, punching, shaping, upsetting, and riveting.
CO3	Fitting Shop, Simple exercises involving basic operations like sawing, chipping, filling, drilling, reaming, threading with taps and dies.
CO4	Sheet Metal and Plumbing Shop: Demonstration of basic tools, pipe fittings and operations.

Carpentry Shop: Acquaintance with types of wood, tools and their uses. Simple exercises involving basic operations like sawing, planning, chiselling, etc. Preparation of simple joints, cross half lap joint, dovetail joint, bridle joint, tennon and mortise joint.

Smithy Shop: Acquaintance with types of tools and their uses. Simple exercises involving basic operations like bending, drawing, punching, shaping, upsetting and riveting.

Fitting Shop: Acquaintance with tools, measuring and marking tools, precision measuring tools and their uses. Simple exercises involving basic operations like sawing, chipping, filling, drilling, reaming, threading with taps and dies.

Sheet Metal and Plumbing Shop: Demonstration of basic tools, pipe fittings and operations.

Texts/References

1. S. K. Hajra Choudhury and AK Hajra Choudhury. Elements of Workshop Technology (Vol. I), Media Promoters & Publishers Pvt. Ltd., Bombay.

CE 115 ENGINEERING DRAWING

Cr. Hrs. 1 (0 + 1)

	L	T	P
Credit	**0**	**0**	**1**
Hours	**0**	**0**	**3**

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

CO1	Select, Construct and Interpret appropriate drawing scale as per the situation.
CO2	Draw simple curves like ellipse, cycloid and spiral.
CO3	Draw Orthographic projections of points, lines and planes.
CO4	Draw orthographic projection of solids like cylinders, cones, prisms and pyramids including sections.

CO5	Layout development of solids for practical situations.
CO6	Draw isometric projections of simple objects.

Introduction and letter writing. Construction and use of plain, diagonal and vernier scale. Methods of drawing ellipse, parabola and hyperbola. Methods of drawing cycloids, spirals. Orthographic projection and projection of points.

Projection of lines, projection of planes, projection of solids. Introduction of prism, pyramid, cylinder and cone.

Section of solids, introduction of intersection of surfaces. Development of plane and curved surface. Isometric projection.

Text/Reference

1. N.D. Bhatt. Elementary Engg. Drawing, Rupalee publication, Anand.
2. Lakshmi Narayan and Vaishwanar. A Text Book of Practical Geometry, Jain Brother, New Delhi.
3. R.B. Gupta. A Text Book of Engineering Drawing, Satry Prakashan, New Delhi.
4. Fundamentals of Technical Drawing, Parkinson.

BS 100P ENGINEERING PHYSICS

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**2**

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

CO1	Apply vector calculus approach to problems in electric field and magnetic field.
CO2	Apply laws of physics to simple LRC circuits.
CO3	Learn physics behind various types of lasers and their characteristics.
CO4	Understand the interference and diffraction from wave optics concepts and know its applications.
CO5	Understand polarization of light and its applications.

Unit-I

Electric Field: Line integral of electric field, Potential difference, Field as gradient of potential, Divergence of a vector function, Differential form of Gauss's law, Laplacian, Laplace equations, Curl of a vector function. Gauss's divergence theorem.

Magnetic Field: Curl and Divergence of a magnetic field, Magnetic scalar and vector potential.

Unit-II

Varying Field: Faraday's law-integral and differential form, Self and mutual inductance, Neumann's equation, Charge and discharge of a capacitor through register, Growth and decay of current in LR circuit, Energy stored in electric and magnetic field, Displacement current, Maxwell's equations.

Unit-III

Laser: Coherence, Einstein's coefficient, Spontaneous and stimulated emission, Population inversion, Laser gain (pumping), Spectral narrowing in laser, Coherence length, Ruby and He-Ne laser.

Interference: Division of amplitude, colour of thin films, Newton's ring, Febry-Perot interferometer-principle, operation, determination of wave length and difference in wave length.

Unit-IV

Diffraction: Double slit Fraunhofer diffraction pattern, Fraunhofer diffraction by a plane transmission grating, Formation of spectra.

Polarization: Analysis of linearly, circularly and elliptically polarized light (Half wave and quarter wave plates), Optical activity, specific rotations, Laurent's half shade and its use for determination of specific rotation of sugar solution.

Practicals

1. To find refractive index and dispersive power of material of prism by spectrometer.
2. To find wave length of light by Newton's ring.
3. To find wave length of light by diffraction grating.
4. To find specific rotation of sugar solution by polarimeter.
5. To find wave length of light by Fresnel Biprism.
6. To find frequency of A.C. mains.
7. To determine dielectric constant of liquid using series resonance method.
8. To study charge and discharge of condenser through a resistor (C.R. Circuit).
9. To study LCR resonant circuit, resonance, quality factor and sharpness in (i) series circuit (ii) parallel circuit.

Text Books/References

1. K.K. Tiwari. (1995). Electricity and Magnetism, S. Chand and Company, New Delhi.
2. N. Subrahmanyam and Brijlal. (1993). A Text Book of Optics, S. Chand and Company, New Delhi.
3. Ahmed and Lal. (1966). Electricity, Magnetism and Electronics, Unitech House, Lucknow.
4. D.S. Mathur. (1993). Mechanics, S. Chand and Company, New Delhi.
5. Gupta and Kumar. (1995). Practical Physics, Pragati Prakashan, Meerut.

CE 100 ENGINEERING MECHANICS

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**2**

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

CO1	Draw free body diagrams and determine the resultant of forces and/or moments.
CO2	Determine the centroid and second moment of area of sections.
CO3	Apply laws of mechanics to determine efficiency of simple machines with consideration of friction.
CO4	Analyse statically determinate planar frames.
CO5	Analyse the motion and calculate trajectory characteristics.
CO6	Apply Newton's laws and conservation laws to elastic collisions and motion of rigid bodies.

(A) STATICS

Unit-I

Introduction of condition of equilibrium: Force, system of force, coplanar forces.

Moment and couples: Moment and parallel forces, Couples, General conditions of equilibrium

Practical Applications: Levers, Cracked levers, Steel yards. Sagging chains and toggle joints.

Centre of Gravity: Centre of parallel forces, C.G. in some simple cases, C.G. of Solids.

Moment of Inertia: Moment of inertia, Radius of gyration and perpendicular axis. Determination of moment of inertia of simple sections. Mass of moment of inertia.

Unit-II

Friction: Introduction, Critical angle of friction, Friction on horizontal planes, Friction on inclined planes, Wedge and block, Screw jacks, Rolling friction.

Machines: Introduction, Effects of friction, Loss of work, Reversible and irreversible machine, Law of machine, Wheel and axle, Differential wheel and axle, Pulley block, Screw jack, Single and double purchase crab, Worm and Worm wheel, System of pulleys.

Frames: Statically determinate plane frames, Method of joints, Method of sections, Graphical method.

(B) DYNAMICS

Unit-III

Rectilinear Motion, Motion under gravity, Projectiles equation of the path, Maximum height attained, Time of flight, Horizontal range. Angle of projection, Projectile from a given height, Projectile on an inclined plane, Problems.

Work, Power and Energy: Work, Power, Work done by torque, Energy, Law of conservation.

Unit-IV

Centripetal and centrifugal forces, Laws of motion: Newton's Law of motion and their explanation, Collision of elastic bodies; Impulse and impulsive force, Principle of conservation of momentum, Loss of kinetic energy during impact.

Practicals

1. Verification of law of polygon of forces.
2. Verification of principle of moment in case of compound level.
3. Verification of principle of moment in case of bell crack level.
4. Determination of reaction in case simply supported beam with or without overhang.
5. To determine coefficient of friction between different surfaces on horizontal plane.
6. To determine coefficient of friction between different surfaces in inclined plane.
7. Study of different wheel and Axle.
8. Study of single purchase crab.
9. Study of worm and worm wheel.
10. Study of Weston's pulley block.
11. Determination of mechanical advantage, velocity ratio and efficiency of single purchase crab.
12. Determination of mechanical advantage, velocity ratio and efficiency of double purchase crab.
13. Determination of mechanical advantage, velocity ratio and efficiency of first system of pulley.
14. Determination of mechanical advantage, velocity ratio and efficiency of second system of pulleys.
15. Determination of mechanical advantage, velocity ratio and efficiency of third system of pulleys Flywheel.

Text Books/References

1. I.B. Prasad. Engineering Mechanics, Khanna Publisher, New Delhi.
2. R.S. Khurmi. Applied Mechanics, S. Chand & Company Ltd., New Delhi
3. S.B. Junnarkar. Applied Mechanics, Charotar Publishing House, New Delhi.

4. Saluja. Applied Mechanics, Satya Prakashan, New Delhi.

EE 100 ELECTRICAL ENGINEERING – I

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

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

CO1	Proficiency in solving DC network.
CO2	Know-how of single phase AC circuits
CO3	Competency in solving three phase balanced AC circuits
CO4	Dexterity in using basic electrical instruments
CO5	Comprehension of transformer working principles.

Unit-I

Electro motive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits, hysteresis and eddy current losses.

Kirchoff's law, Delta-star and star-delta conversion, source conversion

Network theorems: Thevenin's, Norton's, superposition, and Maximum Power Transfer theorem.

Unit-II

Single Phase EMF generation, average and effective values of sinusoidal and linear periodic wave forms, instantaneous and average power, power factor, reactive & apparent power, solution of R-L-C, series, parallel, series-parallel circuits, complex representation of impedances, phasor diagram, series and parallel resonance.

Unit-III

Transformer*:* Faraday's laws of Electromagnetic induction, construction and principle operation of single phase transformer, EMF equation, voltage and current relationship and Phasor diagram for ideal transformer.

Fundamentals of DC machines: Working principle, operation and performance of DC machines (Motor and generator)

Unit-IV

Three phase A.C. circuits: Three phase EMF generation, delta and star connection, methods of three phase power measurement; power factor, reactive and apparent power, Series and parallel resonance.

Concept of Three phase induction motor: construction and operation. Basic introduction of single phase induction motor.

Practicals :

1. To Establish the Voltage-Current Relationship in an Electric Circuit and to Measure the Unknown Resistance by Ammeter-Voltmeter Method (Ohm's Law).
2. Experimentally Verify the Number of Resistance Connected in Series and parallel in an Electric Circuit can be replaced by in Equivalent Resistance without Disturbing the Circuit Condition.
3. Verify Kirchhoff's Current Law and voltage law for a DC Circuit.

4. Verify Superposition Theorem For A DC Circuit.
5. Verify Thevenin's Theorem for a Dc Circuit.
6. To Measure Power and power factor in a Single Phase A.C. Series R-L Circuit.
7. Determination of Choke Coil Parameter Resistance (R) and Inductance (L).
8. To Study The Characteristics of an L-C-R Series Circuit.
9. Testing of Single Phase Energy Meter by Direct Loading Method.
10. Determination of Percentage Regulation of a Single Phase Transformer by Direct Loading Method.
11. Determination of Efficiency of a Single Phase Transformer By Direct Loading Method
12. To perform open circuit and short circuit test for single phase transformer
13. To obtain load characteristics of D.C. shunt/series /compound generator
14. To perform no-load & blocked –rotor tests on 3 ph. Induction motor to obtain equivalent circuit parameters
15. To perform no load & blocked –rotor test on 1 ph. induction motor & to determine the parameters of equivalent circuit.

Text Books/References

1. B.L. Therja. Electrical Technology, S. Chand
2. M.E. Van Valkenberg. Network analysis, PHI
3. Soni and Gupta. Introduction to Electrical Network Theory, Dhanpat Rai Publisher
4. R.A. Gupta and Nikhal Gupta. (2002). Fundamentals of electrical & Electronics Engineering, JPH, Ist Edition,
5. H.P. Tiwari. (2002). Electrical & Electronics Engineering, College Book Centre, Jaipur.
6. J.B. Gupta. (2002). Fundamentals of Electrical & Electronics. S.K. Kataria and Sons. Dehli.

REE100: 2(2+0) Environmental Studies and Disaster Management

Cr. Hrs. 2 (2 + 0)

	L	T	P
Credit	**2**	**0**	**0**
Hours	**2**	**0**	**0**

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

CO1	Develop an understanding of different natural resources including renewable resources.
CO2	Realize the importance of ecosystem and biodiversity for maintaining ecological balance.
CO3	Develop an understanding of environmental pollutions and hazards due to engineering/technological activities and general measures to control them.
CO4	Demonstrate an appreciation for need for sustainable development and role of science.
CO5	Aware of important acts and laws in respect of environment.

Unit 1

Environmental Studies: Definition, scope and importance. Natural Resources: Renewable and non-renewable resources; and associated problems.

Forest resources: Use and over-exploitation. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects. Food resources: World food problems, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Energy resources: Growing energy needs; renewable and non-renewable energy sources. Land resources: Land as a resource, land degradation, man

induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources.

Unit 2

Ecosystems: Concept, Structure and function. Energy flow in an ecosystem. Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the various ecosystems.

