Semester-3

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| **BS-204A** | **HIGHER ENGINEERING MATHEMATICS** |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** **(hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 h** |
| **Purpose** | The objective of this course is to familiarize the prospective Engineers with Laplace Transform, partial differential equations which allow deterministic mathematical formulations of phenomena in engineering processes and to study numerical methods for the approximation of their solution.  |
| **Course Outcomes:** After studying the course, students will be able to:  |
| **CO 1** | Describe the concept of Laplace transform and how it is useful in solving the definite integrals and initial value problems. |
| **CO 2** | Solve the Partial Differential Equations for multivariable differential equations originated from real world problems. |
| **CO 3** | Solve the problems using numerical methods in a comprehensive manner  |
| **CO 4** | Describe the essential tool of Numerical differentiation and Integration needed in approximate solutions for the ordinary differential equations. |

**UNIT-I**

**Laplace Transform**

Laplace Transform, Laplace Transform of Elementary Functions, Basic properties of Laplace Transform, Laplace transform of periodic functions, finding inverse Laplace transform by different methods, Convolution theorem, solving ODEs by Laplace Transform method.

**UNIT-II**

**Partial Differential Equations**

Formation of Partial Differential Equations, Solutions of first order linear and non-linear PDEs, Charpit’s method, Solution to homogenous linear partial differential equations (with constant coefficients) by complimentary function and particular integral method.

**UNIT-III**

**Numerical Methods-1**

Solution of polynomial and transcendental equations: Bisection method, Newton-Raphson method and Regula-Falsi method, Finite differences, Relation between operators, Interpolation using Newton’s forward and backward difference formulae. Interpolation with unequal intervals: Newton’s divided difference and Lagrange’s formulae.

**UNIT-IV**

**Numerical Methods-2**

Numerical Differentiation using Newton’s forward and backward difference formulae, Numerical integration: Trapezoidal rule and Simpson’s 1/3rd and 3/8 rules, Ordinary differential equations: Taylor’s series, Euler and modified Euler’s methods. Runge-Kutta method of fourth order for solving first and second order equations.

**Textbooks/References:**

1. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993. AICTE Model Curriculum in Mathematics.
2. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.
3. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1964.
4. Manish Goyal and N.P. Bali, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
8. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
9. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
10. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
11. Erwin Kreyszig and Sanjeev Ahuja, Applied Mathematics-II, Wiley India Publication, Reprint, 2015.

**Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.**

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| **RA-201 A** | **Manufacturing Technology** |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time****(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To Study the various manufacturing processes along with the latest developments in this field. |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | To understand the casting fundamentals, and different casting processes. |
| **CO2** | Understand the powder metallurgy processes and different plastic shaping processes. |
| **CO3** | understand different welding processes with their applications |
| **CO4** | Know the applications of various Traditional, Non-Traditional manufacturing process & CNC machines |

**UNIT-I**

**Fundamentals of castings:** Introduction to casting: basic requirements of casting processes, casting terminology, solidification process: cooling curves, prediction of solidification time, the cast structure, molten metal problems, fluidity and pouring temperature, role of gating system, solidification shrinkage, riser and riser design, risering aids, Patterns, design considerations in castings.

**Expandable-mold casting processes:** Sand casting, cores and core making, other expendable-mold processes with multiple use patterns, expendable-mold processes with multiple use patterns, shakeout, cleaning and finishing. **Multiple-use-mold casting processes**: Permanent mold casting, die casting, squeeze casting and semisolid metal casting, centrifugal casting, cleaning treating and heat treating of castings, automation in foundry operations.

**UNIT-II**

**Powder metallurgy:** Characterization of engineering powders: geometric features, other features production of metallic powders: atomization: other production methods, conventional pressing and sintering: blending and mixing of the powders, compaction, sintering, heat treatment and finishing, design considerations in powder metallurgy.

**Shaping processes for plastics:** Properties of polymer melts, extrusion, production of sheet and film, fiber and filament production (spinning), coating processes, injection molding, compression and transfer molding, blow molding and rotational molding, thermoforming.

**UNIT–III**

**Joining processes:** Principles of fusion welding processes, arc welding processes-consumable electrodes: shielded metal arc welding, gas metal arc welding, flux-cored arc welding, submerged arc welding, Arc welding processes-non-consumable electrodes: gas tungsten arc welding, plasma arc welding, resistance welding processes, other fusion-welding processes: electron-beam welding, laser-beam welding, electro-slag welding, thermit welding.

**UNIT–IV**

**Metal forming processes:** classifications of metal forming processes, bulk deformation processes, material behavior in metal forming, temperature in metal forming, rolling: flat rolling and its analysis, shape rolling, rolling mills, forging: open-die forging, impression-die forging, flashless forging, forging hammers, presses, and dies, extrusion: types of extrusion, analysis of extrusion, extrusion dies and presses, defects in extruded products, wire and bar drawing, analysis of drawing, drawing practice, tube drawing

Introducing to CNC machines: Basics of Turning tool Geometry, ATC, Programming methods. – Manual part

programming, Milling, Turning, (Simple Programs), Computer Aided part programming (Simple problems, DNC, Types , Applications, Types of CNC Programming Software’s, Over view CNC machining centers, Turning centre.

