Gondwana University, Gadchiroli

Four Year Degree Course in Engineering and Technology

Course and Examination Scheme with Model AICTE Curriculum of Bachelor of Engineering

Seventh (VII) Semester of Mechanical Engineering

| S.N. | Course Category | Corse Code | Subject | Teaching Scheme | | | | Examination Scheme | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Hrs /week | | | No of Credits | Theory | | | | | | Practical | | | |
| | | | | L | T | P | | Duration of paper (Hrs) | Max Marks | Max Marks Sessional | | Total | Min Passing | Max Marks | Max Marks | Total | Min Passing Marks |
| | | | | | | | | | ESE | MSE | IE | | | TW | POE | | |
| 1 | Professional Core Courses | PCC-ME-401 | Automation in Manufacturing | 3 | 1 | 0 | 4 | 3 | 80 | 10 | 10 | 100 | 40 | - | - | - | - |
| 2 | Professional Core Courses | PCC-ME-402 | Computer Aided Design | 3 | 0 | 0 | 3 | 3 | 80 | 10 | 10 | 100 | 40 | - | - | - | - |
| 3 | Professional Elective Courses | PEC-MEL-421-426 | Elective -III | 3 | 0 | 0 | 3 | 3 | 80 | 10 | 10 | 100 | 40 | - | - | - | - |
| 4 | Open Elective Course | OEC-401 | Open Elective -III | 3 | 0 | 0 | 3 | 3 | 80 | 10 | 10 | 100 | 40 | - | - | - | - |
| 5 | Professional Core Courses | PCC-ME 4031 | Automation in Manufacturing | 0 | 0 | 2 | 1 | - | - | - | - | - | - | 25 | 25 | 50 | 25 |
| 6 | Professional Core Courses | PCC-ME 4032 | Computer Aided Design | 0 | 0 | 2 | 1 | - | - | - | - | - | - | 25 | 25 | 50 | 25 |
| 7 | Project | PROJ-ME 403 | Project III | 0 | 0 | 6 | 3 | - | - | - | - | - | - | 75 | -- | 75 | 40 |
| **Total** | | | | **12** | **1** | **10** | **18** | - | **320** | **40** | **40** | **400** | - | **125** | **50** | **175** | - |
| **Semester Total** | | | | **23** | | | **18** | **575** | | | | | | | | | |

**Elective-III:-**

1. PEC-MEL-421 Stress Analysis
2. PEC-MEL-422 Hydraulics and Pneumatics
3. PEC-MEL-423 Mechatronics Systems
4. PEC-MEL-424 Tool Design

**Open Elective-III:-**

1. OEC-4011 Automobile Engineering
2. OEC-4012 Applied Ergonomics
3. OEC-4013 Advance Welding Technology
4. OEC-4014 Energy Conservation and Management

Dr. L.P. Dhole
Member BOS
Mechanical Engineering

Dr. S.M. Rajurkar
Chairman, BOS Mech. Engg

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| PCC-ME-401 | Automation in Manufacturing (Theory) | 3L:1T:0P | 4 Credits |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

**Automation:** - Definition, types, reasons for automating. Functions in manufacturing.
**Automated Flow Lines:** - Methods of work part transport, Buffer storage. General terminology and analysis of transfer lines without storage, partial automation, automated flow lines with storage buffers, Line balancing, Methods of line balancing. Manual Assembly Lines., Automated Assembly Systems - Types, parts delivery system.

**UNIT – II** **[ 8 Hrs. ]**

**Numerical Control Production Systems: -** Basic concepts, NC coordinate systems .Types of NC systems - Point to point, straight cut & continuous path. Tape & tape readers. NC part programming - Punched tape & Tape formats, NC words, Methods of Part Programming, Manual part programming. Introduction to APT (Programming not expected), Direct Numerical Control. Computer Numerical Control. Applications & economics of NC.

**UNIT – III** **[ 8 Hrs. ]**

**Industrial Robotics:** - Introduction, Robot anatomy, Robot control systems, Robot Configurations, end effectors, sensors, Introduction to Robot Programming. Robot Applications in material handling.
**Computer Aided Design:** Fundamentals of CAD, Design process, Benefits of Computer Aided Design.
**Computer Aided Manufacturing: -** Manufacturing planning, manufacturing control, Computer integrated manufacturing.
**Flexible Manufacturing Systems** – Levels of flexibility Components, FMS benefits.
**Computer Aided Process Planning**: - Retrieval CAPP systems, generative CAPP systems, benefits of CAPP.