Biodiversity and its conservation: Introduction, definition, genetic species & ecosystem diversity and biogeographical classification of India.

Value of biodiversity. Biodiversity at global, national and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation.

Unit 3

Environmental Pollution: definition, cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards.
Solid Waste Management: causes, effects and control measures of urban and industrial wastes.
Role of an individual in prevention of pollution.
Social Issues and the Environment: Urban problems related to energy; Water conservation, rain water harvesting, watershed management.
Environmental ethics: Issues and possible solutions; Wasteland reclamation, Consumerism and waste products. Environment Protection Act.
Issues involved in enforcement of environmental legislation. Public awareness, Human Population and the Environment: population growth, Family Welfare Programme.
Environment and human health: Human Rights, Value Education, HIV/AIDS, Women and Child Welfare.
Role of Information Technology in Environment and human health.

Unit 4

Natural Disasters- Meaning and nature, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Climatic change: global warming, Sea level rise, ozone depletion.

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, accidents.

Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Armed forces in disaster response; Disaster response; Police and other organizations.

Suggested Readings

1. Agarwal K. C., Environmental Biology, Nidi Publications, Bikaner, 2001
2. Bharucha Erach. 2005. Text Book of Environmental Studies for Undergraduate Courses. University Grants Commission, University Press, Hyderabad.
3. Chary Manohar and Jaya Ram Reddy. 2004. Principles of Environmental Studies. BS Publishers, Hyderabad.
4. Chaudhary, B. L. and Jitendra Pandey: Environmental Studies, Apex Publishing House, Udaipur, 2005

5. Climate Change.1995: Adaptation and mitigation of climate change-Scientific Technical Analysis Cambridge University Press, Cambridge.
6. Gupta P K. 2004. Methods in Environmental Analysis – Water. Soil and Air. Agro bios, Jodhpur.
7. Husain Majid. 2013. Environment and Ecology: Biodiversity, Climate Change and Disaster Management. online book.
8. Jhadav, H & Bhosale, V. M.: Environmental Protection & Laws, Himalaya Pub. House, Delhi
9. Kaul S N, Ashuthosh Gautam. 2002. Water and Waste Water Analysis. Days Publishing House, Delhi.
10. Rao, M. N. and A. K. Datta, Waste Water Treatment. Oxford & IBH Publ. Co. Pvt. Ltd.
11. Sharma J P. 2003. Introduction to Environment Science. Lakshmi Publications.
12. Sharma, B. K., Environmental Chemistry. Goel Publishing House, Meerut
13. Sharma, R.K. & Sharma, G. 2005. Natural Disaster. APH Publishing Corporation, New Delhi.
14. Singh Pratap, N. S. Rathore and A. N. Mathur: Environmental Studies, Himanshu Publications, Udaipur, 2004
15. Trivedi R. K. and P. K. Goel, Introduction to Air Pollution, Techno Science Publications.

BS 100C ENGINEERING CHEMISTRY

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**2**

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

CO1	Demonstrate knowledge of science behind common impurities in water and methods to treat them.
CO2	Knowledge of methods to determine the calorific value of fuels, perform flue gas analysis and combustion analysis.
CO3	Apply the science for understanding corrosion and its prevention.
CO4	Demonstrate a knowledge of superconducting and organic electronic materials.
CO5	Knowledge of Kinetics of Reactions

Unit-I

Sources of water, common impurities, requisites of drinking water in municipal water supply. Purification of water, sterilization, break point chlorination. Hardness, determination of hardness by Complexometric (EDTA) method, degree of hardness, Boiler troubles, carry over corrosion, Sludge and scale formation. Caustic embrittlement, cause of boiler troubles and their prevention.

Unit-II

Classification of fuels, solid fuels, Proximate and Ultimate analysis of coal, significance of constituents, theoretical method for calculation of Gross and net calorific values. Liquid fuels-Petroleum origin, Refining of Petroleum, knocking, octane number, anti knocking agents. Flue gas analysis by Orsat Apparatus, Calculations based on combustion.

Unit-III

Corrosion: Definition and its significance, Dry and Wet theories of corrosion, Cathodic & Anodic protection of corrosion, types of corrosion, factors affecting corrosion.

New Engineering Materials: Introduction, Properties and Applications of Super Condcutors, Organic electronic materials, Fullerenes.

Unit-IV

Chemical Kinetics: Order and Molecularity of reaction, first and second order reaction, Derivation of equations for first and second order reaction, determination of order of reaction, Energy of activation and Arrhenius equations, Numerical of first and second order reactions.

Engineering Chemistry Practicals

1. Determination of viscosity of a liquid.
2. Estimation of free chlorine in a water sample.
3. Determination of temporary and permanent hardness by EDTA method.
4. Determination of Copper Sulphate iodometrically.
5. Estimation of Potassium dichromate iodometrically.
6. Determination of purity of Ferrous Ammonium Sulphate (Mohr's Salt) using Potassium Permanganate.
7. Estimation of available chlorine in Bleaching Powder sample.
8. Analysis of Brass.
9. Determination of Strength of Ferrous Ammonium Sulphate (FAS) using Potassium Ferricyanide as an external indicator.
10. Analysis of Common Salt.

Text Books/References

1. Jain and Jain. Engineering Chemistry, Dhanpat Rai Publishing Company(P) Ltd., New Delhi.
2. Jain and Gupta. A Text Book of Engineering Chemistry, Jaipur Publishing House, Jaipur.
3. B.K. Sharma. Engg. Chemistry (General), Krishna Prakashan Media (P) Ltd., Merrut.
4. S.S. Dara. A Text Book of Engineering Chemistry, S. Chand & Co., New Delhi.
5. M.M. Uppal. A Text Book of Engineering Chemistry, Khanna Publishers, New Delhi.
6. S.S. Dara. A Text Book on Experiments and Calculations in Engg. Chemistry. S. Chand & Co., New Delhi.
7. Ameta and Yasmin. Practical Engineering Chemistry, Himanshu Publications, New Delhi.

EC 100 ELECTRONICS AND INSTRUMENTATION

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**1**

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

CO1	Characterize passive electronic components.
CO2	Characterize diodes and transistors.
CO3	Demonstrate knowledge of concept and working of amplifier and oscillators circuits.
CO4	Demonstrate understanding of characteristics of power supplies.
CO5	Identify and select appropriate type of transducer for measurement of different quantities.

Unit-I

Passive Components: Construction and characteristics of various types of resistors, capacitors & inductors for electronics circuits, color coding of resistors. Semiconductor Devices: Basic theory of semiconductors, constructions and characteristics of PN diode, Zener diode, photodiode, LED, BJT & JFET

Unit-II

Bipolar Junction Transistor: Introduction to BJT biasing circuits, Basic concept of class-A, class-B, class-AB, class-C amplifiers.

Power supply: Rectifier circuits and filters. Concept of voltage regulators, Zener diode voltage regulators, Transistor series regulator.

Unit-III

Feedback & Oscillators: Concept of positive and negative feedback. Introduction to oscillator. Barkhausen criteria. Working principle of RC- phase shift, Wien bridge, Hartley, Colpitt and Crystal oscillators.

Unit-IV

Transducers:Active and Passive transducers. Working principle of Thermocouple, LVDT, Strain Gauge and Techo Generator. Instrumentation: Introduction to data acquisition system. Working principle of Electronic Multimeter, Cathode Ray Oscillator, Digital Storage Oscillator and Spectrum Analyzer.

CS 100 INTRODUCTION TO COMPUTER PROGRAMMING AND DATA STRUCTURE

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**2**

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

CO1	Understand the basic building blocks of a computer.
CO2	Learn the data types and syntax of C language.
CO3	Write, compile and execute programs in C language for solving engineering problems.
CO4	Demonstrate capability to choose appropriate type of data structures and perform operations on them.

Unit–I

Computer Fundamentals: History of computers; Organization of computers; input unit, output unit, storage unit, central processing unit; CPU operation; Memory subsystem: RAM, ROM, Cache memory; instruction execution cycle; Introduction to binary (Base-2) numbers.

Unit-II

Basics of programming in C: Constants, variables, data types, operators and expressions, input and output operations, decision making & branching: if-else, switch statement; decision making & looping: Arrays.

Unit-III

Character arrays & strings, user defined function, structures & unions, pointer management, dynamic memory allocation.

Unit–IV

Introduction to Data Structures: Introduction to linear arrays & representation of linear array in memory, traversing, insertion & deletion in linear arrays, Bubble sort, Linear & Binary search; Introduction to basic operations of stack such as push, pop; basic operation of queue such as insert, delete; basic operations of linked list such as traverse, insert, delete.

List of experiments/practicals

1. Write a C program to exhibit the use of various operators.
2. Write a C program to exhibit the use of if-else, switch in decision making.
3. Write a C program to exhibit the use of various loops and control statements.
4. Write a C program to exhibit the use of arrays, strings and pointers.
5. Write a C program to exhibit use of user defined functions, call by value, call by reference and recursion.
6. Write a C program to exhibit various storage classes.
7. Write a C program to exhibit the use of structure, union and dynamic memory allocation.
8. Write a C program to implement bubble sorting and searching algorithms (linear search, binary search).
9. Write a C program to exhibit stack and queue and their various operations.
10. Write a C program to understand singly linked list and its various operations (traverse, insert, delete).
11. The list of experimental mentioned above can be augmented based on the requirement by the subject teacher.

Text Books/References

1. E. Balagurusamy. "Programming in ANSI C", Tata McGraw Hill.
2. Kernighan and Ritchie. "The C Programming language", Printice Hall
3. P.K. Sinha & P. Sinha. "Computer Fundamentals", BPB Publication.
4. Seymour Lipschutz. "Data Structure", Schaum's outline series, McGraw Hill.

BS100E:- COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**2**

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

CO1	Understand basic grammar principles and be able to synthesise and transform sentences.
CO2	Write CVs, letters for job application, complaints and emails.
CO3	Prepare technical reports and short essays.
CO4	Learn phonetic symbols and use correct sound, stress and intonation.
CO5	Learn basic do's and don'ts of an interview.
CO6	Show enhance communication ability in English.

UNIT 1

Use of articles, Common Errors in English, Prepositions, Tenses, Concord, Narration and Voice.

UNIT 2

E-mail Writing, Report Writing, Preparation of C.V And Resume Writing, Memo and Notice Writing.

UNIT 3

Personality Traits, Skills for a good Leader, *Effective Time Management Techniques, Seminar, Conference and Group Discussion.*

UNIT 4

Communication, Process of Communication, Types of Communication, Barriers of Communication and Effective Communication.

PRACTICAL

Phonetic, Consonants, Vowels, Diphthongs, Homonyms and Homophones, Conducting Mock Interviews and Mock Gds, One - Word Substitutes, Synonyms and Antonyms, Idio ms and Phrases.

SUGGESTED READINGS:

1) Language in Use (Upper intermediate Level, Adrian Doff Christopher Jones, Cambridge University Press
2) Common Errors in English, Abul Hashem, Ramesh Publishing House, New Delhi.
3) A Practical Course for Developing Writing Skills in English, J.K. Gangal, PHI Learning Pvt. Ltd., New Delhi.
4) Thomson and martin. (1997). A Practical English Grammar Exercise Book, Vol. I and II, O.U.P. Publication
5) Spoken English for India, R.K. Bansal & J.B. Harrison, Orient Longman, Delhi.
6) The sounds of English, Veena Kumar, Makaav Educational Software, New Delhi.
7) English Phonetics & Phonology , P. Roach, Cambridge University Press, London.
8) The Written Word , Vandana R. Singh, Oxford University Press (New Delhi).
9) English for Engineers: Made Easy, Aeda Abidi & Ritu Chaudhary, Cengage Learning, (New Delhi)
10) Daniel Coleman, Emotional Intelligence, Bantam Book, 2006

FIRST YEAR B.TECH. (II SEMESTER)

BS 121 MATHEMATICS – II

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

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

CO1	Show knowledge of vector calculus and its applications in engineering.
CO2	Solve second order differential equations for application in their field of engineering.
CO3	Solve partial differential equations of first order and higher orders (with constant coefficients).
CO4	Solve simultaneous equations by matrix methods.
CO5	Determine eigenvalues and eigenvectors.
CO6	Diagonalise a matrix and invert a matrix.

Unit-I

Vectors Calculus: Scalar and Vector field. Differentiation of vector functions, Gradient, Divergence, Curl and Differential Operator. Integration of vector functions, Line, Surface and volume Integrals. Green's Theorem in a Plane, Gauss's and Stoke's Theorem (without proof) and their Applications.

Unit-II

Differential Equations: Second Order Ordinary Differential Equations with Variables Coefficients. Exact Forms. Part of Complimentary Function is known. Change of Dependent Variable. Change of Independent Variable, Normal Forms. Method of Variation of Parameter.

Unit-III

Partial Differential Equations: Formation of partial differential equations. Partial Differential Equations of First Order, Lagrange's Form, Standard Forms Higher order linear partial differential equations with constant coefficients.