**TEXT BOOKS:**

1. Manufacturing Technology Serope kalpakjain Steuen.R.Sechmid Pearson Education Asia 5 th Ed. 2006
2. Manufacturing Technology Vol 1 & 2 P.N.Rao Tata McGraw Hill 2001
3. N C Machine Programming and software Design ChnoHwachang, Michael.A.Melkan off Prentice Hall 1989

**REFERENCES:**

1. Process and materials of Manufacturing Roy A Lindberg Pearson 4 th Ed 2006.
2. Workshop Technology Hajra Choudhary. Vol I & II Media Publishers, Bombay 2004

**Note: The paper setter will set the paper as per the question paper template provided.**

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| **RA- 203 A** | **SENSORS AND INSTRUMENTATION** |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time****(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | a) To understand the concepts of measurement technology.b) To learn the various sensors used to measure various physical parameters.c)To learn the fundamentals of signal conditioning, data acquisition and communication systems used in the development of mechatronics system.  |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | Familiarize with various calibration techniques and signal types for sensors. |
| **CO2** | Apply the various sensors in the Automotive and Mechatronics applications. |
| **CO3** | Understand the basic principles of various pressure and temperature, smart sensors. |
| **CO4** | Implement the Data Acquisition systems with different sensors for real time applications. |

**UNIT-I**

**Introduction:** Sensors & Transducer: Definition, Classification & selection of sensors, Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.

**UNIT-II**

**Measurement of temperature using Thermistor**, Thermocouple & RTD, Concept of thermal imaging, Measurement of position using Hall effect sensors, Proximity sensors: Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.

**UNIT–III**

**Virtual Instrumentation:** Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters & graphs, Structures: Case, Sequence & Formula nodes, Need of software based instruments for industrial automation.

**UNIT–IV**

**Data Acquisition Methods:** Basic block diagram, Analog and Digital IO, Counters, Timers, Types of ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication.

**Intelligent Sensors:** General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Selftesting & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

**TEXT BOOKS:**

1. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013

2. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.

3. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.

4. Gary Johnson / Lab VIEW Graphical Programing II Edition / McGraw Hill 1997.

**REFERENCE BOOKS:**

1. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.

2. A.D. Helfrick and W.D. cooper,Modern Electronic Instrumentation & Measurement Techniques, PHI – 2001

3. Hermann K.P. Neubert, “Instrument Transducers” 2nd Edition 2012, Oxford University Press.

**Note: The paper setter will set the paper as per the question paper template provided.**

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| **RA-205A** |  **MECHANICS OF SOLIDS** |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time****(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | a) To understand the concepts of stress, strain, principal stresses and principal planes.b) To study the concept of shearing force and bending moment due to external loads in determinate  beams and their effect on stresses.c) To determine stresses and deformation in circular shafts and helical spring due to torsion.d) To compute slopes and deflections in determinate beams by various methods.e) To study the stresses and deformations induced in thin and thick shells |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes. |
| **CO2** | to calculate the SF and BM in beams subjected to different loading conditions. |
| **CO3** | to determine the torsion in the transmitting shafts subjected to different loading conditions, stresses in crane hook, rings, chain link for different cross section and also the deflection of curved bars and rings. |
| **CO4** | to find strain energy in beams and shafts under different loading conditions and will be able to explain the energy methods and Castigliano’s theorem. |

**UNIT-I**

Simple Stresses & Strains : Concept & types of Stresses and strains, Poisson’s ratio, stresses and strain in simple and compound bars under axial loading, stress strain diagrams, Hook’s law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading, Numerical problems.

Principle Stresses: Two dimensional systems, stress at a point on a plane, principal stresses and principal planes, Mohr’s circle of stresses, Numerical Problems.

**UNIT-II**

Shear Force & Bending Moments: Shear Force & Bending Moments: Definitions, SF & BM diagrams for cantilevers, simply supported beams with or without over-hang and calculation of maximum BM & SF and the point of contraflexture under (i) concentrated loads, (ii) uniformly distributed loads over whole span or a part of it, (iii)combination of concentrated loads and uniformly distributed loads, (iv) uniformly varying loads and (v) application of moments, relation between the rate of loading, the shear force and the bending moments, Numerical Problems.

Flexural and Shear Stresses – Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I,T, Angle, channel sections, composite beams, shear stresses in beams with derivation, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections, combined bending and torsion, equivalent torque,. Numerical problems.

**UNIT–III**

Torsion: Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

Bending of Curved Bars : Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars & rings,

deflection of rings by Castigliano’s theorem, stresses in simple chain links, deflection of simple chain links, Problems.

**UNIT–IV**

Strain Energy & Impact Loading: Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano’s theorem, Numerical.

Theories of Elastic Failures: Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading, Numericals.

**TEXT BOOKS:**

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016

2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

**REFERENCES:**

1. Egor. P.Popov “Engineering Mechanics of Solids” Prentice Hall of India, New Delhi, 2002

2. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing ‘co. Ltd., New Delhi, 2005.

3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013

4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010. edition, CRC Press, 2015

**Note: The paper setter will set the paper as per the question paper template provided.**

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| **RA-207A** | **ELECTRONIC DEVICES AND CIRCUITS** |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time****(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | a) To understand the structure of basic electronic devices.b) Be exposed to active and passive circuit elements.c) To familiarize the operation and applications of transistor like BJT and FET.d) Explore the characteristics of amplifier gain and frequency response.e) To learn the required functionality of positive and negative feedback systems. |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | Explain the structure and working operation of basic electronic devices |
| **CO2** | Analyze the characteristics of different electronic devices such as diodes and transistors |
| **CO3** | Choose and adapt the required components to construct an amplifier circuit |
| **CO4** | Employ the acquired knowledge in design and analysis of oscillators. |

**UNIT-I**

**PN Junction Devices:** PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance, Rectifiers – Half Wave and Full Wave Rectifier, clipping and clamping circuits. Display devices- LCD, LED, Seven Segment display, Laser diodes, Zener diode: characteristics and it’s applications.