**UNIT – IV** **[ 8 Hrs. ]**

**Automated Material handling and Storage: -** Introduction to Material Handling Equipment, Unit Load Concept, Automated Guided vehicle Systems. Types:- Driverless trains, AGVS pallet trucks, AGVS unit-load carriers, Traffic control & safety, AGVS applications.
**Automated Storage & Retrieval System** -Types :- Unit load AS / RS, mini load AS / RS, man on board AS/RS, automated item retrieval system, deep lane AS/RS - Basic components & special features of AS/RS, Carousel storage systems.

**UNIT – V** **[ 8 Hrs. ]**

**Modeling and Simulation**: Optimization Techniques, Product Design, Process route modelling, Low cost automation: Hydraulic and pneumatic system Concepts and Components, Mechanical

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and Electromechanical System.

**Group Technology** :- Part families, parts classification & coding, Opitz classification systems, production flow analysis, Machine cell design - composite part concept, types of cell design, best machine arrangement, benefits of group technology.

**TEXT BOOKS**

1. 1. Automation, Production Systems, and Computer-Integrated Manufacturing by Mikell P. Groover, Pearson Prentice Hall
2. Manufacturing – Engineering and Technology by Serope Kalpakjian and Steven R. Schmid, 7th edition, Pearson
3. Computer control of manufacturing system by Yoram Koren, , 1st edition
4. CAD / CAM – Zimmers & Groover – PHI

**REFERENCE S BOOKS:**

1. Introduction to Hydraulics and Pneumatics by S. Ilango, V.Soundara Rajan
2. Optimization Techniques and Design by J.S.Arora, McGraw Hill

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| PCC-ME-402 | Computer Aided Design (Theory) | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

Definition of CAD, CAD software modules (Operating system, Graphics, Applications, Programming, Communication). Rasterization principle, Rasterization of line, frame buffer, N-bit plane buffers, Simple color frame buffer. Line generation using Bresenham's & DDA algorithms for line, circle, ellipse. Two dimensional geometric and co-ordinate transformations like scaling, translation, rotation, reflection, shear. Concepts of homogeneous representation and concatenated transformations. Inverse transformations. ( Enumeration of entity on graph paper )

**UNIT – II** **[ 8 Hrs. ]**

Three dimensional geometric and co-ordinate transformation like scaling, translation, rotation & reflection. Reflection about on arbitrary line, Bezier Curve (for Control points). Algorithms for windowing and clipping.

**UNIT – III** **[ 8 Hrs. ]**

Fundamental concept of finite element method: Plane stress and strain, Compatibility condition, Minimum potential energy principle, Displacement function, shape function for linear & quadratic bar element, Stiffness matrix, Force Matrix.

**UNIT – IV** **[ 8 Hrs. ]**

Truss problems (Linear shape functions only), Shape functions for CST, Two dimensional problems using constant strain triangle.

**UNIT – V** **[ 8 Hrs. ]**

Objectives of optimum design, adequate and optimum design, Johnson's Method of optimum design, primary design equation, subsidiary design equations and limit equations, optimum design with normal specifications of simple machine elements like: tension bar, transmission shaft, pressure vessel, helical spring etc. Introduction to redundant specifications with suitable examples.

**TEXT BOOKS**


1. CAD / CAM , Theory & Practice - Ibrahim Zeid
2. Procedural Elements for Computer Graphics - D. Rogers Computer control of manufacturing system by YoramKoren, , 1st edition
3. Introduction to Finite Elements in Engineering – Chandrupatla & A. D. Belegudu
4. Johnson R.C., "Mechanical Design Synthesis with Optimization Applications". Von Nostrand – Reynold Pub.


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| PEC-MEL-421 | Elective - III<br>Stress Analysis (Theory) | 3L :0T :0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 10 Hrs. ]**

Two Dimensional Problems in Cartesian Coordinate system – Fundamentals of stress & strain, stress-strain relationship, Elastic constant, Plane stress, Plane strain, differential equation of equilibrium , Boundary conditions, Saint Venant`s principle, Compatibility equation, Airy`s stress function, Stress analysis of cantilever subjected to concentrated load, Stress Analysis of simply supported beam subjected to Uniformly Distributed Load.

**UNIT – II** **[ 10 Hrs. ]**

Two dimensional problems in polar coordinate systems – General equations of equilibrium in polar coordinate, compatibility equation, stress distribution about symmetric axis, stress analysis of cylinder subjected to internal & external pressure, Pure bending of curved beams, effect of hole on the stress distribution in plates, Stress analysis of rotating circular disk.

**UNIT – III** **[ 10 Hrs. ]**

Two Dimensional Photo elasticity – Introduction to basic optics related to photo elasticity; stress optic law, plane & circular polariscope arrangements, effect of stressed model in plane & circular polariscope, Isoclinic & Isochromatics, stress trajectories, calibration of photo elastic material (determination of fringe constant), various photo elastic materials & their properties. Casting of photo elastic models, Tardy`s compensation technique, Separation techniques like shear difference, oblique incidence & electrical analogy.