Unit-IV

Matrices: Rank of a matrix, Inverse of a matrix by elementary transformations. Consistency and Solution of simultaneous linear equations. Eigen values and Eigen vectors, Cayley-Hamilton theorem (without proof). Diagonalization of matrix.

Text Books/References

1. Guar, Y.N. and Koul, C.l. (2013) Engineering Mathematics, Vols. I & II, Jaipur Publishing House, Jaipur.
2. Babu Ram: Engineering Mathematics-I, Pearson Education, India (2011).
3. B.V. Ramana (2012) Higher Engineering Mathematics, Tata McGraw Hill, India.
4. J.L. Bansal and H.S. Dhami (2012) Differential Equations, Vols. I & II, Jaipur Publishing House, Jaipur.
5. M. Ray and Chaturvedi: A Text Book of Differential Equations, Student Friend & Co. Publisher, Agra.
6. Rao V. Dukkipati (2012) Engineering Mathematics, New Age International (P) Ltd., New Delhi.

CE 122 CIVIL ENGINEERING

Cr. Hrs. 2 (1 + 1)

	L	T	P
Credit	**1**	**0**	**1**
Hours	**1**	**0**	**2**

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

CO1	Demonstrate knowledge of various surveying methods.
CO2	Conduct a chain survey.
CO3	Conduct a compass survey.
CO4	Conduct levelling survey and be able to do RL calculations.
CO5	Demonstrate knowledge of properties of various building materials.

(A) SURVEYING AND LEVELING

Unit-I

Principle and purpose of plane surveying.

Chain Surveying: Instrument for chaining, Direct & indirect ranging. Methods of chain along plane & sloping ground, Base line, check line, Tie line, Offset, Chain angle & recording in field book.

Compass Surveying : True & Magnetic meridian, whole circle bearing & quadrantal bearing system, construction & use of Prismatic & Surveyor Compass, Local attraction.

Unit-II

Level and leveling : Definition of various terms used in leveling. Types of Bench mark and their uses. Construction and use of Dumpy and Tilting levels, Leveling staves. Temporary adjustment of Dumpy level. Simple, differential leveling, fly leveling, longitudinal and cross sectioning, plotting of profile leveling. Determination of level by line of collimation and rise and fall method, Arithmetical checks. Level book and record keeping, leveling difficulties and errors in leveling.

(B) BUILDING MATERIAL

Unit-III

Stones: Different types, properties of good building stones, common testing of stones, Dressing of stones and use of stones in construction.

Bricks: Types, raw materials, identification, composition. Properties and uses of ordinary bricks, fire resistant and chemical resistant bricks.

Limes: Definition, sources of lime, slaking of lime, ISI classification of lime.

Unit-IV

Cement: Chemical composition, types of cement, properties, uses and tests on cement.

Mortars: Proportioning, properties of ingredients and use of lime, cement and gauge mortars.

Cement Concrete: Ingredients, common proportions, properties of fresh hardened concrete, Water cement ratio, curing and consolidation of concrete.

Practicals

1. Study of accessories used in measurement of distances.
2. Ranging Direct and indirect and use of chain and tape.
3. Chining along sloping ground.

4. Chain surveying, field book recording and taking offsets for location details.
5. Study of prismatic and surveying compass and taking bearings.
6. Study of Dumpy level, temporary adjustment and R.L. calculations.
7. Study of Tilting level, temporary adjustment and R.L. calculations.
8. Simply and differential leveling operation, record in level book, practice for staff reading line of collimation and Rise and fall method calculations.
9. L-section and cross sectioning, fly leveling operation.
10. Plotting of working profile.

Practical: Lab experiments based on theory.

Text Books/References

1. S.C. Rangwala. Engineering Materials, Charotar Book Stall, Anand.
2. B.C. Punmiya. Surveying & Field Work (Vol. I), Laxmi publications, New Delhi.

ME 123 MACHINE DRAWING – I

Cr. Hrs. 1 (0 + 1)

	L	T	P
Credit	**0**	**0**	**1**
Hours	**0**	**0**	**3**

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

CO1	Introduction to BIS codes.
CO2	Introduction to Orthographic Projection.
CO3	How to draw the missing views and Sectional Views.
CO4	Knowledge about Riveted and Welded Joints, Screw Fastenings.
CO5	Knowledge of Conventional representation of threads, Different types of lock nuts, studs, machine screws, cap screws and wood screws.

Introduction, conventional representation of different materials used in machine drawing, Introduction to BIS codes.

Orthographic Projection: First and third angle methods of projection. Preparation of working drawing from models and isometric views. Drawing of missing views.

Dimensioning: Different methods of dimensioning.

Sectional Views: Concept of sectioning. Revolved and oblique section. Sectional drawing of simple machine parts

Riveted and Welded Joints: Types of rivet heads and riveted joints. Processes for producing leak proof joints. Symbols for different types of welded joints.

Screw Fastenings: Nomenclature, thread profiles, multistart threads, left and right hand threads. Square headed and hexagonal nuts and bolts. Conventional representation of threads. Different types of lock nuts, studs, machine screws, cap screws and wood screws. Foundation bolts.

Different types of joints: Knuckle joint, cotter joint and universal joint.

Text Books/References

1. N.D. Bhatt. Machine Drawing, Charotar Book Stall, Anand.
2. V. Laxminarayan and M.L. Mathur. A Text Book of Machine Drawing, Jain Brothers, New Delhi.
3. P.S. Gill. Machine Drawing: S.K. Kataria & Sons, New Delhi.

ME 124 WORKSHOP TECHNOLOGY

Cr. Hrs. 3 (2 + 1)

	L	T	P
Credit	**2**	**0**	**1**
Hours	**2**	**0**	**3**

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

CO1: Understand welding principles, equipment and tools of arc-gas and resistance welding, brazing and soldering.

CO2: Describe construction, operations and tools of lathe, shaper and drilling machines.

CO3: Understand basic hot and cold forming operations.

CO4: Demonstrate knowledge of types of patterns, cores, moulding sands and tools.

CO5: Understand sand, permanent mould and investments castings and casting defects.

Unit-I

Welding: Introduction to types of welding; Principle of Electric arc welding, welding tools and safety devices, welding positions, welding joints, types of welds, Resistance welding, Oxyacetylene gas welding, types of flames, Soldering and Brazing.

Unit-II

Lathes: Constructional details of centre lathe. Main operations and tools used on centre lathes.

Shaper: Types of shapers. Constructional details of standard shaper, shaper tools and main operations.

Unit-III

Drilling Machines: Types of drilling machines. Constructional details of pillar type and radial drilling machines. Main operations. Twist drills, drill angles and sizes.

Forming : Basic descriptions and applications of hot and cold working processes, forging, bending, shearing, drawing and forming operations.

Unit-IV

Foundry & Casting Practice : Introduction, types of pattterns, mouldings, moulding Materials, cores, moulding tools and equipments. Moulding sands, properties of moulding sands. Casting defects.

Casting methods : Permanent mould casting, investment casting.

Practicals

Practical exercises on welding, pattern making, foundry and machining operations.

Text Books/References

1. Mathur, Mehta and Tiwari : Elements of Mechanical Engineering, Jain Brothers, New Delhi.
2. S.K. Hajra Choudhury and A.K. Hajra Choudhury. Elements of Workshop Technology (Vol. I and II), Media promoters & Publishers Pvt. Ltd., Bombay.

SECOND YEAR (SEMESTER-I)

BS 211 (All Branches) MATHEMATICS – III

Cr. Hrs. 3 (3 + 0)

L T P

Credit 3 0 0

Hours 3 0 0

COURSE OUTCOME –

CO1: Proficiency in numerical method for solving mathematical equations.
CO2: Ability in interpolation techniques.
CO3: Capability to numerical integration and differentiation in solving problems.
CO4: Competence in Laplace transforms application in solving engineering problems.

UNIT-I

Interpolation: Finite differences, various difference operators and their relationships, factorial notation. Interpolation with equal intervals; Newton's forward and backward interpolation formulae, Lagrange's interpolation formula for unequal intervals.

UNIT-II

Gauss forward and backward interpolation formulae, Stirling's and Bessel's central difference interpolation formulae.
Numerical Differentiation: Numerical differentiation based on Newton's forward and backward, Gauss forward and backward interpolation formulae.

UNIT-III

Numerical Integration: Numerical integration by Trapezoidal, Simpson's rule. *Numerical Solutions of Ordinary Differential Equations:* Picard's method, Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta methods.

UNIT-IV

Laplace Transform: Laplace transforms of elementary functions; Basic properties of Laplace transform; Initial value theorem, final value theorem and convolution property of Laplace transform; Inverse Laplace transforms. Applications of Laplace transform to solve ordinary differential equations.

EE 211 CIRCUIT THEORY – I

Cr. Hrs. 4 (3 + 1)

L T P

Credit 3 0 1

Hours 3 1 2

COURSE OUTCOME –

CO1: Proficiency in fundamental laws and elements of electrical networks.

CO2: Competence in waveforms, signals, transients and steady state response of various RLC circuits.

CO3: ability to solve any DC or AC electrical circuit using various network theorems.

CO4: Capability to harness mathematical tools like Laplace and Fourier transforms to solve electrical circuits.

UNIT-I

Basic circuit element and waveform: circuit component, ideal and practical voltage and current sources and their inter conversion, independent and dependent sources, unilateral and bilateral, active and passive, linear and non linear, distributed and lumped parameters.

Network theorem for AC network: Mesh and Nodal analysis, thevenin, Norton, superposition, maximum power transfer, milliman, telegen, compensation, reciprocity theorem.

UNIT-II

Resonance in series and parallel circuit, Q factor, selectivity, Transient and steady state response, solution of differential equation, Effect and determination of initial conditions and time constants, analysis of coupled circuit under sinusoidal excitation, coefficient of coupling, analysis of 3phase balanced and unbalanced circuit, measurement of 3 phase active and reactive power.

UNIT-III

Two port Network: open circuit, Short circuit, transmission, Hybrid parameters, their inter-relationship and interconnection, Two port symmetry, Input Impedance, output impedance, Image Impedance, rune's test

UNIT –IV

Fourier series: Periodic function, Trigonometric Fourier series, Evaluation of Fourier coefficient, waveform symmetry Analysis of simple circuit with non sinusoidal excitation

EE 212 (EE, CS) ELECTRICAL MEASUREMENTS & INSTRUMENTS

Cr. Hrs. 4 (3 + 1)

L T P

Credit 3 0 1

Hours 3 0 2

COURSE OUTCOME –

CO1: Proficiency in measurement of circuit quantities.
CO2: Competence in Minimization of errors in measurement.
CO3: Capability of harnessing Instrument transformer in measurements.
CO4 : know-how of Magnetic Measurements.

UNIT-I

Measuring Instruments: Principle of operation, construction detail, torque equation, scale shape, uses and error in Moving iron, Electrodynamics and induction instruments for the measurement of voltage, current, power and energy. *Galvanometers:* D'Arsonval, Vibration and Ballistic galvanometers, Dynamic equation of motion and its solution for various conditions, Relative damping, logarithmic decrement and galvanometer sensitivities.

UNIT-II

Potentiometers: Theory of operation and construction of D.C. and A.C. potentiometers (polar and coordinate type), Their standardization and applications. *Measurements of Resistance*: Methods of measurement of medium, low and high resistances, three and four terminal type resistance, Kelvin's double bridge, Price's guard wire and Loss of charge method.

UNIT-III

A.C. Bridges-Four arm A.C. Bridge for the measurement of inductance, capacitance, quality and dissipation factor. Screening, Wagner earthling.
Instrument Transformers: Theory and construction of current and potential transformers, Ratio and phase angle errors and their minimization, effects of variation of power factor, secondary burden and frequency on errors, Testing of CTs and PTs.

UNIT-IV

Magnetic Measurements-Determination of B-H curve and hysteresis loop of ring and bar specimens, Measurement and separation of iron losses. *Electronic Instruments*-Transistor voltmeter, TVM using FET in input stage, Digital voltmeters: Ramp type, integrated type, Measurement of time, phase and frequency using digital counters, Principle and working of cathode ray oscilloscope.

Wave analyzers: Frequency selective and heterodyne wave analyzers and its applications.

EE 213 ELECTRICAL WORKSHOP

Cr. Hrs. 1 (0 + 1)

L T P

Credit 0 0 1

Hours 0 1 2

COURSE OUTCOME –

CO1: Proficiency in working of electrical appliances used in daily life.
CO2: Competency in electrical appliances problem solving.
CO3: Ability to devise optimum earthing practices.
CO4: Capability in various basic House Wiring techniques.