**UNIT-II**

**Transistors and Thyristors:** BJT, JFET, MOSFET- structure, operation, characteristics and Biasing, UJT, Thyristors and IGBT - Structure and characteristics.

**Amplifiers:** BJT small signal model , Analysis of CE, CB, CC amplifiers- Gain and frequency response , MOSFET small signal model, Analysis of CS and Source follower – Gain and frequency response, High frequency analysis.

**UNIT–III**

**Multistage Amplifiers and Differential Amplifier:** BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis, FET input stages, Single tuned amplifiers – Gain and frequency response, Neutralization methods, Power amplifiers –Types (Qualitative analysis).

**UNIT–IV**

**Feedback Amplifiers and Oscillators:** Advantages of negative feedback, voltage series & current series feedback amplifier, Shunt feedback amplifier, positive feedback, Oscillators: Condition for oscillations, Types: phase shift, Wien Bridge, Hartley, Colpitts and Crystal oscillators

**TEXT BOOKS:**

1. David A. Bell ,”Electronic devices and circuits”, Oxford University higher education, 5th edition 2008.

2. Sedra and smith, “Microelectronic circuits”,7th Ed., Oxford University Press.

**REFERENCES:**

1. Balbir Kumar, Shail.B.Jain, “Electronic devices and circuits” PHI learning private limited, 2nd edition 2014.

2. Thomas L.Floyd, “Electronic devices” Conventional current version, Pearson prentice hall, 10th Edition, 2017.

3. Donald A Neamen, “Electronic Circuit Analysis and Design” Tata McGraw Hill, 3rd Edition, 2003.

4. Robert L.Boylestad, “Electronic devices and circuit theory”, 2002.

5. Robert B. Northrop, “Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation”, CRC Press, 2004

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| **ES-201 A** | **ENGINEERING MECHANICS** |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time****(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To understand the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensionsTo comprehend the effect of friction on equilibrium and the laws of motion, the kinematics of motion and the interrelationship and to learn to write the dynamic equilibrium equationTo emphasis the concepts through solved examples |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | Apply knowledge of mathematics, science and engineering to analyze the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions |
| **CO2** | Design and conduct experiment, as well as to analyze the effect of friction on equilibrium and the laws of motion, the kinematics of motion and the interrelationship and analyze dynamic equilibrium equation |
| **CO3** | Design, construct and analyze Engineering Mechanics through solved examples |

**UNIT-I**

FUNDAMENTAL OF MECHANICS: Fundamental of Mechanics: Basic Concepts Force System and Equilibrium, Definition of Force, Moment and Couple, Principle of Transmissibility, Varignon‗s theorem, Resultant of force system – Concurrent and non-concurrent coplanar forces, Condition of static equilibrium for coplanar force system, stability of equilibrium, applications in solving the problems on static equilibrium of bodies.

**UNIT-II**

PRACTICAL APPLICATION OF FORCE SYSTEM: Structural member: definition, Degree of freedom, concept of free body diagrams, types of supports and reactions, types of loads, Analysis of Trusses-method of joints, method of sections. Friction: Introduction, Static dry friction, simple contact friction problems, ladders, wedges.

**UNIT–III**

PROPERTIES OF SURFACES: Properties of sections – area, centroids of lines, areas and volumes, moment of inertia first moment of inertia, second moment of inertia and product moment of inertia, polar moment of inertia, radius of gyration, mass moment of inertia.

**UNIT–IV**

KINEMATICS AND KINETICS OF PARTICLES: Equations of motion - Rectilinear motion, curvelinear motion, Relative motion, D‗Alembert‗s principle, work- Energy equation – Conservative forces and principle of conservation of energy, Impulse – momentum, Impact – Direct central impact and oblique central impact.

KINEMATICS AND KINETICS OF RIGID BODIES: Plane motion, Absolute motion, Relative motion, translating axes and rotating axes, work and energy, impulse and momentum.

**TEXT BOOKS:**

1. Rajesekaran, S and Sankara Subramanian., G., Engineering Mechanics, Vikas Publishing House Private Ltd., 2012.

**REFERENCES:**

1. Palanichamy, M.S. Nagan, S., Engineering Mechanics – Statics & Dynamics, Tata McGraw-Hill,2001.

2. Beer, F.P and Johnson Jr. E.R, Vector Mechanics for Engineers, Vol. 1 Statics and Vol.2 Dynamics, McGraw – Hill International Edition, 1997

3. Bhavikatti,S.S and K.G.Rajashekarappa, Engineering Mechanics, New Age International (P) Ltd, New Delhi,2010.

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| **RA- 209 LA** | **ELECTRONIC DEVICES AND CIRCUITS LAB** |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major****Test** | **Minor****Test** | **Practical** | **Total** | **Time****(Hrs.)** |
| **0** | **0** | **2** | **1** | **0** | **40** | **60** | **100** | **3** |
| **Purpose** | To introduce basic semiconductor devices, their characteristics and applicationTo understand analysis and design of simple diode circuitsTo learn to analyze the PN junction behaviour at the circuit level and its role in the operation of diodes and active devices |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO 1** | Analyze PN junctions in semiconductor devices under various conditions. |
| **CO 2** | Design and analyze simple rectifiers and voltage regulators using diodes. |
| **CO 3** | Describe the behaviour of special purpose diodes. |
| **CO 4** | Design and analyze simple BJT , FET circuits and oscillators. |

**LIST OF EXPERIMENTS:**

1. To study V-I characteristics of P-N junction diode.

2. To study clipper circuit and clamper circuits.

3.To study the reverse breakdown characteristics of given Zener diode as a voltage regulator.