**UNIT – IV** **[ 10 Hrs. ]**

Introduction to 3D photo elasticity – Phenomenon of Stress freezing, Method of stress freezing, slicing techniques, determination of material fringe constant at critical temperature. Scaling Model – Prototype relations.

Introduction to Reflection polariscope, fringe sharpening & fringe multiplication.

Strain gage technique for stress & strain analysis – Introduction to electrical resistant strain gage, gage factor, bridge circuit, bridge balance, output voltage of Wheatstone bridge, temperature compensation, various bridge configurations.

Determination of principle strains & stresses using strain rosettes.

Introduction to Strain measurement on rotating components, Static & Dynamic Strain measurement, Introduction to semiconductor gages, high temperature strain gages & self–temperature compensated gages, Introduction to commercial strain indicators.

Brittle coating method for stress & strain analysis.

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**REFERENCE S BOOKS:**


1. Theory of Elasticity - S.P. Timoshenko
2. Experimental Stress Analysis - Dalley S.W., Riley W.F.
3. Experimental Stress Analysis - T.K.Ray
4. Experimental Stress Analysis - L.S. Srinath


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| PEC-MEL-422 | Elective – III<br>Hydraulics and Pneumatics (Theory) | 3L :0T :0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

**FLUID POWER SYSTEMS AND FUNDAMENTALS:**

Basics of industrial hydraulics: Basic system of hydraulics, Advantages and disadvantages, Principles of hydraulics

Hydraulic oils and fluid properties: Types of hydraulic fluids and their properties, Physical characteristics, HWCF, maintenance of hydraulic oil

Filters and filtration: Nature and effect of contamination and their sources, Effect of dirt, Filter terminology, Filter types and filter design and construction

**UNIT – II** **[ 8 Hrs. ]**

**HYDRAULIC PUMPS:**

Pump classification, principle of operation, construction and applications of positive displacement pumps.

**UNIT – III** **[ 8 Hrs. ]**

**CONTROL VALVES IN HYDRAULIC SYSTEM:**

Direction Control Valve: Construction and principle of operation, operating methods, control techniques

Flow and pressure control valve: Types and principle of operation

**UNIT – IV** **[ 8 Hrs. ]**

**DESIGN OF HYDRAULIC CIRCUITS:**

Hydraulic actuators, hydraulic cylinders, meter-in meter-out circuit, machine tool clamping, speed control of cylinders, regenerative circuit, bleed off circuit, use of check valve.

**UNIT – V** **[ 8 Hrs. ]**

**DESIGN OF. PNEUMATIC CIRCUITS:**

Concepts and components, arrangement of complete pneumatic system, elements of pneumatic system, actuators, DCV, FCV, logic valves, time delay valves, pressure sequence valves, building pneumatic circuits.

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**TEXT BOOKS**


1. Anthony Esposito, "Fluid Power with Applications", Pearson Education, 2005.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2001.
3. Hydraulics & Pneumatics by Andrew Parr, Jaico Publishing House
4. Pneumatic Systems by S.R. Mujumdar, TMH
5. Srinivasan R., "Hydraulic and Pneumatic controls", Vijay Nicole, 2006.


**REFERENCE S BOOKS**


1. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.
2. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
3. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.


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| PEC-MEL-423 | Elective – III<br>Mechatronics Systems (Theory) | 3L : 0T : 0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**
Lectures: 3 Hours/Week

**Examination Scheme**
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

**Introduction:**

Introduction: Mechatronics, The design process, Systems, Programmable logic controller, Examples of Mechatronics systems.

**UNIT – II** **[ 8 Hrs. ]**

Sensors and Transducers: Definition, terminology, types of sensors (displacement, position and proximity, velocity and motion, force, fluid pressure, liquid flow, liquid level, temperature, light sensors) selection of sensors, problems.

Signal Conditioning: Introduction, operational amplifier, protection, filtering, Wheatstone bridge, digital signals, multiplexers, data acquisition, digital signal processing, pulse modulation, problems.

**UNIT – III** **[ 8 Hrs. ]**

Pneumatic and hydraulic actuation systems: Actuation systems, Pneumatic and hydraulic systems, Directional control valves, pressure control valves, cylinders, process control valves, Rotary actuators.

Basic System Models: Mathematical models, mechanical system building blocks, electrical system building blocks, Fluid system building blocks, thermal system building blocks.

**UNIT – IV** **[ 8 Hrs. ]**

System Models: Mechanical translational and rotational systems, electrochemical, hydro-mechanical systems.

Dynamic Responses of Systems: Modelling dynamic systems, first-order systems, second-order systems, performance measures for second-order systems.