Accessories & ratings of the wiring materials, *wiring circuits*: stair case, fluorescent tube lighting circuit, flasher for moving lights circuits, connection of sodium vapours and mercury vapour lamp, wiring layout of simple domestic and commercial buildings; Preparation of detailed estimation in the standard format for installation of surface conduit/casing and capping wiring in a small house/office, *Study the various types of electrical appliances*: electric iron, Geyser, mixer/systems, table fan & ceiling fan, principles of thermostats, regulators; Practice of earthling; Study of U.P.S, Battery Charger; Design small single -phase transformer of given rating;

Printed Circuit board: Design guideline General components, layout scheme, PCB size, design rules for digital circuit and analogy circuit PCB's single and multiplayer boards, Automation and Computer in PCB design, CAD packages and tools, Electronic circuit and minimum system design by using PCB design software packages.

EC 212 (EE) ELECTRONICS – I

Cr. Hrs. 4 (3 + 1)

L T P

Credit 3 0 1

Hours 3 1 2

COURSE OUTCOME –

CO1: Competency in theory of operation of solid-state devices.
CO2: Proficiency in technicalities various solid-state devices & their biasing techniques.
CO3: Ability to hands-on laboratory experience of solid state devices.
CO4: Capability to design & analyse small signal Amplifiers.

UNIT-I

Semiconductors: Intrinsic and extrinsic semiconductors, Mobility and conductivity, types of doping and its effect on properties of semiconductor, Diffusion, Mass-action Law, Graded semiconductors. *Theory of PN Junction Diodes:* The open circuited junction, space charge region. The biased p-n junction, the volt-ampere characteristics and volt-ampere equation and effect of temperature on V-I characteristic, junction diode switching times, diode capacitance.

UNIT-II

Diode circuits: Half wave and full wave single-phase rectifiers and their analysis, peak inverse voltage, various types of filters their analysis and applications. Voltage multipliers, Clipping and clamping circuit. *Other Types of Diodes:* Zener and avalanche breakdown phenomenon in zener diodes, photo-diodes, light emitting diodes, solar cells, narrator diodes.
Bipolar Junction Transistors: The ideal current controlled source, The junction transistor, Ebermoll representation of the BJT, The common base (CB) and common emitter (CE) configuration and their input and output characteristics, current gains alpha & beta, common collector, the forward active, reverse active, cut off and saturation, Modes of BJT.

UNIT-III

BJT biasing and d.c. models, stabilization techniques. BJT as a switch and as an amplifier, The BJT small signal models, h-parameter and hybrid bimodal, BJT as a diode, Transistor ratings.

Field effect Transistors: Ideal voltage controlled current source, junction field effect transistor and its V-I characteristics and its construction. The JFET transfer characteristics. MOSFET: Enhancement and depletion type. Brief idea about construction of MOSFETs, V-I characteristic.

UNIT-IV

Small signal Amplifiers at Low Frequency: Analysis of BJT and FET in various modes; input and output resistance, voltage and current gain, Miller theorem and its dual. Cascaded BJT amplifiers, Differential amplifiers and its analysis, composite transistor stages: Darlington pair and others, Boot strapping.

EC 216 (EC, EE) DIGITAL ELECTRONICS

Cr. Hrs. 4 (3 + 1)

L T P

Credit 3 0 1

Hours 3 1 2

COURSE OUTCOME –

CO1: Proficiency in applications of digital circuits in present scenario.
CO2: Competency in Boolean algebra and correlation between Boolean expressions.
CO3: Ability in analysing and designing of combinational and sequential circuits.
CO4: Capability to harness various memory devices & their applications.

UNIT-I

Number System & Codes: Radix and Radix conversion, Sign, magnitude and complement notation, Arithmetic shift weightedcodes,Excess-3 code, Gray code, ASCII & EBCDIC codes, Fixed and floating point arithmetic, BCD addition and subtraction.

UNIT-II

Boolean Algebra And Digital Logic Gates: Features of logic algebra, postulates of Boolean algebra, Theorems of Boolean algebra, Boolean function drive logic gates, Exclusive- OR, NAND, NOR gates, their block diagrams and truth tables, logic diagrams from Boolean expressions and vice –versa, converting logic diagrams to universal logic, positive, negative and mixed logic, logic gate conversion.
Minimizing Techniques: Minterm, Maxterm, Karnaugh Map, K map up to 4 variables, simplification of logic function with K map, conversion of truth table of POS and SOP form, Incomplete specified functions, Variable mapping, Quinn-Mc Klusky minimization techniques.

UNIT-III

Combinational Systems: Combinational logic circuit design, half and full adder, subtractor, Binary serial and parallel adders, BCD adder, BCD to7-segment decoder, multiplexer, De-multiplexer,

encoder, octal to binary, BCD to excess-3 encoder, Diode switching matrix, Design of logic circuits by multiplexers, encoder, decoders, and de-multiplexer.

UNIT-IV

Sequential Systems: Latches, flip flops, R-S, D, J-K, Master Slave flip-flops, Conversion of flip-flops, Asynchronous (ripple), Synchronous decade counter, Modulus counter, skipping stated counter, counter design, Ring counter, Counter applications, Registers, buffer registers, shift register.

CE 211 (AE, EE, MI) STRENGTH OF MATERIALS

Cr. Hrs. 3 (2 + 1)

L T P

Credit 2 0 1

Hours 2 1 2

COURSE OUTCOME –

CO1: Proficiency in basic mechanical properties of materials.
CO2: Competency in behaviours of various engineering structural materials.
CO3: know-how of engineering structures and beams.
CO4: Capability to harness Buckling, stability & torsion issues

UNIT-I

Fundamentals : Stress and strain, engineering properties, Saint-Venant's Principle. Stress strain diagram's, mechanical properties of materials, elasticity and plasticity. Shear stress. and strain, pure shear. Complementary shear. Linear elasticity and Hooke's law. poison's ratio, volumetric strain, bulk modulus of elasticity. Elastic constants and relation between elastic modulic. Stress and strain in axially loaded members. Temperature stresses and effects.

UNIT-II

Analysis of stress and strain : Stress at a point, stress components. Stresses on inclined planes. Plane stress and strain. Mohr's circle representation of plain stress and strain. Principle stresses and strains, maximum shear stresses. Hooke's law for plain stress. Stresses in thin cylinder and special shells subjected to internal &external pressures.

UNIT-III

Beam under Flexural Loads : Bending moment and shear force, relation between load,. Shear force and bending moment. Bending moment and shear force diagrams for simply supported, Cantilever and overhang beams under static loading of different types viz. point loads, Uniformly distributed loads, linearly varying loads, Pure bending. Theory of simple bending of initially straight beams. Flexural stresses in beams. Built up and composite beams. Shear stresses in beams of rectangular, Circular and Isection. Shear formula, effect of shear strain.

UNIT-IV

Torsion : Torsion of solid and hollow circular shafts. Non-uniform torsion.
Columns : Buckling and stability, critical load. Euler's theory for initially straight column with different end conditions, equivalent length, Limitation of Euler's formula. Rankine's formula. column under concentric loading. Secant, Perry's and Indian standard Formulae.

SECOND YEAR (SEMESTER-II)

EE 221 CIRCUIT THEORY – II

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Competency in advanced methods for network analysis.
CO2: Proficiency in time domain & frequency domain analysis.
CO3: Capability to design filters and their applicability.
CO4: Ability to concepts of network synthesis and its application.

UNIT-I

Laplace transform and its application to network analysis, transform networks and sources, initial and final value, and inverse transform, Unit impulse response, unit step response, the time shift theorem, convolution.

UNIT-II

Network functions and complex frequency plane- transfer functions, concepts of complex frequency, poles and zero and restrictions on their location in s-plane, relation between natural transient frequencies and resonance. Time domain behavior from pole-zero configuration ,frequency response , magnitude and phase of network functions ,a relation between time domain and frequency domain analysis .

UNIT-III

Filters –two port reactance networks, image impedance, attenuation, phase shift and insertion loss, characteristics and design of constant –k and m-derived filters

UNIT-IV

Fourier integral and continuous spectra – the Fourier Integral spectrum analysis for recurring pulse, relationship between Fourier and lap lace transform, analysis of circuit using Fourier transforms ,sinusoidal transfer function. Network synthesis – the positive real concept , brunet 's

positive realness , properties of function , Hurwitz polynomials , synthesis of two elements networks LC ,RC and networks, causer and foster networks .

EE 222 POWER SYSTEM – I

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Proficiency in insulator's voltage distribution over an insulator string.
CO2: Competency in designing parameters of transmission lines and their performance.
CO3: Capability to harness distribution system configurations, equipment and loads.
CO4: Know-how of travelling waves and their significance.

UNIT-I

Basics of power system; Insulators: Type of insulators, bushings, voltage distribution over an insulator string, grading and methods of improving string efficiency, pollution flashover; Corona: Electric stress between parallel conductor's, Disruptive critical voltage and visual critical voltage, calculation for three phase overhead lines for corona power loss, factors effecting corona, effect of corona.

UNIT-II

Parameters of transmission lines: Resistance, inductance and capacitance of overhead lines, effect of earth on capacitance, line transposition, geometric mean radius and distance, calculation of inductance and capacitance of single phase transmission line, Skin and Proximity effect.

UNIT-III

Performance of transmission lines: Steady state analysis of short, medium and long transmission lines, Generalized ABCD line constants, receiving end and sending end power circle diagrams, Ferranti effect, interference with communication circuits.

UNIT-IV

Underground cables: Type of cables, insulation resistance and capacitance calculation, reduction of maximum stresses, causes of breakdown, idea about oil and gas filled cables, thermal rating of cables. Travelling waves: Travelling waves on transmission lines, wave equation, specification of travelling waves, reflection and refraction of travelling waves, typical cases of line terminations .

EE 223 ELECTRICAL MACHINES – I

Cr. Hrs.	**4 (3 + 1)**		
	L	**T**	**P**
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Proficiency in electrical machines and their applications.
CO2: Competency in testing & operational issues of Transformers.
CO3: Dexterity in operational aspects, starters and speed control Of DC Machines.
CO4: Know-how of cross fields machinery and their applications.

UNIT-I

Transformers: Constructional features, emf equation, phasor diagram, equivalent circuits, open circuit and short circuit test, Sumpner's test, efficiency, voltage regulation, all-day efficiency, separation of losses, parallel operation, autotransformers.

UNIT-II

Polyphase Transformers: standard connections for three-phase operation, single phasing and unbalanced load conditions on a three phase transformer, Scott connection and six-phase transformation. Electromechanical Energy Conversion: Basic principles of electromechanical energy conversion, energy balance, basic principles of operation of electric generators and motors. DC Machines: Fundamentals of DC machine, construction, armature windings, simple lap and wave windings, chording, equalizing connections.

UNIT-III

DC Generators: EMF equation, Types of DC generators, no load and load characteristics, parallel operation. Armature Reaction: Distribution of armature and field mmfs, cross magnetizing and demagnetizing mmfs and their approximate estimation. Commutation: Introduction to commutation, reactance voltage, resistance commutation and interpoles.

UNIT-IV

DC Motors: Principle of operation, production of torque, back emf, torque-current and torque-speed characteristics, starting of motors, speed control by variation of armature voltage, field current and Ward Leonard method, electric braking, losses and efficiency, direct and indirect tests, Swinburne's test, Hopkinson's test, field test and retardation test, Rosenberg generator. Cross-Field Machines: Basic principles of operation of metadyne and amplidyne and their applications.

EE 224 ELECTRICAL COMPUTATION

Cr. Hrs. 1 (0 + 1)

	L	T	P
Credit	**0**	**0**	**1**
Hours	**0**	**1**	**2**

COURSE OUTCOME –

CO1: Competency in programming of C/C^{+} for various Electrical problems.
CO2: Proficiency in use of MATLAB as a versatile tool in Electrical Engineering.
CO3:Capability in harnessing PSCAD in modelling & simulation of electrical circuits.
CO4: Capability in harnessing PSIM in simulation of power Electronics circuits.

Review of C fundamentals: Data Structure in C: manipulating strings of character, input & output of strings. Using structures in arrays & arrays in structures, Pointer data type, pointers and arrays, pointer and functions. Enumerated data type, creating new data type names, simulation & application of stack,. List data structure, manipulation of linked list, Files-sequential & unformatted files, Projection preparing & running complete 'C' Program; Introduction to MATLAB and Simulink: To design and simulate various of electrical circuits and system.

Introduction to PSIM: To design and simulate various of electrical circuits and system; Introduction to PSCAD: Modelling, Simulating and Designing HVDC & AC transmission system using CB, Relays, faults, with no. of buses.

THIRD YEAR (SEMESTER-I)

BS 311 (EE) MATHEMATICS – V

Cr. Hrs. 2 (2 + 0)

	L	T	P
Credit	**2**	**0**	**0**
Hours	**2**	**1**	**0**

COURSE OUTCOME –

CO1: Proficiency in solving Differences equations.
CO2: Competence in general Z-transformation and their applications.
CO3 : Capability in numerical methods for solution of simultaneous linear equations.
CO4 : Ability to solve engineering specific partial differential equation problems.

UNIT-I

Difference Equations: Homogeneous linear difference equations with constant coefficients; Non-homogeneous linear difference equations with constant coefficients, method of undetermined coefficients, method of operators; Homogeneous\ Non-homogeneous linear difference equations of first order with variable coefficients.