4.To study half wave rectifier , Full wave rectifier & bridge rectifier and effect of different filter circuits on ac ripple at different loads.

5. To study the input and output characteristics of a given transistor in common emitter configuration

 6. To study characteristics of JFET & evaluate various parameters rd , Idss , Vpo , gm .

7. To study Hartley Oscillator.

8. To study RC phase shift oscillator.

9. To study Wien bridge Oscillator.

 10. To study the different types of negative feedback in two stage amplifier and to observe

 its effects upon amplifier parameters.

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

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| **RA-211 LA** | **Manufacturing Technology & CNC Lab** |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **0** | **0** | **2** | **1** | **0** | **40** | **60** | **100** | **3** |
|  |  |
| **Purpose** | To study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries. |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | Demonstrate the safety precautions exercised in the mechanical workshop. |
| **CO 2** | Make the workpiece as per given shape and size using Lathe. |
| **CO 3** | Join two metals using arc welding. |
| **CO 4** | Use sheet metal fabrication tools and make simple tray and funnel. |
| **CO5** | Use different moulding tools, patterns and prepare sand moulds. |

**List of Experiments:**

Machining and Machining time estimations for:

1. Taper Turning
2. External Thread cutting
3. Internal Thread Cutting
4. Eccentric Turning
5. Knurling
6. Square Head Shaping
7. Hexagonal Head Shaping
8. Fabrication of simple structural shapes using Gas Metal Arc Welding
9. Joining of plates and pipes using Gas Metal Arc Welding/ Arc Welding /Submerged arc welding
10. Preparation of green sand moulds
11. Manufacturing of simple sheet metal components using shearing and bending operations.
12. Manufacturing of sheet metal components using metal spinning on a lathe
13. Develop a part programme for following lathe operations and make the job on CNC lathe and CNC turning center (for finish pass only) – (At least two)

 Calculating coordinate points for a cylindrical job by considering sign convention

 for lathe

 - Plain turning and facing operations

 - Taper turning operations

 - Operation along contour using circular interpolation.

1. Develop a part program by using canned cycle on CNC lathe for turning , facing
2. Preparation of preventive maintenance schedule for CNC machine.

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

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| **RA -217 LA** | **MECHANICS OF SOLIDS LAB** |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **0** | **0** | **2** | **1** | **0** | **40** | **60** | **100** | **3** |
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| **Purpose** | To make the students aware of different properties of material using different experiments.  |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | design and conduct experiments, acquire data, analyze and interpret data |
| **CO 2** | determine the behavior of ferrous metals subjected to normal and shear stresses by means of experiments. |
| **CO 3** | determine the behavior of structural elements, such as bars subjected to tension, compression, shear, bending, and torsion by means of experiments.  |
| **CO 4** | physically insight into the behavior materials and structural elements, including distribution of stresses and strains, deformations and failure modes. |
| **CO5** | present objectives, describe test procedures and results, synthesize and discuss the test results. |

**List of Experiments:**

1. To study the Brinell hardness testing machine & perform the Brinell hardness test.

2. To study the Rockwell hardness testing machine & perform the Rockwell hardness test.

3. To study the Vickers hardness testing machine & perform the Vickers hardness test.

4. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test.

5. To study the Impact testing machine and perform the Impact tests (Izod&Charpy).

6. To study the Universal testing machine and perform the tensile, compression & bending tests.

7. To perform the shear test on UTM.

8. To study the torsion testing machine and perform the torsion test.

9. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under point and distributed Loads.

10. To prepare the composite specimen using hot compression molding machine and test for different mechanical properties.

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**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

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| **RA-219 A** | [**INDUSTRIAL**](#_top) **TRAINING-I** |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **0** | **0** | **2** | **--** | **--** | **100** | **--** | **100** | **03** |
|  |  |
| **Purpose** | To provide comprehensive learning platform to students where they can enhance their employ ability skills and exposure to the industrial environment. |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | acquire and apply fundamental principles of engineering. |
| **CO 2** | update with all the latest changes in technological world. |
| **CO 3** | develop self-improvement through continuous professional development and life-long learning |
| **CO 4** | aware the social, cultural, global and environmental responsibility as an engineer. |

**Note: RA-219A** [**Industrial**](#_top) **Training-I** is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.

The candidate has to submit a training report of his/her work/project/assignment completed in the industry during the training period. The evaluation will be made on the basis of submitted training report and viva-voce/presentation.

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| **MC 901 A** | **Environmental Sciences** |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **0** | **100** | **-** | **100** | **3 Hrs.** |
| **Purpose** | To learn the multidisciplinary nature, scope and importance of Environmental sciences. |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | learn the importance of natural resources. |
| **CO2** | learn the theoretical and practical aspects of eco system. |
| **CO3** | learn the basic concepts of conservation of biodiversity. |
| **CO4** | understand the basic concept of sustainable development. |

**UNIT 1**

The multidisciplinary nature of environmental studies, Definition, Scope and Importance, Need for public awareness, Natural Resources: Renewable and Non-Renewable Resources: Natural resources and associated problems.