**UNIT – V** **[ 8 Hrs. ]**

Controllers: Continuous and discrete processes, control modes, two-step mode, proportional mode, derivation control, integral control, PID controller, digital controllers, control system performance.

**Text Books:**

1. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, W. Bolton, Pearson Education Asia, (1999)

**Reference Books:**

1. Introduction to Mechatronics and Measurement Systems, D. G. Alciatore and M. B. Histand, Tata McGraw& Hill (2003)
2. Mechatronics (HMT), Tata McGraw Hill (1998)

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| PEC-MEL -424 | Elective - III<br>Tool Design (Theory) | 3L :0T :0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**SYLLABUS:**

**Unit 1 Introduction to tool design** **[8 hrs]**

Tooling, general tool design procedure, tool engineering functions and its importance to enhance productivity and quality. Cutting tool materials, Tool angles and signature, Carbide inserts grades - ISO designation and applications, tool holders for turning-ISO designation, Solid type tool, brazed tip tool, throw-away, indexable insert types, coated carbides and chip breakers.

**Unit –II Design of multi point cutting tool** **[8 hrs]**

Types of drills, Drill bit design and selection of tool geometry. Re-sharpening of drill bit. Tool holders for milling, ISO designation. Tool mounting systems Milling cutters, Design of elements like number of teeth and height, circular pitch, body thickness, chamfer width, fillet radius and selection of tool geometry.

**Unit – III Press tools** **[8 hrs]**

Classification and working of power presses, Concept and calculations of press tonnage and shut height of a press, components of a simple die, press tool operation, die accessories, shearing action in punch & die, clearance, shear on punch and die, Centre of pressure, and strip layout. Simple, progressive, compound, combination and inverted dies.

**Unit – IV Drawing dies** **[8 hrs]**

Single action, double action and triple action dies, Design of drawing dies for simple components. Die casting - Die casting alloys, terminology-core, cavity, sprue, slug, fixed and movable cores, finger cams, draft, ejector pins and plates, gate, goose nozzle, over-flow, platten, plunger, runner, vent, water-line etc. Types of Dies: Single cavity, multi-cavity dies, combination dies, unit dies

**Unit – V Economics of tooling** **[8 hrs]**

Introduction, machine tool replacement, elements of machining cost, tool cost, cutting speed for minimum cost, return on investment, mathematical analysis of economic equipment selection, economics of small tool selection, small tool replacement, break - even point analysis, economic lot size, minimum cost analysis.

TEXT BOOKS:

1. Cyril Donaldson, George H. Lecain,V.C.Goold, "Tool Design", McGraw Hill Education, 5th edition,2017.

2.P.N.Rao, "Manufacturing technology", McGraw Hill Education, 4th edition, 2013.

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**Reference books:**


1. John.G. Nee, William Dufraine, John W.Evans, Mark Hill, " Fundamentals of Tool Design", Society of Manufacturing Engineers, 2010.
2. Frank W.Wilson, "Fundamentals of Tool Design",PHI publications.
3. Kempester M.H.A., "An introduction to Jig and Tool design", VIVABooksPvt.Ltd., 2004.
4. Ranganath B.J., "Metal cutting and Tool Design", Vikas publishing house.
5. HMT, "Production Technology", TataMcGraw Hill, 2013.
6. Arshinov& G. Alekseev, "Metal cutting theory and practice", MIR publishers, Moscow.
7. Rodin, "Design and production of metal cutting tools", Beekman publishers.
8. P C Sharma, A textbook of production Engineering, P C Sharma


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| OEC-4011 | Open Elective-III<br>Automobile Engineering (Theory) | 3L : 0T : 0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**
Lectures: 3 Hours/Week

**Examination Scheme**
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

Components of an automobile, vehicle specifications, classification of automobiles, layout with reference to power plant, chassis, construction and details (frames, sub-frames, frameless vehicles, vehicle dimensions), details of chassis & body materials. Safety Considerations; Safety Features of Latest Vehicle. Engine Construction -Structural components and materials. Recent development in Automobiles.

**UNIT – II** **[ 8 Hrs. ]**

**Clutch** – Necessity, requirements of clutch systems, types of clutches, single & multi-plate clutch, semi-centrifugal clutch, centrifugal clutch, fluid clutch, clutch operations, clutch components.

**Gear Box** - Necessity of transmission, principle, types of transmission, sliding mesh, constant mesh, synchromesh, transfer gear box, gear selector mechanism, lubrication & control, over drive, torque Converter, automatic transmission and continuously variable transmission.

**UNIT – III** **[ 8 Hrs. ]**

**Transmission System:** - Propeller shaft, universal joint, constant velocity joint, hotchkiss drive, torque tube drive, differential - need & types, rear axles & front axles.