UNIT-II

Z-Transforms: Basic properties of Z-transforms; Initial value theorem, final value theorem and convolution theorem of Z-transforms; Inverse Z transforms; Applications of Z-transforms to solve difference equations.

UNIT-III

Solutions of Simultaneous Linear Equations: Gaussian elimination method, pivoting; Gauss-Jordan method; Gauss-Seidal method; Cholesky's method. Eigen values and Eigen vectors**:** Power and inverse power method.

UNIT-IV

Fourier Transforms: Complex Fourier transforms, Fourier sine and cosine transforms; Inverse Fourier transforms; Simple properties of Fourier transforms; Applications of Fourier transforms to solve partial differential equations.

EE 311 POWER SYSTEM – II

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Proficiency in protective schemes and various faults in the Power System.
CO2: Capability in harnessing switchgear equipment for reliability.
CO3: Competency in protection of power system.
CO4: Know-how of Symmetrical Component & per unit system

UNIT-I

Per Unit System: Percent and per unit quantities, single line diagram & impedance diagram for a balance system; Symmetrical Fault Analysis: Transient in R-L Circuit, symmetrical and asymmetrical short-circuit current in synchronous generation, equivalent circuit of synchronous machine in different conditions, analysis of three phase fault.

UNIT-II

Symmetrical Component: Fortesque theorem and symmetrical component transformation, phase shift in star delta transformer, sequence impedance and sequence circuit for synchronous machine, transformer and transmission line, sequence network of a power system. Unsymmetrical fault analysis: Single line to ground fault, Line to line
fault, Double line to ground fault.

UNIT-III

Switchgear & Protection: Fuses, Selectivity, Discrimination, Sensitivity, Reliability, Fastness, Time grading & current grading, Primary & back up protection.
Construction & operation of relays: Electromagnetic over current relays, Reverse Power Directional relay, Instantaneous Earth Fault Relay, Buchholtz Relay. Distance protection of transmission lines, C. T. & P. T. connection for distance relays.

UNIT-IV

Unit Protection: Protection of Transformer, stator winding of alternator, Protection against Excitation failure, Prime mover failure, Frame Leakage, Differential protection of: Generator-Transformer unit, 3-phase transformer, Buchholz protection. *Circuit Breakers:* Theorem of

current interruption, Recovery theory, Construction and operation of Bulk oil, Air blast, MOCB, SF6, Vacuum circuit breaker, Advantages & disadvantages of static relay.

EE 312 POWER ELECTRONICS – I

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Proficiency in Power Electronics systems as an enabling technology.
CO2: Know-how of basic power electrical devices.
CO3: Competency in analyzing basic converter topologies.
CO4: Ability in designing single-phase and three-phase thyristor converters.

UNIT-I

Semiconductor Power Devices: Characteristics of power Diodes, power Transistors like BJT, MOSFET& IGBT, Diac, SCR and UJT

UNIT-II

Thyristor: Principle of operation, Construction and characteristics, specification and ratings, pulse transformer, optical isolators, methods of turn on, Protection of SCR protection against over voltage, over current, dv/dt, di/dt, switching surges, overheating. Gate protection,
SCR mounting, Heat transfer process in SCR, *Thyristor firing circuit*- Principle features of a typical gate triggering circuit R & R-C, UJT relaxation oscillator

UNIT-III

Converters: Half wave converters for single, two, three, six phase; Single phase and three-phase full wave convertor with R, R-L and RLE loads; Performance factors for line commutated converters; Inversion operation semi converters, dual converter; Effect of source impedance; Microprocessor based firing scheme for three phase fully controlled bridge converter.

UNIT-IV

Power supplies: Basic series and shunt voltage regulators, Integrated circuit regulators. Switch mode d.c. Power supplies, Fly back converter, forward converter, push-pull converter, half and full bridge converters, A.C. power supplies; UPS configurations, On-line and Off-line UPS.

EE 313 ELECTRICAL MACHINES – II

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Capability in harnessing electromechanical energy conversion.
CO2: Proficiency in operational technicalities of induction motors.
C03: Competency in operational technicalities of synchronous motor.
C04: know-how of Fractional Horse Power Motors.

UNIT-I

Induction Motors: Rotating magnetic fields, construction, basic principal of induction motor, induction motor as a generalized transformer, phasor diagram, equivalent circuits, no-load and blocked rotor tests, circle diagram, calculation of performance, Torque-slip characteristic, effect of rotor resistance, operating characteristics of induction motor, speed control, starting and braking, cogging, crawling.

UNIT-II

Single Phase Induction Motor: Basic Principle, revolving field theory, methods of starting, equivalent circuit. Induction generator, Induction regulators.
Synchronous Generators- Constructional features, general equation of induced emf, effect of distribution, chording, armature reaction, theory of cylindrical rotor machine, saturation effects, phasor diagram, open circuit, short circuit and zero power factor characteristic, Poitier triangle, regulation by synchronous impedance, M.M.F. & A.S.A. methods and their relative comparison. Theory of Salient pole machines Blondel's two reaction theory, phasor diagram, direct and quadrature-axis reactance their determination; parallel operation of alternators, synchronizing operation of infinite bus, synchronizing power, power-angle characteristics, stability.

UNIT-III

Synchronous Motor: Construction, principle of operation, equivalent circuit, phasor diagram, power flow equation, V curves, starting, hunting & damping. *Commutator Motors*-Effects of injected EMF, commutator as frequency changer, single phase series motor and Schrage motor.

UNIT-IV

Fractional Horse Power Motors: Construction, principle of operation, elementary analysis, characteristics and applications of universal motors, repulsion motors, hysteresis motor, brush less motors, linear induction and stepper motors.

EE 314 CONTROL SYSTEM – I

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Capability in transfer function modelling.
CO2: Proficiency in performance predictions including relative stability.
CO3: Competency in analysing stability & behaviour of linear dynamic systems.
CO4: Ability to devise a dynamic system from its time or frequency response.

UNIT-I

Representation of simple open loop and closed loop system, electrical analogy, Laplace transforms, Mathematical modelling, transfer functions, block diagram reduction techniques, signal flow graphs, mason's gain formula, control system components – error detectors, potentiometers, synchros, d.c. and a.c techogenerator , d.c .and a.c. servo motors.

UNIT-II

Time Response analysis and Design specifications: Transient and steady state response, standard test signals, Time response of a first order and second order system to standard signals, steady state error, error coefficients, generalized error series sensitivity, control actions (proportional, derivative and integral controls)

UNIT-III

Concept of stability, Absolute stability, relative stability, Routh Hurwitz criteria, Characteristic equation, Root Locus Technique

UNIT-IV

Frequency Response Analysis: Frequency Domain Specification, correlation between time and Frequency Response, Polar plot, Bode Plot, Gain Margin, Phase Margin Nquist stability criteria, Compensation: Lag, Lead and Lag-Lead Network

EE 315 COMPUTER ARCHITECTURE & INDUSTRIAL CONTROL

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Know-how of modern microprocessor functions.
CO2: Capability in harnessing microprocessor peripheral devices for system development.
CO3: Competency in the assembly language programming.
CO4: Know-how of PLC and Industrial control for engineering problems.

UNIT-I

Microprocessor Architecture: Inter 8085 Architecture, Buses, Registers, status flag, Opcode & operands, Word size, Pin configuration, Instruction cycle, Fetch operation, Machine cycle & state, Instruction & data flow. Timing diagram for-opcode fetch, Memory read & write, I/O read and write, Instruction & data formats, Addressing modes, Instruction set, Stack & subroutines, Data Transfer Schemes, *Programming the 8085*, Programming techniques-looping, counting, indexing, counters and time delays, subroutines.

UNIT-II

Programming the 8085: Programming techniques looping, counting, indexing, counters and time delays, subroutines. Interrupts of 8085, Debugging of programs. Modular & structured programming, Macro, Micro programming. *Micro controllers*-Introduction & applications, *Computer memories*-Tape, disk and floppy disk storage, semiconductor memories systems, bubble memories- CCD memory. Input –output devices- VDU, graphic display, magnetic tape unit, printers, mouse, plotters & digitiser.

UNIT-III

Programmable logic controller: Principles of operation, architecture of Programmable controller, programming the programmable controller, software, configurations, applications, conclusions.

UNIT-IV

Distributed Digital Control: Fundamental requirements of distributed process control system, system architecture, distributed control system, configuration, and some popular distributed control system *Industrial Control Applications:* Introduction, cement, thermal power, water treatment, steel plant.

THIRD YEAR (SEMESTER-II)

EE 321 ELECTROMAGNETIC & FIELD THEORY

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

COURSE OUTCOME –

CO1: Proficiency in Vector relation of various co-ordinate systems.
CO2: Capability in analysing Electric field due to charge configuration.
CO3: Competency in Magnetostatics & Field mapping.
CO4: Ability to analyse Time-Varying Fields.

UNIT-I

Vector relation in rectangular, cylindrical, spherical and general curvilinear coordinate system, line, surface & volume integral; Concept and physical interpretation of: Gradient, Divergence, Curl, Stokes Theorem, Helmholtz Theorem**.**

UNIT-II

Electrostatics: Introduction to Electric field vectors, Electric field due to charge configuration, Potential function and displacement ratio; Gauss law, Poison's and Laplace's equation's, Uniqueness theorem, continuity equation, Capacitance & electrostatic energy, Field determination by method of image, Boundary condition, Field mapping and concept of field cell.

UNIT-III

Magneto statics: Introduction to magnetic field vectors, Bio-Savant and Ampere's law, Magnetic scalar and vector potential Self and mutual inductance energy stored in magnetic field, Boundary condition, Analogy between electric and magnetic field, Field mapping and concept of field cell.

UNIT-IV

Time-Varying Fields: Faraday's law, Displacement current & equation of continuity, Maxwell's equation, UPW: Free space, dielectrics and conductors, Skin effect and sinusoidal time variation, Reflection, refraction and polarization of UPW, standing wave ratio, Pointing vector and power consideration .Radiation and Transmission, Retarded potential and concepts of radiation, radiation from small current elements, Transmission line parameters, Introduction to EMI & EMC. EMI coupling nodes, methods of eliminating interference, shielding, grounding, conducted EMI.EMI testing, emission testing, susceptibility testing.

EE 322 POWER ELECTRONICS – II

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Proficiency in converter system technicalities.
CO2: Capability in Cyclo-converters design & operation.
CO3: Competency in choppers design, control & operational issues.
CO4: Ability to design different Inverter system.

UNIT-I

Converters: Performance measures of single and three-phase converters, discontinuous conduction in two quadrant converters, power factor improvements: Extinction angle control, symmetrical angle control, pulse width modulation control, and sinusoidal pulse width modulation control; Thyristor commutation scheme- Line commutation, load commutation, forced and external pulse commutation

UNIT-II

Cycloconverter: Basic principle of operation, single phase to single phase, three phase to three phase and three phase to single phase cycloconverters, Output equation.

UNIT-III

Choppers: Principle of chopper operation, control strategies, step-up chopper, reversible chopper, Steady state time domain analysis of type-A chopper, Chopper configuration, and chopper commutation. AC Chopper, Multiphase chopper.

UNIT-IV

Inverters: Inverter classification, Voltage source thyristor inverters, single phase half and full bridge inverters with auxiliary communication and with complementary communication, Three phase bridge inverters with 180 mode & 120 mode, Pulse width modulation inverters, Current source inverters, single phase capacitor-commutated CSI with restive load, single phase auto-sequential commutated inverter, three phase auto-sequential commutated inverter, single phase series inverters & parallel or push pull inverters, Voltage control of inverters.

EE 323 INSTRUMENTATION

Cr. Hrs. 4 (3 + 1)
L T P
Credit 3 0 1
Hours 3 0 2

COURSE OUTCOME –

CO1 : Know-how of instrumentation errors & error computation.
CO2: Proficiency in Signal conditioning.
CO3: Competency in transducer technology.
CO4: Ability in Signal recovery techniques.

UNIT-I

Theory of errors: Accuracy and precision, systematic and random errors, limits of errors, probable errors and standard deviation, Gaussian error curves, Combinational errors.

UNIT-II

Transducers: Constructional features, operating characteristics and selection. Criteria of active, passive and digital transducers block diagram representation for the instrumentation of strain, displacement, velocity, acceleration, force, torque, flow, pressure and temperature.

UNIT-III

Signal conditioning: a.c. & d.c. Bridges, analysis of unbalanced bridges, Instrumentation amplifier, operational amplifiers, choppers, established and carrier amplifiers, charge amplifiers, A/D & D/A converters. Phase sensitive detectors, shielding and grounding.

UNIT-IV

Signal recovery: Signal filtering, averaging, correlation and coding. Signal transmission and telemetry: Modulation and encoding methods, transmission media, Time division and frequency multiplexing. Signal recording and display- Analog and digital display, Recorders, storage oscilloscopes, printers and plotters, Data acquisition system (analog and digital).