1. Forest Resources: Use and over-exploitation, deforestation, case studies. Timber eztraction, mining, dams and their effects on forests and tribal people.
2. Water Resources: Use & over-utilization of surface & ground water, floods, drought, conflicts over water, dams-benefits and problems.
3. Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
4. Food Resources: World Food Problems, changes caused by agriculture and overgazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
5. Energy Resources: Growing energy needs, renewable & non-renewable energy sources, use of alternate energy sources. Case studies.
6. Land Resources: Land as a resource, land, degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyle.

**UNIT II**

**Ecosystem-Concept of an ecosystem**. Sturcture and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological Succession, Food Chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest Ecosystem, (b) Grassland Ecosystem, (c) Desert Ecosystem and (d) Aquatic Ecosystems (ponds, streams, lakes, rivers, oceans, esturaries

Field Work: Visit to a local area to document Environment assets-river/forest/grassland/hill/mountain, Visit to a local polluted site-Urban /Rural Industrial/Agricultural, Study of common plants, insects and birds, Study of simple ecosystems-pond, river, hill, slopes etc. (Field work equal to 5 lecture hours).

**UNIT III**

**Biodiversity and its conservation:** Introduction, Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversityof global, National and local levels. India as a mega-diversity nation Hot spots of Biodiversity, Threats to biodiversity: Habitat loss, poaching of wild life, man-wildlife conflicts, Endangered and endemic species of India, Conservation of Biodiversity- In situ and Ex-Situ conservation of biodiversity.

**Environmental Pollution Definition:** Cause, effects and control measures of (a) Air Pollution (b) Water Pollution (c) Soil Pollution (d) Marine Pollution (e) Noise Pollution (f) Thermal Pollution (g) Nuclear Hazards

Solid waste management- cause, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides

**UNIT IV**

**Social Issues and the Environment**. From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people: Its problems and concerns, Case Studies: Environmental ethics-issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies: Wasteland Reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public Awareness, Human population and the Environment, Population growth, variation among nations, Population explosion-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, Case Studies, Drugs and their effects; Useful and harmful drugs, Use and abuse of drugs, Stimulant and depressan drugs, Concept of drug de-addiction, Legal position on drugs and laws related to drugs.

**Suggested Books**

* + - * Environmental Studies- Deswal and Deswal. Dhanpat Rai and Co.
			* Environmental Science and Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India.
			* Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
			* Environmental Science- Botkin and Keller. 2012. Wiley , India

**Note: The Examiner will be given the question paper template to set the question paper.**

Semester-4

|  |  |
| --- | --- |
| **HTM-901** | **Universal Human Values-II** |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time****(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | Purpose and motivation for the course, recapitulation from Universal Human Values-I |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence. |
| **CO2** | understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence. |
| **CO3** | Strengthen self-reflection. |
| **CO4** | develop commitment and courage to act. |

**Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I

2. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration

3. Continuous Happiness and Prosperity- A look at basic Human Aspirations

4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority

5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

**Module 2: Understanding Harmony in the Human Being - Harmony in Myself!**

7. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’

8. Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility

9. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)

10. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’

11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

12. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one’s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

**Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**

13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship

14. Understanding the meaning of Trust; Difference between intention and competence

15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship

16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students’ lives

**Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**

18. Understanding the harmony in the Nature

19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature

20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space

21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.

**Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics**

22. Natural acceptance of human values

23. Definitiveness of Ethical Human Conduct

24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production

systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

26. Case studies of typical holistic technologies, management models and production systems

27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations

28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc.

**READINGS:**

**Text Book**

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book).

4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5. Small is Beautiful - E. F Schumacher.

6. Slow is Beautiful - Cecile Andrews

7. Economy of Permanence - J CKumarappa

8. Bharat Mein Angreji Raj - PanditSunderlal

9. Rediscovering India - by Dharampal

10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

11. India Wins Freedom - Maulana Abdul Kalam Azad

12. Vivekananda - Romain Rolland (English)

13. Gandhi - Romain Rolland (English)

**Reference Books:**

**MODE OF CONDUCT**

Lecture hours are to be used for lecture/practice sessions.

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Practice hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor’s role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions, the mentor encourages the student to connect with one’s own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. The student is encouraged to take up” ordinary” situations rather than” extra-ordinary” situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Practice experiments are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty. Teacher preparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemed essential.

**ASSESSMENT:**

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by

faculty mentor: 5 marks

Self-assessment: 5 marks

Assessment by peers: 5 marks

Socially relevant project/Group Activities/Assignments: 10 marks

Semester End Examination: 75 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

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| **RA-202 A** | **AUTOMATIC CONTROL SYSTEMS** |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time****(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To study the basics of control system and its response. Stability of mechanical and electrical systems. Use of MATLAB to design a stable control system.a) To introduce the elements of control system and their modelling using various Techniques.b) To introduce methods for analysing the time response.c) To impart knowledge about the frequency response and the stability of systemsd) To introduce the state variable analysis method |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | understand the basics of the control system |
| **CO2** | study the concept of time response of control system |
| **CO3** | study the concept of frequency response of control system & different types of stability criteria of the system. |
| **CO4** | provide a complete idea about the behaviour of a system at any given time utilizing the history of system using state space analysis  |

**UNIT-I**

**Introduction: Basic** elements of control systems- Open loop and closed loop systems-Differential equation representation of physical systems- Transfer function, Mathematical modelling of Electrical and Mechanical (translational and rotational) systems, Block diagram reduction techniques, Signal flow graph – Mason‟ gain formula.