**Brakes** - Need, types - mechanical, hydraulic, pneumatic brakes, electrical brakes, engine exhaust brakes, drum & disc brakes, comparison, details of components, brake adjustment.

**UNIT – IV** **[ 8 Hrs. ]**

**Steering systems and Wheels materials** - Principle of steering, center point steering, steering linkages, steering geometry and wheel alignment, power steering, special steering systems. Tyres; tyres specification, factors affecting tyres performance, special tyres, wheel balancing.

**Suspension systems** - Function of spring and shock absorber, conventional and independent suspension system, telescopic shock absorber, linked suspension systems.

**UNIT – V** **[ 8 Hrs. ]**

**Electrical Systems** - Construction, operation & maintenance of batteries, alternator. working principles and operation of regulators, starter motor, battery Ignition and magneto ignition systems, ignition timing, electronic ignition, Lighting, horn, side indicator wiper, automobile air-conditioning, panel board instruments, maintenance, trouble shooting and service, procedures, overhauling, engine tune up, tools and equipment for repair and overhaul, testing equipments.

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**REFERENCE S BOOKS:**


1. Automobile Mechanics - Joseph Heitner
2. Motor Vehicle Technology - J. A. Dolan
3. Automotive Mechanics - W. H. Crouse
4. Motor Vehicle : K. Newton and W. Seeds, T. K. Gawet.
5. Automotive Mechanics – Ganeshan
6. Automobile Engineering, Kirpal Singh, Vol. I & II, Standard Publishers, New Delhi, 2002.


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| OEC-4012 | Open Elective-III<br>Applied Ergonomics (Theory) | 3L :0T :0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

Introduction and Overview of Ergonomics, areas of application, A brief history of ergonomics, sub divisions of ergonomics, What is an ergonomist, what they do, introduction to human machine system, environmental components, objectives of ergonomics, Anthropometry, Anthropometric data and analysis, Sources of human variability, human centered design principles, human centered automation.

**UNIT – II** **[ 8 Hrs. ]**

Physical Ergonomics: Introduction to Human physiology, posture and movement, musculoskeletal system, metabolism, cardiovascular system, respiratory system, muscular efforts, energy expenditure rate, work activity and energy expenditure, work physiology, anthropometric design principles, design for extreme individuals, design for adjustability, design for average user, fitting person to job and fitting job to person, Muscle Strength and Endurance, heat balance and thermoregulation.

**UNIT – III** **[ 8 Hrs. ]**

Cognitive Ergonomics: Human sensory system, perception, attention resources, memory, response selection and execution, various common cognitive tasks, cognitive Fatigue and Human Performance, design guidelines for cognitive work.

**UNIT – IV** **[ 8 Hrs. ]**

Physical Environment and its importance, visual environment and lighting, physics of the light, visibility and lighting system, Guidelines on light intensity, Guidelines on brightness differences. Auditory environment and noise, effect of noise on humans, noise factors and effects, physiological effect of noise, noise control, guidelines on noise, climate control in the work environment, heat stress and cold stress, guidelines on thermal comfort, guidelines on heat and cold, applied problems in ergonomics.

**UNIT – V** **[ 8 Hrs. ]**

Work Systems, Motion and time study, Manual work System, Worker Machine Systems, Industrial accidents and preventive measures, Human Errors, Organization Ergonomics, Biomechanics and applications of biomechanics.

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**REFERENCE S BOOKS:**


1. R. S. Bridger, "Introduction to Ergonomics", CRC Press.
2. R. S. Bridger "Introduction to Human Factors and Ergonomics" CRC Press.
3. An Introduction to Human Factors Engineering by Christopher D. Wickens
4. The practice and management of Industrial Ergonomics by David C. A.
5. Engineering Psychology and Cognitive Ergonomics (Ed. Don harris)
6. Work Systems and the Methods, Measurement, and Management of Work, by Mikell P. Groover, ISBN 0-13-140650-7. ©2007 Pearson Education, Inc., Upper Saddle River, NJ. All rights reserved.
7. https://nptel.ac.in/courses/112104222 NPTEL Course on Applied Ergonomics.


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| OEC - 4013 | Open Elective-III<br>Advance Welding Technology (Theory) | 3L : 0T : 0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**
Lectures: 3 Hours/Week

**Examination Scheme**
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

**Introduction:**

Introduction: Classification of welding processes, weld design, applications and need of advanced welding processes, solidification of weld metal, Welding terms and definitions, welding positions, elements and construction of welding symbols, welding power sources and physics of welding arc.

**UNIT – II** **[ 8 Hrs. ]**

Electron beam welding (EBW): Principle, working, key holing, power source requirements, controlling variables of EBW, applications.

Plasma arc welding (PAW): Principle, working, key holing, power source requirements, controlling variables of PAW, applications.