EE 324 CONTROL SYSTEM – II

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Know-how of State Space Analysis.
CO2 : Capability in devising developing Sampled Data System .
CO3: Competency in Non linear systems & stability criterion.
CO4: Dexterity in analyzing controllability and observability of systems.

UNIT-I

State Space Analysis: Concept of state, state space representation of systems, phase variable form, canonical variable form, physical variable form, Diagonalization, relationship between state equation and transfer function, solution of state equation, concept of controllability and observability, eigen values and eigen vector.

UNIT-II

Sampled Data System: importance of sampling, mathematical analysis of sampling, spectrum analysis of sampling process, Shannon’s Theorem, signal reconstruction, hold circuit, Z

transform, inverse Z transform, difference equation, pulse transfer function, state variable representation of sampled data system, solution of discrete state equation.

UNIT-III

Non linear system- characteristic of non linear system, type of Non linearity, jump resonance, limit cycle, describing function method of analysis.

UNIT-IV

Liapunov stability criteria- introduction, stability definitions and theorems, Liapunov function for linear system.

EE 325 ELECTRICAL ENGINEERING MATERIALS

Cr. Hrs.	**3(3+ 0)**		
	L	**T**	**P**
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

COURSE OUTCOME –

CO1: Know-how of specific conductor materials.
CO2: Proficiency in magnetic material & typical applications.
CO3: Competency in semi-conductors technicalities and their utility.
CO4: Awareness of advancement in super conducting materials & its technicalities.

UNIT-I

Conductor Materials: Electrical, thermal and mechanical properties of conductive and resistive materials. Important characteristics and applications of specific conductor materials like copper, aluminium, AAC, ACSR, silver, gold, platinum and tungsten, study of important resistance materials, carbon and nicrome, standard resistance materials. Soldering alloys.

UNIT-II

Super-conducting Materials: Introduction, critical field and critical current density, type I and type II superconductors, intermediate state, penetration depth and thin films, Superconductivity at high frequencies, application of superconductivity. Advancements in super conducting materials. Dielectric materials: Dielectric behaviour of materials under static and dynamic field, Polarisation, induced and permanent dipole moments, Surface resistivity. Breakdown processes. Thermal properties Electrical properties of important dielectric materials including plastics and ceramics, ferroelectric and piezo-electric materials.

UNIT-III

Magnetic Materials: characteristics of diamagnetic, paramagnetic, ferromagnetic, ferromagnetic and anti-ferromagnetic materials, Properties and applications of common no retentive and

retentive magnetic materials including various alloys, ferrites and powder cores. Eddy current and hysteresis losses, Curie point.

UNIT-IV

Semiconductor materials: Electric properties of semiconducting elements and compounds and their application. Zone refining and crystal growth. Miscellaneous materials: important electronic properties of electron emitting materials, photosensitive materials and luminescent materials.

EE 326 SYSTEM DESIGN & SIMULATION LAB

Cr. Hrs. 1 (0 + 1)

	L	T	P
Credit	**0**	**0**	**1**
Hours	**0**	**1**	**2**

COURSE OUTCOME –

CO1: Capability to simulate electrical system using MATLAB, PSIM & PSCAD.
CO2: Proficiency in MATLAB programming of control & power Electronics system.
CO3: Competency in harmonic analysis.
CO4: Dexterity in drive control systems simulation using MATLAB.

Design & Simulation of rudimentary electrical system using MATLAB, PSIM, PSCAD, software packages; Study of emerging trends in Design and control of different electrical system: HVDC, HVAC systems design, harmonic analysis, Interfacing problems & design of fuel cell, solar and wind based system; Design & Simulation of recent trends in drive control technology: Vector and DTC controlled system, Non –linear system designing, design and simulation of ALFC and AVR, Simulation of power flow and stabilities problems.

FINAL YEAR (SEMESTER-I)

EE 411 ELECTRICAL MACHINE DESIGN

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Know-how of machine design and designing limitations.
CO 2: Proficiency in designing heating and cooling system of electrical machines.
CO3: Competency in design of transformers & its technicalities.
CO4: Dexterity in DC and AC machines design.

UNIT-I

Principle of electrical machine design- Design factors, limitations in design, magnetic circuit calculations, magnetic leakage calculations, magnetising current calculations, unbalanced magnetic pull. Heat dissipation, Heating, cooling curve, Estimation of minimum temperature rise, cooling media, quantity of cooling media, design of fan, Ratings.

UNIT-II

General features of armature winding, single layer, double layer & commutator winding, integral & fractional slot winding, winding factors, harmonics, Eddy current losses in conductors. Design of D.C. Machines, output equation, main dimensions, staggering of buses, selection of no. of poles, airgap, specific magnetic & electric loading.

UNIT-III

Design of transformers,. General consideration, output equation, EMF per turn, main dimension conductor size, window yoke & over all dimensions, tank design, choice of electric & magnetic loading.

UNIT-IV

Design of Induction motors, output equation, selection of frame size, selection of no. of stator slots, calculation of air gap length & conductor size. Design of squirrel cage motor, Rotor bar, elimination of harmonic torque. Design of synchronous machine, output equation, selection of no. of slots, Runaway speed, main dimension, Effect of SCR on machine performance, air gap.

EE 412 ELECTRIC DRIVES AND CONTROL

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Proficiency in design of Switching Mode Regulators.

CO2: Know-how of Dynamics of Electric Drives.

CO3: Ability in designing closed loop control of D.C. drive.

CO4: Competency in A.C. drives technology.

UNIT-1

Switching Mode Regulators: Buck, boost, buck-boost and Cuk regulators; Ac Voltage Controllers: Single-phase AC controllers with R and RL load, sequence control of AC controllers, three phase AC controllers.

UNIT-II

Dynamics Of Electric Drives: Fundamental Torque Equations, Speed- Torque conventions And Multi-quadrant Operation, Equivalent Values Of Drive Parameters, Components Of Load Torques, Nature And Classification Of Load Torques, Calculation Of Time And Energy Loss In Transient Operation, Steady State Stability, Load Equalization.

UNIT-III

D.C. Drives: Characteristics of separately exited D.C. Motor and its operating modes for motoring regenerating braking & dynamic braking. Types of Electrical braking, Phase control drives, chopper control drives. Block diagram and explanation for close loop control of d.c. drive. Soft start, acceleration control and current limiting, various industrial applications of drive

UNIT-IV

A.C. drive-Speed control of Induction motor, stator voltage control & soft start, variable frequency control from current sources, rotor resistance control, slip power recovery. Block diagrams & their explanation for closed loop control, stator voltage control, volts hertz control with current limiting, volts hertz control with slip regulation, static Cramer drive. Synchronous motor drive-volts hertz control & brushless d.c. and a.c. motors. Sensor less control Electric drives.

EE 413 ELECTRICAL ENGINEERING ECONOMICS AND MANAGEMENT

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

COURSE OUTCOME –

CO1: Know-how of physical and financial efficiency of electrical goods and services.
CO2: Competency in computation of Depreciation of electrical system.
CO3: Ability in harnessing economical choice of electrical apparatus.
CO4: Fitness in Management functions.

UNIT-I

Definition of Economics, Income, Investment, Assets, Liability, utility, Market and its types, Money, Price, value, wants, wealth, capital and its types, supply and demand , Law of Returns, Concept of physical and financial efficiency of electrical goods and services, Importance of Engineering economics, Annuities and its kind, Profit, supply & demand, elasticity, necessity & luxuries, free competition and monopoly, law of diminishing returns.

UNIT-II

Depreciation and its various method for calculating- Straight line, diminishing balance, Sinking fund, sum of the Year Digit method, Depreciation in utilizing electrical energy. Element of cost, Direct and Indirect expenses, component of cost, Depreciation and its various method for calculation-Straight line, diminishing balance, Sinking fund, sum of the Year Digit. Linear break-even analysis Comparison of alternatives- Annual cost, Present worth, Rate of return, payback & benefit to cost ratio methods.

UNIT-III

Economical choice of electrical apparatus, economic life of electrical machine. Economic choice of motors, Transformers, Electrical lamps, Economic choice of Transmission Line and Distribution substation, Kelvin Law for cables.

UNIT-IV

Management- Functions of Management, office management, Human Resource Management, store management.

EE 414 ELECTRIC ENERGY SYSTEMS THEORY

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

COURSE OUTCOME –

CO1: Proficiency in electric supply systems.
CO2: Competency in Load flow analysis.
CO3: Ability in steady state and dynamic performance evaluation of AVR.
CO4: Capability to ANFC control of multi area system.

UNIT-I

Fundamental concept of electric energy system theory; electric supply systems; economics of power transmission.

UNIT-II

Load flow analysis: Static load flow equation, system variable and its solution, Bus admittance matrix, Bus classification, Solution of load flow problem by gauss siedal, Newton Rephson and fast decoupled method, Comparison of above method.

UNIT-III

The energy system in steady state-Basic generator control loops, Mathematical modelling and description of various components of automatic voltage regulator, steady state and dynamic performance of AVR.

UNIT-IV

Automatic load-frequency control of single area system, Mathematical modelling and description of various components of ALFC, steady state and dynamic performance of ALFC, steady state, dynamic and transient stabilities, Equal Area criterion, step by step method of solving swing equation.

EE 415 GENERATION OF ELECTRICAL POWER

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

COURSE OUTCOME –

CO1: Know-how of Bulk Energy Generation.
CO2: Ability in devising Tariffs strategies.
CO3: Competency in Selection and location of various power plants.
CO4: Capability in Computation of most economical power factor in varying condition.

UNIT-I

Method of Bulk Energy Generation: Introduction to thermal, hydel, nuclear and gas power plants with their layouts, Concept of co-generation, Impact of thermal, hydro and nuclear stations on environment.

New Energy Sources: Elementary ideas of electric energy generation by wind, solar, tidal and geothermal energy and fuel cell, Open and close cycle MHD power generation.

UNIT-II

Load And Load Curve: Types of load, chronological load curves, load duration curve, energy load curve, mass curve, maximum demand, demand factor, load factor, capacity factor, utilization factor, diversity factor.

Power Plant Economics: Capital cost of plants, annual fixed and operating costs of plants, generation cost and depreciation. Effect of load factor on unit energy cost, Role of load diversity in power system economics, off peak energy utilization. Energy cost reduction.

UNIT-III

Tariffs: Objectives of tariffs. General tariff form, flat demand rate, straight meter rate, block meter rate, two part tariffs, power factor dependent tariffs, three part tariff, spot (time differentiated) pricing.

Power Factor Improvement: Causes and effects of low power factor, advantages of power factor improvement, power factor improvement using shunt capacitors and synchronous condensers. Calculation of most economical power factor when kW demand is constant and kVA demand is constant.

UNIT-IV

Selection Of Power Plant: Comparative study of thermal, hydel, nuclear and gas power plants. Base load and peak load plants, Size of generating units, types of reserve and size of plant, Selection and location of power plants.

EE 416 DISTRIBUTED GENERATION

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

COURSE OUTCOME –

CO1: Know-how of worldwide potentials of renewal sources & solar Measurement.
CO2: Ability in devising maximum power point tracking (MPPT) .
CO3: Competency in design of a standalone PV system.
CO4: Capability in devising converters for wind energy system.

UNIT I

Energy Scenario: Conventional and nonconventional energy resources, energy needs of India and energy consumption patterns, worldwide potentials of these sources, energy and its environmental impacts.

Solar Radiation and its Measurement: Introduction, solar constant, solar radiation at the earth's surface, solar radiation geometry, solar radiation measurements, estimation of average solar radiation.

UNIT II

Solar Thermal Systems: Types of collectors, collection systems and efficiency.
Solar Photo Voltaic (PV) Technology: Solar cell characteristics, parameters of solar cell and its equivalent circuit, PV Module and arrays, perturb and observe maximum power point tracking (MPPT) technique, components of PV system, design of a standalone PV system.

UNIT III

Wind Energy Conversion System (WECS): Introduction, wind data and energy estimation, site selection considerations, Overview of Wind Energy Conversion System: installed capacity and growth rate, small and large wind turbines, stand-alone and grid Connected applications, on-land and off-shore applications, cost; Wind Turbine Technology: horizontal and vertical axis wind turbines, fixed and variable speed turbines; WECS Configuration: fixed speed WECS without

power interface, variable speed system with reduced capacity converters, variable speed with full capacity power converters.