**UNIT-II**

**Time Domain Analysis:** Time response analysis –Analysis of transient and steady state behaviour of control systems. Standard Test signals- Time response of first and second order system, Time domain specifications, Types of systems, Steady state error –generalized error coefficients – response with P, PD, PI and PID controllers.

**UNIT–III**

**Frequency Domain Analysis and Stability:** **:** Frequency domain specifications, Time and frequency response correlation , Characteristic equation , Routh Hurwitz criterion of stability , Nyquist stability , Nyquist stability criterion , Polar plot , Bode plot ,Root Locus Method:Root locus concepts , Construction of root loci , Root contours.

**UNIT–IV**

**STATE SPACE ANALYSIS**: Limitations of conventional control theory, Concepts of state, state variables and state model , state model for linear time invariant systems , Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability., Introduction to state space representation using physical - Phase and canonical variables-diagonal canonical form-Jordan canonical form.

**TEXT BOOKS:**

**1.** Nagrath I J, and Gopal, M, 'Control Systems Engineering" Prentice Hall of India, New Delhi, 2008.

**2.** Richard C Dorf and Robert H Bishop, "Modern Control Systems.", Addison-Wesley -2007

**REFERENCES:**

**1.** Ogata K, "Modern Control Engineering", Pearson Education, New Delhi, 2006.

**2.** Kuo B C, "Automatic Control Systems", Prentice-Hall of India Pvt. Ltd, New Delhi, 2004.

**3.** Norman C. Nise S, “Control system Engineering‟, John Wiley & Sons, Singapore, 2004.

**Note: The paper setter will set the paper as per the question paper templates provided.**

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| **Course No.**  | **Course Title**  | **Teaching Schedule**  | **Credits** | **Allotment of Marks**  | **Duration of Exam** **(Hrs.)**  |
| **L**  | **T**  | **P**  | **Theory**  | **Sessional**  | **Total**  |  |
| **RA-204 A** | **COMPUTER AIDED DESIGN AND ANALYSIS** | 3  | 0 | 0  | 3 | 75  | 25  | 100  | 3  |
| **Purpose** | The subject empowers the students to know about the extreme function of computer in designing, manufacturing as well as in the business scenario. |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | describe the history and application CAD/CAM. |
| **CO 2** | aware about the Modeling of different types of curves, surface and solid. The modeling is used for further analysis. |
| **CO 3** | know about the transformation of points and lines in computer aided software.  |
| **CO 4** | know the usages of the numerical control machines and its code and How computer is useful in making the process planning. |

**UNIT-I**

Introduction to CAD/CAM, Historical Development, Industrial look at CAD/CAM Application of CA/CAM, Display devices, Input/ Output Devices, CPU.

Introduction to CIM, Definition, Nature of Elements of CIM, CIM Wheel,

Introduction to computer aided quality control, Contact and Non Conduct Inspection Method.

**UNIT-II**

Wireframe modeling, Representation of curves, Parametric and non-parametric curves, straight lines, Hermite cubic splines, B splines curves.

Plane surface, ruled surface, surface of revolution, bi-cubic surface, Bezier surface, B spline surface, Solid modeling, boundary representation, sweeping, parametric solid modeling.

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**UNIT-III**

Introduction, Transformation of points & line, 2-D translation, rotation, Reflection, Scaling, shearing and combined transformation, Homogeneous coordinates, Orthographic and perspective Projections.

Group technology, Part families, Part classification and coding, Optiz method, product flow analysis, Machine cell Design, Advantages of GT

**UNIT-IV**

Numerical control, Types of NC systems, MCU & other components, Co-ordinate system, NC manual part programming, G & M codes, part program for simple parts, Computer assisted part programming.

Introduction, FMS component, Types of FMS, FMS layout, planning for FMS, advantage and applications

Introduction, conventional process planning, Steps in variant process planning, types of

CAPP, planning for CAPP

**Text books:**

1. **Chris McMahon and Jimmie Browne**, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. **Rogers, D.F. and Adams, A**., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
3. **Ibrahim Zeid**, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
4. **M.P. Groover**, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall

**Reference Books:**

1. **Ibrahim Zeid**, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. **P. Radhakrishnan, S. Subramanayan and V.Raju**, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
3. **Groover M.P. and Zimmers E. W.**, CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
4. **Dr. Sadhu Singh**, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
5. **Chang, Wang &Wysk** Computer Aided Manufacturing. Prentice Hall
6. **Kundra** &**Rao**, Numerical Control and Computer Aided Manufacturing by, Rao and Tiwari, Tata Mc-Graw Hill.
7. **Mattson**, CNC programming Principles and applications, Cengage Learning India Pvt.

Ltd. Delhi

**NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.**

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| **RA-206 A** | **ELECTRICAL MACHINES AND POWER**  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time****(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | a) To study about basic electrical prime movers, electrical transmission and distribution systems.b) To study about the transformersc) To study about the different types of induction motorsd) To study about the special machinese) To study about the power system |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | Understand the principles of operations and characteristics of DC machines |
| **CO2** | Describe the electrical transformers and induction motors |
| **CO3** | visualize the operation of synchronous motors, stepper and servo motors |
| **CO4** | understand about the basic structure of power system. |

**UNIT–I**

**D.C. Machines:** Constructional details , EMF equation , methods of excitation – self and separately excited generators , characteristics of series and shunt generators , principle of operation of D.C. Motor , function of commutator in DC motors, back emf and torque equation , characteristics of series, shunt and compound motors , starting of D.C. Motors , types of starters , speed control and braking of DC. Motors.