**UNIT – III** **[ 8 Hrs. ]**

LASER welding: Principle, parallelism and intensity, focusing, quantum theory, population inversion, types of lasing materials, working and applications.

Heat flow welding: Calculation of heat temperature, width of heat affected zone, correlation of heat input with power density, cooling rate and solidification rates, residual stresses in weld components and their measurements, weld defects and its prevention.

**UNIT – IV** **[ 8 Hrs. ]**

Ultrasonic welding: Principle, working, types, limitations and applications.

Frictions stir welding: Principle, working, types, limitations and applications.

**UNIT – V** **[ 8 Hrs. ]**

Atomic hydrogen welding: Atomic hydrogen welding system, Principle, working, atomic hydrogen flame, atomic hydrogen arc column, limitations and applications.

Under water welding: Principle, working, types, limitations and applications.

Testing of welding: Destructive and non-destructive testing methods for welds

**Text Books:**

1. Welding Technology - O. P. Khanna
2.

**Reference Books:**

1. Welding Technology - R. Little - TMH Pub.
2. Welding Manufacturing Process - Dr. Y.V. Deshmukh, P. K. Roy.
3. Manufacturing Technology - Foundry, Forming and welding by P. N. Rao, Tata McGraw Hill, 2006.

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| OEC-4014 | Open Elective-III<br>Energy Conservation and Management<br>(Theory) | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

**Energy Scenario:** Introduction, Classification of Energy, Global primary energy reserves and commercial energy production, Final energy consumption, Indian energy scenario, Sector wise energy consumption, energy needs of growing economy, Integrated energy policy, energy intensity on purchasing power parity (PPP), long term energy scenario, energy pricing, energy security, energy conservation and its importance,

**Energy Conservation Act 2001 and related policies:** Energy conservation Act 2001 and its features, Schemes of Bureau of Energy Efficiency (BEE), Electricity Act 2003, Integrated energy policy, National action plan on climate change (NPACC)

**UNIT – II** **[ 8 Hrs. ]**

**Financial Management**: Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs)

**Energy Monitoring and Targeting**: Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS)

**UNIT – III** **[ 8 Hrs. ]**

**Basics of Energy:-** introduction, Work Energy and power, electricity basics, thermal energy basics, energy units and conservations.

**Energy Management & Audit:** Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering, BEE regulation, 2008

**UNIT – IV** **[ 8 Hrs. ]**

**Energy Monitoring and Targeting:** Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques - energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS)

**Energy Efficiency in Thermal Utilities and systems:** Energy efficiency in thermal utilities like boilers, furnaces, pumps and fans , compressors, cogeneration (steam and gas turbines),

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heat exchangers ,lighting system, Motors belts and drives, refrigeration system.

**UNIT – V** **[ 8 Hrs. ]**

**Heat Recovery and Co-generation:**Heat recovery from ventilation, air co-generation of heat and electricity, heat recovery and bottoming cycles

**Energy Efficiency and Climate Change:**-Energy and Environment, Global Environment Issues, Acid rain, ozone layer depletion, Global warming and climate change and their impacts, International agreement:- UNFCCC, Intergovernmental panel on climate change (IPCC), Conference of parties (COP), Kyoto Protocol, CDM methodology and procedure, European Unions efforts to combat climate change, sustainable development

## TEXT BOOKS


1. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press
2. Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press
3. Bureau of Energy Efficiency Reference book: No.1, 2, 3 4
4. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Inter science publication
5. Energy Engineering and Management, AmlanChakrabarti, Prentice hall India 2011
6. Energy Management Principles , CB Smith, Pergamon Press, New York


## REFERENCE S BOOKS


1. Carbon Capture and Sequestration: Integrating Technology, Monitoring, and Regulation edited by, E J Wilson and D Gerard, Blackwell Publishing
2. Heating and Cooling of Buildings - Design for Efficiency, J. Krieder and A. Rabl, McGraw Hill Publication, 1994
3. Energy Management Hand Book, W. C. Turner, John Wiley and sons
4. Energy Conservation In Process Industry, W. F. Kenny


Head of Department
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| PCC-ME 4031 | Automation in Manufacturing (Laboratory) | 0L:0T:2P | 1 Credits |
|---|---|---|---|

**Teaching Scheme**

Practical: 2 Hours/Week

**Examination Scheme**

University Assessment: 25 Marks

College Assessment: 25 Marks

**LIST OF PRACTICALS:**

**Minimum Eight Experiments out of the following should be performed.**

1. Performance, Simulation on CNC Lathe.
2. Performance, Simulation of CNC Milling Machine.
3. Manual Part Programming
4. Study of Robot joints and configurations.
5. Performance, Robot operations for industrial Practices
6. Study of Flexible Manufacturing System.
7. Study of Computer Aided Process Planning System.
8. Study of Automated Guided Vehicle System
9. Study of Automated Storage and Retrieval system.
10. Study of hydraulic and Pneumatic System.
11. Study of Group Technology.