UNIT IV

Power Converters in WECS: Introduction, various topologies of power electronics converters (PECs): AC voltage Controllers, Interleaved Boost Converters, Two-Level Voltage Source Converters, Three- Level Neutral Point Clamped Converters, PWM Current Source Converters, Control of Grid-Connected Inverter; grid interconnection requirements for wind farms, integration issues, operational issues, challenges for grid integration

Text/Reference Books

1. G D Rai. Non Conventional Energy Sources. Khanna Publisher
2. John Twidell and Tony Weir. Renewable Energy Sources. CRC Press
3. Wind power plants and projects developments, Joshua Earnest and T Wizelius, PHI, New Delhi, 2011.
4. Handbook of renewable energy technology, World Scientific, Singapore, 2011.
5. Power Conversion and Control of Wind Energy Systems. Bin Wu, Y. Lang, N.Zargari and S. Koura. Wiley IEEE Press

FINAL YEAR (SEMESTER-II)

EE 421ADVANCED POWER SYSTEMS

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

COURSE OUTCOME –

CO1: Know-how of high voltage AC system.
CO2: Proficiency in HVDC transmission.
CO3: Know-how of FACTS and their applications.
CO4: Capability to harness multi-terminal DC systems.

UNIT-I

EHV AC Transmission: Need of EHV transmission lines, power handling capacity and surge impedance loading. Problems of EHV transmission, bundled conductors geometric mean radius of bundle, properties of bundle conductors. Electrostatic fields of EHV lines and their effects, corona effects: Corona loss, audio and radio noise.

UNIT-II

HVDC Transmission: Types of D.C. links, advantages and disadvantages of HVDC transmission, Basic scheme and equipment of converter station. Analysis of HVDC Converters, twelve-pulse converter. Ground return. Basic principles of DC link control and basic converter control characteristics, system control hierarchy, various controls of HVDC like VDCOL, firing angle control, current and extinction angle control, gamma controller, power controller.

UNIT-III

Introduction to multi-terminal DC systems, application of MTDC Systems, types of MTDC systems, Control and protection of MTDC systems. Description of various converters and inverters circuits, HVDC circuit breakers, Harmonics and filters, Measurement of HVDC quantities, Reactive power requirements and sources of reactive power. Converter Faults and protection against over currents, over voltages.

UNIT-IV

FACTS: Problems of AC transmission lines. Phenomena of voltage collapse, basic theory of line compensation. Basic features of FACTS controllers, Basic schemes and operations of thyristor controlled series compensator phase angle regulator and dynamic brake, Introduction to static synchronous compensator (STATCOM) and unified power flow controller (UPFC).

EE 422 NEURAL AND FUZZY BASED CONTROL SYSTEM

Cr. Hrs. 4 (3 + 1)

	L	T	P
Credit	**3**	**0**	**1**
Hours	**3**	**0**	**2**

COURSE OUTCOME –

CO1: Know-how of Artificial neural networks.
CO2: Proficiency in learning techniques of artificial neural networks.
CO3: Know-how of fuzzy control techniques.
CO4: Capability to Adaptive Fuzzy control design.

UNIT I

Artificial Neural Networks: Neural Networks- an overview, Introduction to Artificial Neural Networks (ANN), Historical Development of Neural Networks, Biological Neural Networks, Comparison Between the Brain and Computer, Comparison Between Artificial and Biological Neural Network. Basic Building Blocks of ANN: Network Architecture, Setting of Weights, Activation Function, ANN Terminologies

UNIT II

Fundamental Models of Artificial Neural Networks: Introduction, McCulloch-Pitts Neuron Model. Learning Rules: Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule (Widrow-Hoff Rule or Least Mean Square (LMS) Rule), Back Propagation Rule

UNIT III

Fuzzy Logic: Fuzzy logic concepts and application areas, classical and fuzzy Sets, fuzzy relation and membership functions, fuzzification and defuzzification methods, fuzzy rule base system.

UNIT IV

Neural Network and Fuzzy Logic application in load forecasting, fault detection, economic load dispatch, voltage and reactive power control, load flow and electric drive control.

Practical Lab experiments based on theory

Text/Reference Book

1. S N Sivanandanm, S Sumathi and S N Deepa. Introduction to Neural Networks Using MATLAB- Tata McGraw- Hill Publishing Company Limited.
2. J.M. Zurada. Introduction of artificial neural systems - Jaico Publication House.
3. D. Driankov, H. Hellendoorn and M Rein frank. An introduction to fuzzy control - Narosa Publication House, 2nd reprint.

ELECTIVE – I
EE 423 (a) UTILIZATION OF ELECTRICAL POWER

Cr. Hrs. 3 (3 + 0)
L T P
Credit 3 0 0
Hours 3 0 0

COURSE OUTCOME –

CO1: Proficiency in drive system design.
CO2: Know-how of Different methods of electric heating.
CO3: Competency in the interior & flood lighting design.
CO4: Capability in designing Systems of electric traction.

Unit-I

Electric drives- Characteristics of load, characteristic of different drives, size and rating of electric drives, load equalization and flywheel, Selection of electric drives for specific application, Electric braking, Behavior of motor during starting, acceleration braking & reversing operation.

Unit-II

Different methods of electric heating, principle of high frequency induction and dielectric heating, Arc furnace & induction furnace.

Unit-III

Principles of illumination, electric light sources, Designing scheme for commercial, Industrial street & flood lighting.

Unit-IV

Systems of electric traction, track electrification, Means of supplying power & train lighting, substation equipment & layout, over head equipment, D.C. & A.C. traction motor, speed control, various method of starting, Metadyne control series-parallel starting methods of electric braking of traction motor speed-time curve, Tractive efforts specific energy conversion, Mechanics of train movement

Text Books/References

1. H. Pratap. Utilization of Electrical Power.
2. Soni, Gupta, Bhatnagar. Electrical power systems, Dhanpath Rai and company.

EE 423 (b) ROBOT CONTROL AND SENSING

Cr. Hrs. 3 (3 + 0)
L T P
Credit 3 0 0
Hours 3 0 0

COURSE OUTCOME –

CO1: Know-how of Robotic Arm Kinematics.
CO2: Competency in trajectory planning.
CO3: Proficiency in Control of Robot Manipulators.
CO4: Capability in robot programming languages.

Unit-I

*Introduction***:** Background, Historical development; *Robot Arm Kinematics***:** Introduction, The direct Kinematics Problem, The Inverse kinematics solution; *Robot Arm Dynamics***:** Introduction, Lagrange-Euler Formulation, Newton-Euler formation, Generalized D'Alembert equations of motion.

Unit-II

*Planning of Manipulator Trajectories***:** Introduction, General Considerations on trajectory planning, Joint-interpolated Trajectories, Planning of Manipulator Cartesian path trajectories.

Unit-III

*Control of Robot Manipulators***:** Introduction, Control of the Puma Robot Arm, Computed Torque technique, Near-minimum-time control, Variable structure control, Non-linear decoupled feedback control, Resolved motion control, Adaptive control; *Sensing:* Introduction, Range sensing, Proximity sensing, Touch Sensors, Force and torque sensing.

Unit-IV

Basic Concepts of robot vision and robot programming languages and learning. Industrial applications of robots selection and use of robots for foundry and casting, welding, material banding, machining Inspection, assembly and painting.

Text Books/References

1. F U K.S. Gonzalez / Lee. Robotics, controlling, sensing, vision and intelligence.
2. Yoren Korean. Robotics for Engineers.
3. Engel Berger. Robotics in practice.

EE 423 (c) NON-LINEAR SYSTEMS

Cr. Hrs. 3 (3 + 0)
L T P
Credit 3 0 0
Hours 3 0 0

COURSE OUTCOME –

CO1: Ability in Compensation and design of nonlinear system.
CO2: Proficiency in Phase plane analysis.
CO3: Competency in harnessing Popov's stability criterion.
CO4: Capability in solving nonlinear system problems.

Unit-I

Linear versus nonlinear systems. Describing function analysis: Fundamentals, common nonlinearities (saturation, dead-zone, on-off nonlinearity, backlash, hysteresis) and their describing functions. Describing function analysis of nonlinear systems, Reliability of describing method analysis, Compensation and design of nonlinear system using describing function method.

Unit-II

Phase plane analysis: Phase portraits, Singular points characterization. Analysis of non-linear systems using phase plane technique, Existence of limit cycles. Linearization: Exact linearization, input-state linearization, input-output linearization.

Unit-III

Concept of stability, Stability in the sense of Lyapunov and absolute stability. Zero-input and BIBO stability. Second (or direct) method of Lyapunov stability theory for continuous and discrete time systems.

Unit-IV

Popov's stability criterion, generalized circle criterion, Kalman- Yakubovich-Popov Lemma. Popov's hyper stability theorem. Disturbance issues in nonlinear control, non-linear control system design problem; Approximate solution of nonlinear system using the perturbation method and averaging method.

Text Books/References

1. Gopal Nagrath. Control System Engineering.

2. Ogata. Modern control systems.
3. H. K. Khalil. (1995). Nonlinear Systems. Prentice Hall, Englewood Cli_s, NJ, second edition.
4. S. S. Sastry. Nonlinear Systems: Analysis, Stability and Control.

EE 423 (d) BIOMEDICAL INSTRUMENTATION

Cr. Hrs. 3 (3 + 0)
L T P
Credit 3 0 0
Hours 3 0 0

COURSE OUTCOME –

CO1: Ability in noise evaluation of biomedical instrumentation.
CO2: Competency in harnessing Transducers and sensors.
CO3: Proficiency in Signal conditioning of bioelectric devices.
CO4: Competency in Instrumentation schemes for respiratory system.

Unit-I

Basic theories: Error contributions and analysis, effects of noise and evaluation.

Unit-II

Transducers and sensors Basic principles –magnetic, pressure, optical etc. Blood flow, pressure, cardiac rate etc bioelectric potentials, biopotential electrodes, biochemical transducers, medical surface electrodes.

Unit-III

Signal conditioning-Bioelectric amplifiers, differential amplifiers, Op amps and their applications, isolation and chopper stabilized amplifiers, other signal processing circuits. Display devices.

Unit-IV

Instrumentation schemes for respiratory system, cardiovascular system, Brain functions, Human nervous system, neuro muscular system measurement. Assisting and therapeutic devices, X-ray and radioisotope instrumentation, MRI scanner, ICU equipments, patient monitoring. Biotelemetry. Applications of fiber optics and lasers in medicine.

Text Books/References

1. L.C. Crumble. Biomedical instrumentation and measurement.
2. R.S. Khadpur. Handbook of biomedical test.

EE 423 (e) OPTIMAL CONTROL THEORY

Cr. Hrs. 3 (3 + 0)
L T P
Credit 3 0 0
Hours 3 0 0

COURSE OUTCOME –

CO1: Know-how of Optimality Problem in Control Theory.
CO2: Proficiency in devising Minimum Principle for optimality.
CO3: Competency in Dynamic Programming for Linear optimal systems.
CO4: Know-how of Calculus of Variations.

UNIT-I

Optimality Problem in Control Theory: Introduction; Examples of optimality problems; The 'n-interval' theorem, Mathematical models; Classification of problem constraints, Conditions of optimality.

UNIT-II

Calculus of Variations: Basic concepts; Variations of functional; Externals, Fundamental theorem of the calculus of variations; The Euler equation, Problems with constraints; Constraints of integral and boundary condition types; Differential equation constraints, Variation approach to optimal control; Costae equations; The Hamiltonian equation; Necessary conditions of optimality, Boundary conditions; Linear regulators.

UNIT-III

Pontryagin's Minimum Principle: The needle variation method, Minimum principle optimality conditions, Time-optimal and energy-optimal systems. No regular Cases: Singular optimal problems, Non-convex optimal problems; Optimal sliding modes.

UNIT-IV

Dynamic Programming: Bellman's optimality principle, Discrete time systems, Continuous time systems; Bellman's function; The Hamilton- Jacobi-Bellman equation, Linear optimal systems; The Riccati equation; Singular problems.

Text Books/References

1. D. Kirk. Optimal Control Theory: an introduction, Prentice-Hall.
2. Arthur E. Bryson. (1999). Dynamic Optimization, Jr., Addison-Wesley.

EC 423(f) (EE) COMMUNICATION ENGINEERING

Cr. Hrs. 3 (3 + 0)

	L	T	P
Credit	**3**	**0**	**0**
Hours	**3**	**0**	**0**

COURSE OUTCOME –

CO1: Competence in Calculus of Variations techniques.
CO2: Know-how of satellite and optical fibre communication systems.
CO3: Proficiency in Digital communication system.

CO4: Capability in computing autocorrelation function of a random process.

UNIT-I

Modulation techniques: Amplitude modulation, AM-DSB, AMDSB/SC.AM/SSB & their generation and detection. Angle (FM& Phase) modulation, modulation and demodulation techniques, PLL–applications in modulating and receiver circuits.

UNIT-II

Pulse modulations- PAM, PDM, PPM, PCM, delta modulations. Performance of analog modulation schemes under noise, non-linearity and their comparison. Radio Receiver systems.

UNIT-III

Digital communication system: Basic information theory-Units of information entropy, Uncertainty & information, rate of communication, redundancy relation between system capacity & information content of messages.

UNIT-IV

Introduction to satellite and optical fibber communication system. Noise-Atmospheric, thermal, shot & partition noise, white noise, Noise figure & experimental determination of noise figure, minimum noise figure networks.