**UNIT–II**

**Transformer:** Constructional detail , Working Principle , EMF Equation ,Transformation Ratio , Transformer on No Load , Transformer on Load , Equivalent Circuit , Parameters referred to HV/LV Windings , Phasor diagram at ideal, no load and on load conditions, Losses, Voltage regulation and efficiency, OC & SC test, Load Test , concept of auto transformer

**UNIT–III**

**Induction Motors:** Construction , types , principle of operation of three-phase induction motors ,equivalent circuit , Torque equation, Torque-slip characteristics, starting and speed control of three phase induction motor, single-phase induction motors (only qualitative analysis).

**Synchronous and Special Machines:** Construction of Synchronous machine, types, emf equation, Brushless alternators, Reluctance motor, Stepper motor, Servo motor.

**UNIT–IV**

**Introduction to Power System:** Structure of electric power systems: generation, transmission, and distribution systems, EHVAC and EHVDC transmission system , Underground and overhead system, Modern trends in power system transmission, Effects of increase in Voltage on transmission line efficiency, Radial and ring main system. Relative copper consumption in various systems. Conductor size and Kelvin’s Law, substation layout. (Concepts only).

**TEXT BOOKS:**

**1.** Murugesh Kumar K. , “Electric Machines Vo I”, Vikas Publishing House Pvt Ltd, 2010.

**2.** Murugesh Kumar K. , “Electric Machines Vol II”, Vikas Publishing House Pvt Ltd, 2010

**3.** Mehta V.K. and Rohit Mehta, “Principles of Power System”, S.Chand and Company Ltd, 2003.

**REFERENCE BOOKS:**

**1.** Fitzgerald A.E., Charles Kingsley, Stephen.D.Umans, “Electric Machinery”, Tata McGraw Hill publishing Company Ltd, 2003.

**2.** Gupta J.B., “Theory and Performance of Electrical Machines”, S.K.Kataria and Sons, 2002

**3.** Kothari D.P. and Nagrath I.J., “Electric Machines”, Tata McGraw Hill Publishing Company Ltd, 2002.

**4.** Bhimbhra P.S. “Electrical Machinery”, Khanna Publishers, 2003.

**Note: The paper setter will set the paper as per the question paper templates provided.**

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| **RA- 208 A** | **KINEMATICS AND DYNAMICS OF MACHINCES** |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time****(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | a) To understand the basic knowledge about kinematics of machines.b) To understand the basic components and layout of linkages in the assembly of a system/ machine.c) To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.d) To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.e) To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | Understand the basic knowledge of kinematics of machines |
| **CO2** | apply fundamentals of mechanism for the design of new mechanisms |
| **CO3** | know about the linkages, design few linkage mechanisms and cam mechanisms for specified output motions |
| **CO4** | Impart knowledge about the gears and gear trains |

**UNIT-I**

**Kinematic of Machines:** Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

**UNIT-II**

**Robot Kinematics and Dynamics:** Direct kinematics of a manipulator, workspace, Inverse kinematics, Algebraic approaches to inverse kinematics, Lagrange – Euler formulation of dynamic equations of a manipulator, Geometric approaches for inverse kinematics

**Gears and Gear Trains:** Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains

**UNIT–III**

**Force Analysis:** Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D‟Alembert‟s principle – superposition principle – dynamic Force Analysis in simple machine members

**UNIT–IV**

**Balancing and Vibration:** Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft

TEXT BOOKS:

1. Ambekar A.G., “Mechanism and Machine Theory” Prentice Hall of India, New Delhi, 2007

2. Shigley J.E., Pennock G.R and Uicker J.J., “Theory of Machines and Mechanisms”, Oxford University Press, 2003

REFERENCES:

1. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 1984.

2. Ghosh. A, and A.K. Mallick, “Theory and Machine”, Affiliated East-West Pvt. Ltd., New Delhi, 1988.

3. Rao.J.S. and Dukkipatti R.V. “Mechanisms and Machines”, Wiley-Eastern Ltd., New Delhi, 1992.

4. John Hannah and Stephens R.C., “Mechanics of Machines”, Viva Low Prices Student Edition, 1999.

5. V.Ramamurthi, Mechanisms of Machine, Narosa Publishing House, 2002.

6. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.

**Note: The paper setter will set the paper as per the question paper templates provided.**

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| **Course No.**  | **Course Title**  | **Credits** | **Teaching Schedule**  | **Allotment of Marks**  | **Duration of Exam** **(Hrs.)**  |
| **L**  | **T**  | **P**  | **Minor Test**  | **Practical**  | **Total**  |
| **RA-210 LA** | **COMPUTER AIDED DESIGN LAB** | 1 | 0  | 0  | 2  | 40  | 60  | 100  | 3  |
| **Purpose** | To empower the students to know about the computer aided design by using CAD |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | aware about the 2D drawing and modelling. |
| **CO 2** | know how to use 3D software in part designing. |
| **CO 3** | know about the assembly and aware about the G codes and M codes. |
| **CO 4** | aware about the NC part programming and OPTIZE method.  |