A Journal /Report on practical is required to be submitted by each Student. University Practical examination shall be of viva-voce 10 marks and Practical performance / test 15 marks.

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| PCC-ME-4032 | Computer Aided Design (Laboratory) | 0L:0T:2P | Credit - 01 |
|---|---|---|---|

**Teaching Scheme**

Practical: 2 Hours/Week

**Examination Scheme**

University Assessment: 25 Marks

College Assessment: 25 Marks

**LIST OF PRACTICALS:**

**Minimum Eight Experiments out of the following should be performed.**

1. Development of application program for DDA.
2. Development of application program for Bresenham's Line Generation Algorithm.
3. Development of application program for Bresenham's Circle Generation Algorithm
4. Development of application program for Bresenham's Ellips Generation Algorithm
5. Development of application program for Scaling, Translation and Rotation
6. Development of application program for standard reflection
7. Development of application program for clipping
8. Solution of 1D FE problems (Linear Bar) using commercial / freeware / self developed application programs.
9. Solution of 1D FE problems (Quadratic Bar) using commercial / freeware / self developed application programs
10. Solution of Truss problems using commercial / freeware / self developed application programs
11. Solution of 2D FE problems based on CST using commercial / freeware / self developed application programs

A Journal / Report on practical is required to be submitted by each Student. University Practical examination shall be of viva-voce 10 marks and Practical performance / test 15 marks.

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| PROJ-ME-403 | Project-III | 0L:0T:6P | 3 Credits |
|---|---|---|---|

| Teaching Scheme | Examination Scheme |
|---|---|
| Practical: 6 Hours/Week | College Assessment: 75 Marks |

**GUIDELINES:-**

It is intended to start the project work early in the seventh semester. It is expected to carry out the literature review/survey and design of the project work, finalize the methodology and schedule of the project.

Project batch (4-6 students) shall work on project topic under the supervision of Project guide and shall present a seminar using audio-visual aids for about 30 minutes duration. Seminar delivery shall be followed by question-answer session. A report shall be submitted at the time of end term examination.

**Evaluation Scheme:**

1. The evaluation shall be carried out on continuous basis. There shall be at least two presentations during the semester, by the students as per the progress of the work. Each of these presentations shall be evaluated in presence of supervisor and expert and accordingly graded – 15 marks.

2. Publication based on literature review / survey of selected topic – 15 marks

3. The end-term presentation shall be in presence of panel of examiners – 30 Marks

Dr. L.P. Dhole
member, BOS
Mechanical Engineering

Dr. S.W. Rajurkar
Chairman, BOS,
Mech. Engg.

Head of Department
Mechanical Engg. Dept.
Govt. College of Engg. Chandrapur

Gondwana University, Gadchiroli

Four Year Degree Course in Engineering and Technology

Course and Examination Scheme with Model AICTE Curriculum of Bachelor of Engineering

Eighth (VIII) Semester of Mechanical Engineering

| S.N. | Course Category | Corse Code | Subject | Teaching Scheme | | | | Examination Scheme | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Hrs/week | | | No of Credits | Theory | | | | | | Practical | | | |
| | | | | L | T | P | | Duration of paper (Hrs) | Max Marks | Max Marks Sessional | | Total | Min Passing | Max Marks | Max Marks | Total | Min Passing Marks |
| | | | | | | | | | ESE | MSE | IE | | | TW | POE | | |
| 1 | Professional Core Courses | PCC-ME-404 | Refrigeration and Air Conditioning | 3 | 1 | 0 | 4 | 3 | 80 | 10 | 10 | 100 | 40 | - | - | - | - |
| | Professional Core Courses | PCC-ME-405 | Design of Mechanical Drives | 3 | 0 | 0 | 3 | 3 | 80 | 10 | 10 | 100 | 40 | - | - | - | - |
| 2 | Professional Elective Courses | PEC-MEL-431-436 | Elective -IV | 3 | 0 | 0 | 3 | 3 | 80 | 10 | 10 | 100 | 40 | - | - | - | - |
| 3 | Open Elective Course | OEC-402 | Open Elective -IV | 3 | 0 | 0 | 3 | 3 | 80 | 10 | 10 | 100 | 40 | - | - | - | - |
| 4 | Professional Core Courses | PCC-ME 4061 | Thermal Engineering Laboratory-I | 0 | 0 | 2 | 1 | - | - | - | - | - | - | 25 | 25 | 50 | 25 |
| 5 | Professional Core Courses | PCC-ME 4062 | Design of Mechanical Drives | 0 | 0 | 2 | 1 | - | - | - | - | - | - | 25 | 25 | 50 | 25 |
| 6 | Project | PROJ-ME 404 | Project -IV | 0 | 0 | 6 | 3 | - | - | - | - | - | - | 75 | 75 | 150 | 75 |
| | | | Total | 12 | 1 | 10 | 18 | - | 320 | 40 | 40 | 400 | - | 125 | 125 | 250 | - |
| | | | Semester Total | 23 | | | 18 | 650 | | | | | | | | | |