ELECTIVE – II
EE 424 (a) POWER SYSTEM RELIABILITY

Cr. Hrs. 3 (3 + 0)
L T P
Credit 3 0 0
Hours 3 0 0

COURSE OUTCOME –

CO1: Ability in devising System Reliability.
CO2: Capability in harnessing Interconnected System.
CO3: Proficiency in computing load probability.
CO4: Competency in generating capacity reliability evaluation.

Unit-I

System Reliability: Introduction, definition of reliability, failure, probability, concepts, power quality variation, reliability measurements, power supply quality survey, Reliability aids, and recent development. *Reliability Concepts:* Measure of reliability rules for combining probabilities, Mathematical expectation. Distributions, reliability theory series and parallel systems, Markov processes. Static generating capacity reliability.

Unit-II

Outage Definition: Loss of load probability methods, loss of energy probability method. Load forecast, System Design and planning, Strategies for generation, Transmission & Distribution networks. Transmission system reliability evaluation-Average interruption rate method. The frequency and duration method.

Unit-III

Interconnected System: Generating capacity reliability evaluation introduction. The loss of load approach, reliability evaluation in two and more than two interconnected systems, Interconnection benefits.

Unit-IV

Load Forecasting: Necessity short-term forecasting by preliminary analysis control, medium term forecasting by field survey method, and long-time forecasting by statistical method. Regression analysis. Analysis of time series. Factors in power system loading.

Text Books/References

1. Billiton Roy & Ronald N.Allan. Reliability Evaluation of power system volume-I .
2. Billiton Roy & ## Ronald N.Allan. Reliability Evaluation of power System volume-II .
3. J Endreny. Reliability modelling in electric power system.
4. A.S. Pabla. Electric power distribution.

EE 424 (b) HIGH VOLTAGE ENGINEERING

Cr. Hrs. 3 (3 + 0)
L T P
Credit 3 0 0
Hours 3 0 0

COURSE OUTCOME –

CO1: Know-how of mechanism of breakdown in gases, liquids and solids.
CO2: Proficiency in H.V.D.C. voltage stabilization.
CO3: Capability in H.V. testing.
CO4: Competency in Measurements of high voltage.

Unit-I

Mechanism of breakdown in gases, liquids and solids, Townsands, and Streamer theories, Paschin's law, Impulse generator circuit. Techniques to observe wave front on CRO.

Unit-II

Method of generation of power frequency high voltages-cascade transformers and resonance methods. Generation of H.V.D.C. voltage stabilization, tesla coil.

Unit-III

Measurements of high voltage: Potential divider, sphere gap, electrostatic voltmeter, oscilloscope and their application in high voltage measurements, Measurement of loss angle and partial discharge measurement techniques.

Unit-IV

H.V. testing: Wet and dry flash over test, testing of insulators in simulated pollution conditions. Accumulation of charges in clouds, direct and indirect strokes, isokeravnic level,. Switching surges, protection of system against surges.

Text Books/References

1. K. Naidu. High voltage engineering.
2. C.L.Wadhwa. High voltage engineering, New Age.

EE 424 (c) ELECTRO-MECHANICAL ENERGY CONVERSION

Cr. Hrs. 3 (3 + 0)
L T P
Credit 3 0 0
Hours 3 0 0

COURSE OUTCOME –

CO1: Ability to model dynamic equation of electromagnetic systems.
CO2: Capability in computation of Energy conversion force and torque.
CO3: Competency in modelling two and three phase A.C. machines.
CO4: Proficiency in deriving D.C. machine characteristics from generalized equation.

Unit-I

Dynamic equation of electromagnetic and electrostatic systems, energy balance equation. Introduction to state functions for electromechanical conservative and non-conservative systems.

Unit-II

Energy conversion force and torque calculations in coupled coils in translator and rotating motion. Mutual and motional inductance. Energy storage in coupled stationary coils.

Unit-III

Generalized relations for a distributed winding. Generalized rotating machines energy conversion equation. Derivation of D.C. machine characteristics from generalized equation.

Unit-IV

Generalized equations for two phase and three phase a.c. machines coordinate transformation. Derivation of characteristics of two phase and three phase synchronous machine from generalized equation. Cross-field D.C. machines and their characteristics.

Text Books/References

1. P.S. Bimbhra. Electrical Machine Theory, Khanna publisher.
2. J.B. Gupta. Electrical Machine, Katariya and Sons.

EE 424 (d) POWER SYSTEM DYNAMICS

Cr. Hrs. 3 (3 + 0)
L T P
Credit 3 0 0
Hours 3 0 0

COURSE OUTCOME –

CO1: Ability to develop Dynamic models of synchronous machines.
CO2: Proficiency in Modeling of single machine infinite bus system.
CO3: Capability in devising voltage stability techniques.
CO4: Competency in Dynamic equi-valencing of power system.

Unit-I

Dynamic models of synchronous machines, excitation system turbines, governors, loads.

Unit-II

Modeling of single machine infinite bus system, mathematical modeling of multi-machine system.

Unit-III

Dynamic & transient. Stability analysis of single machine & multimachine systems. Power system stabilizer design for multimachine systems.

Unit-IV

Dynamic equi-valencing, voltage stability techniques for the improvement of stability. Direct method of transient stability analysis: transient energy function approach.

Text Books/References

1. Olle L. Elgerd. Electric Energy Systems Theory, PHI.
2. C.L Wadhwa. Electrical Power Systems, New Age.

EE 424 (e) MODERN CONTROL THEORY

Cr. Hrs. 3 (3 + 0)

L T P
Credit 3 0 0
Hours 3 0 0

COURSE OUTCOME –

CO1: Ability to State space design of linear systems.
CO2: Capability in Adaptive Control.
CO3: Proficiency in Control optimization.
CO4: Competency in non–linear system analysis.

Unit-I

State variable method and design of linear systems: Concept of state, state variable, and state model, state space representation using physical, phase and canonical variables and their block diagram representation, state model and transfer function, diagonalisation, solution of state equation, state transition matrix its properties and computation, concept of controllability and observability and their test criterion, pole placement design using state feedback, state observer, reduced order and full order observer design.

Unit-II

Adaptive Control: Definitions, essential aspects of adaptive control, and classifications of adaptive control systems. *Model Reference Adaptive Systems:* Different configurations of model reference adaptive systems: Classifications of MRAS, mathematical description equivalent representation as a nonlinear time-varying system, direct and indirect MRAC. Continuous time MRAC systems: Introduction, MIT Rule, Lyapunoy approach, hyper stability approach, Monopoly's augmented error approach, narendra's and convergence studies.

Unit-III

Optimal Control Concept of optimization, static and dynamic optimization, parameter optimization Lagrange multiplier, and concept of optimal control. *Calculus of variation:* Problem of Lagrange, mayors & bolze. Fixed end point problem – Euler Lagrange equation, variable end point problem and transerversality condition, limitation of calculus of variation.

Unit-IV

Non – linear system analysis: Behavior of non-linear systems, common physical non linearities, describing function method, concept derivation of describing function method, phase Plane method, singular points, stability of non-linear systems, and construction of phase Trajectories by isoclines method, non-linear system analysis by phase plane method.

Text Books/References

1. M.Gopal. Modern Control System Theory: New Age Publications.
2. K. Ogata. (1997). Modern Control Engg. Third Edition, and PHI.
3. M. Gopal. (1997). Control System, Principles & design:, TMH New Delhi,

4. B .C .Kuo. (1996). Automatic Control Systems: Sixth Edition, PHI.
5. Anderson & Moore. Optimal control:, PHI.
6. K.J. Astron. Adaptive Control system, 2nd Edition Pearson.

EE 424 (f) MICROWAVE ENGINEERING

Cr. Hrs. 3 (3 + 0)
L T P
Credit 3 0 0
Hours 3 0 0

COURSE OUTCOME –

CO1: Ability in harnessing Maxwell's equations.
CO2: Proficiency in Microwave solid state devices.
CO3: Capability in Microwave communication links.
CO4: Competency in microwave mechanism.

Unit-I

Maxwell's equations, wave equations and their solutions in rectangular and cylindrical co-ordinates, wave guides, microwave resonators, attenuators, phase shifter, directional coupler, E-plane, H-plane and magic trees, coupling probes and loop. Slotted lines as standing wave detector. Discontinuities in wave-guides.

Unit-II

Microwave solid state devices: Ferrite devices, Tunnel diodes, Varactor, diodes, Crystal detectors and miners, Gunn diodes, Impact diodes, Laser and Maser. Microwave generators and Amplifiers: Klystrons reflex Klystrons, Magnetrons.

Unit-III

Microwave Measurements: Frequency, power, attenuation, phase shift, impedance, noise figure, standing wave ratio and dielectrics at microwave frequency. Rapid broadband measuring techniques, calibration techniques.

Unit-IV

Microwave communication links, propagation of microwave, effect of earth and its curvature Duct formation. Transmission line equation. Introduction to troposcatter communication and Satellite communication.

Text Books/References

1. Rizzi. Microwave Engine ering : Passive Circuit.
2. Gupta & Srivastava. Microwave Devices and Circuit Design.
3. Das, Annapurna & Sisir K Das. Microwave Engineering.
4. Robert Collin. Foundations for Microwave Engineering.

EE 424 (g) DISTRIBUTED CONTROL SYSTEM

Cr. Hrs. 3 (3 + 0)
L T P
Credit 3 0 0
Hours 3 0 0

COURSE OUTCOME –

CO1: Ability to design Programmable Logic Controllers for specific application.
CO2: Capability to PLC Programming Techniques.
CO3: Proficiency in Logic design and PLC Wiring Techniques .
CO4: Competency in Ladder Program Execution.

Unit-I

*Programmable Logic Controllers**:*** Ladder Diagrams Fundamentals, Basic Components and their Symbols, Fundamentals of Ladder Diagrams, Machine Control Terminology. The Programmable Logic Controller A Brief History, PLC Configurations, System Block Diagram, Update-Solve the Ladder-Update, Update, Solve the Ladder. Fundamental PLC Programming: Physical Components vs. Program Components, Example Problem – Lighting Control, Internal Relays, Disagreement Circuit, Majority Circuit, Oscillator, Holding (also called Sealed, or Latched) Contacts, Always-ON and Always-OFF Contacts, Ladder Diagrams Having More Than One Rung.

Advanced Programming Techniques: Ladder Program Execution Sequence, Flip Flops, R-S Flip Flop, One Shot, D Flip Flop, T Flip Flop, JK Flip Flop, Counters, Sequencers, Timers, Master Control Relays and Control Zones. Mnemonic Programming Code: AND Ladder Rung, Entering Normally Closed Contacts, OR Ladder Rung, Simple Branches, Complex Branches.

Unit-II

Wiring Techniques: PLC Power Connection, Input Wiring, Inputs Having a Single Common, Isolated Inputs, Output Wiring, Relay Outputs, Solid State Outputs. *Analog I/O:* Analog (A/D) Input, Analog (D/A) Output, Analog Data Handling, Analog Input Potential Problems Discrete Position Sensors Sensor Output Classification, Connectivity Discrete Sensors to PLC Inputs, Proximity Sensors, Inductive Proximity Sensors, Capacitive Proximity Sensors, Ultrasonic Proximity Sensors, Optical Proximity Sensors. Applications of PLC: Motor Controls AC Motor Starter, AC Motor Overload Protection, Specifying a Motor Starter, DC Motor Controller, Variable Speed (Variable Frequency) AC Motor Drive.

Unit-III

Distributed Computer Control for Industrial Automation: Introduction and Overview: Aims of Plant Automation, Classical Approaches, to Plant Automation Computer-Based Plant Automation Concepts, Distributed Computer Control System Architecture: Evolution of Hierarchical System Structure, Functional Levels, Database Organization, System Implementation Concepts, And Human Interface System Elements: Field Stations, Intermediate Stations, Central Computer

Station, Monitoring and Command Facility. *Data communication links:* Transfer of process data, communication within the system, MAO – Manufacturing Automation Protocol, Buses and communication networks of DCS.

Unit-IV

Software: Real-time Operating System, Communication Software, Process-Oriented Languages, Application Software, Software Configuration and Parameterization, Knowledge-Based Software Algorithms: Data Acquisition and Signal Processing Algorithms, Closed- Loop and Sequential Control, Optimal and Adaptive Control, Implementation Examples, Algorithms Available Within DCCS. *Applications:* Brief overview of applications of PLC, SCADA & DCS in Power Plants, Iron and Steel Plants, Pulp and Paper Plants.

Text books/References

1. P. Bhatkar Vijay. Distributed computer control for industrial Automation. Marcel Dekker, Inc. New York and Basel.
2. John R. Hackworth, D. Frederic, J.R. Hackworth. Programmable logic controllers: Pearson education.
3. D. Gary. Programmable Logic Controllers, Thomson Pub., 2nd Edition.
4. John W. Web. Programmable Logic Controllers, PHI Pub. 5th Edition.
5. Krishna Kant. Computer Based industrial Control: PHI.
6. S.K. Singh. Computer Aided Process Control: PHI.