**List of experiments:**

1 To study the 2 dimensional drawing, orthographic views, front view, top view and side view.

2 To study the wireframe, surface and solid modelling.

3 Draw the part drawing of product 1 using any 3D software.

4 Draw the part drawing of product 2 using any 3D software.

5 Make assembly by using any 3D software.

6 To study the G codes and M codes.

7 Write a NC program for milling operation.

8 Write a NC program for drilling operation.

9 Write a NC program for turning operation.

10 To study the optiz method.

**Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the lab.**

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| **RA-212 LA** | **ELECTRICAL MACHINES AND POWER SYSTEMS LAB** |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major****Test** | **Minor****Test** | **Practical** | **Total** | **Time****(Hrs.)** |
| **0** | **0** | **2** | **1** | **0** | **40** | **60** | **100** | **3** |
| **Purpose** | To impart Knowledge about the basic operations of DC machines and help them to develop experimental skills.To measure equivalent circuit parameters of single phase transformers. To expose the students to the basic operations of AC machines and help them to develop experimental skills.  |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO 1** | describe basic operation of DC machines and help them to develop experimental skills. |
| **CO 2** | describe various characteristics of DC generators and determine the efficiency of DC Machines.  |
| **CO 3** | determine the equivalent circuit parameters of single phase transformers. |
| **CO 4** | operate AC electrical machines and determine the equivalent circuit parameters of single phase & 3-phase Induction motor. |

**LIST OF EXPERIMENTS:**

**1.** Draw characteristics of series, shunt and compound generators.

**2.** To perform load test on DC shunt generator & find efficiency & observe speed at different load.

**3.** To perform Hopkinson’s test of DC shunts M/Cs.

**4.** To perform Swinburne’s test of DC shunts motor and find efficiency.

**5.** Speed control of DC shunt motor by armature & field control method, draw graph between speed & field current.

**6.** Parallel operation of two 1-phase transformers and observe load sharing.

**7.** To perform open & short circuit tests on a 1-phase transformer & find parameters.

**8.** To perform light running and block rotor test on 1-phase induction motor and to determine the parameters of the equivalent circuit.

**9.** To perform no load test and block rotor test on 3-phase induction motor and draw the circle diagram.

**10.** To perform load test on a 3-phase induction motor & DC generator set and to determine the efficiency

 of induction motor.

**11.** Determine mechanical losses by light running of a 3-phase induction motor.

**12.** To calculate regulation by synchronous impedance method:-

 a) Conduct open and short circuit test on a three phase alternator.

 b) Determine and plot variation of synchronous impedance with If

 c) Determine SCR

 d) Determine regulations for 0.8 lagging power factor, 0.8 leading power factor and unity PF.

**13.** To plot V curves of a synchronous machine.

 a) Determination of Xo of a synchronous machine.

 b) Measurement Xd & Xq (Direct axis and Quardrature axis reactance) by slip test

**14.** To perform and study parallel operation of synchronous generators.

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

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| --- | --- |
| **RA-214 LA** | **KINEMATICS AND DYNAMICS OF MACHINCES LAB** |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major****Test** | **Minor****Test** | **Practical** | **Total** | **Time****(Hrs.)** |
| **0** | **0** | **2** | **1** | **0** | **40** | **60** | **100** | **3** |
| **Purpose** | To supplement the principles learnt in kinematics and Dynamics of Machinery. To understand how certain measuring devices are used for dynamic testing. |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO 1** | demonstrate the principles of kinematics and dynamics of machinery  |
| **CO 2** | use the measuring devices for dynamic testing. |
| **CO 3** | learn the various mechanism have used in Machines and Robots |
| **CO 4** | understand the concepts and working of Flywheel, Governor and Cams |

**LIST OF EXPERIMENTS:**

1. a) Study of gear parameters.

b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.

2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.

b) Kinematics of single and double universal joints.

3. a) Determination of Mass moment of inertia of Fly wheel and Axle system.

b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table

apparatus.

c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.

4. Motorized gyroscope – Study of gyroscopic effect and couple.

5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.

6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon

7. a) Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.

b) Multi degree freedom suspension system – Determination of influence coefficient.

8. a)Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped Natural frequencies. b) Vibration Absorber – Tuned vibration absorber.

9. Vibration of Equivalent Spring mass system – undamped and damped vibration.

10. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.

11. a) Balancing of rotating masses. (b) Balancing of reciprocating masses.

12. a) Transverse vibration of Free-Free beam – with and without concentrated masses.

b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.

c) Determination of transmissibility ratio using vibrating table

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

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| **MC 902A** | **Constitution of India** |
| **Lecture** | **Tutorial** | **Practical** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **100** | **0** | **100** | **3 Hrs.** |
| **Purpose** | **To know the basic features of Constitution of India** |
| **Course Outcomes:** After studying the course, students will be able to: |
| **CO1** | **Describe the salient features of the Constitution of India.** |
| **CO2** | **Discuss the fundamental duties and federal structure of Constitution of India.** |
| **CO3** | **describe about emergency provisions in Constitution of India.** |
| **CO4** | **describe fundamental rights under Constitution of India.** |

**UNIT-I**

Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India. Salient features and characteristics of the Constitution of India, Scheme of the fundamental rights.

 **UNIT - II**

The scheme of the Fundamental Duties and its legal status. The Directive Principles of State Policy – Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and the States.

Parliamentary Form of Government in India – The constitution powers and status of the President of India

 **UNIT - III**

Amendment of the Constitutional Powers and Procedure. The historical perspectives of the constitutional amendments in India.

Emergency Provisions: National Emergency, President Rule, Financial Emergency. Local Self Government – Constitutional Scheme in India.

 **UNIT-IV**

Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom under Article 19.

Scope of the Right to Life and Personal Liberty under Article 21.

**Text Books**

* 1. Constitution of India. Prof.Narender Kumar (2008) 8th edition. Allahabad Law Agency**.**

**Reference Books:**

* + 1. The constitution of India. P.M. Bakshi (2016) 15th edition. Universal law Publishing.