**Elective-IV:-**

1. PEC-MEL-431 Engineering Tribology
2. PEC-MEL-432 Renewable Energy Sources
3. PEC-MEL-433 Finite Element Methods
4. PEC-MEL-434 Total Quality Management

**Open Elective-IV:-**

1. OEC-4021 Research Methodology and Intellectual Property Rights
2. OEC-4022 Material Handling System
3. OEC-4023 Industrial Management
4. OEC-4024 Process Planning and Cost Estimation

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Dr. L.P. Dhole
Member BOS
Mechanical Engineering

| PCC-ME-404 | Refrigeration & Air Conditioning (Theory) | 3L :1T :0P | 4 Credits |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

**Vapor Compression Refrigeration Systems:**

Refrigeration Principles, Methods, Applications, Reverse Carnot Refrigeration Cycle, Analysis of Single Vapor Compression Refrigeration Cycle, Effect of Sub cooling Superheating, Pressure Drops, Non-isentropic Compression on the Performance of cycle.

Actual vapor compression refrigeration cycle. Introduction to Multi pressure vapor compression system.

**UNIT – II** **[ 8 Hrs. ]**

**Refrigerants and System Components:**

Nomenclature of Refrigerants, Refrigerant properties, Mixture refrigerants, Global warming potential & Ozone depletion potential, Montreal & Kyoto protocol, Alternate refrigerants.

Compressors –reciprocating and rotary, Condensers, Evaporators, Expansion Devices.

**UNIT – III** **[ 8 Hrs. ]**

**Vapour Absorption, Air Cycle Refrigeration & Cryogenics:**

Vapour Absorption Refrigeration Principles, Aqua - Ammonia, Li-Br System and Three Fluid Refrigerator,

Introduction to Air Craft Refrigeration Systems, Joule – Thomson Coefficient &Inversion Curve, Introduction to Cryogenics, Methods of Liquefaction, Thermoelectric and Vortex tube Refrigeration.

**UNIT – IV** **[ 8 Hrs. ]**

**Psychrometry and Air conditioning Systems:**

Psychrometric properties of moist Air, Psychometric Chart, Psychometric processes, Concept of ADP, Bypass Factor, Air Conditioning System.

Human Comfort, Thermal exchanges of body with environment, Physiological hazards from heat, Factors Affecting Human comfort and optimum effective temperature.

**UNIT – V** **[ 8 Hrs. ]**

**Cooling Load Calculation & Air Distribution Principles:**

RSHF, GSHF, ESHF.

Various Components of cooling load, Estimation of cooling Load. Introduction to ducts, fans, Types of supply air outlets, Refrigeration and Air conditioning Controls.

## TEXT BOOKS

1. A text book of Refrigeration - R. S. Khurmi& J. K. Gupta & Air-conditioning ( S. Chand Publication)
2. Refrigeration & Air-conditioning - Dr. P. L. Ballany ( Khanna Publication )
3. Refrigeration & Air-conditioning - C. P. Arora ( TMH Publication )
4. Refrigeration & Air-conditioning - Manohar Prasad (New Age Int. Pub. )
5. Refrigeration & Air-conditioning - S.V. Domkundwar ( DhanpatRai& Sons )
6. Refrigeration & Air-conditioning - Dr. R.C.Arora (PHI)

## REFERENCE S BOOKS

1. Refrigeration & Air-conditioning - Stocker &Jones( McGraw Hill Pub. )
2. Principles of Refrigeration - Roy J. Dossat(PearsonEdu.)
3. Refrigeration & Air-conditioning - Jordon &Priester( PHT Publication )
4. Modern Refrigeration Practice - Guy R. King.
5. Modern Air-conditioning Practice - Norman Harris (McGraw Hill Publications )
6. ASHRAE hand books – Mc-Graw Hill Publication
7. Carriers Air-conditioning - McGraw Hill Publication Design data book
8. Air-conditioning Principles & System - E.G. Pita - Pearson An Energy Approach
9. Refrigeration Principles & Systems, – E.G. Pita An Energy Approach
10. Basic Refrigeration & Air-conditioning - By P.N. Ananthnarayanan - TMH Pub.

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| PCC-ME-405 | Design of Mechanical Drives (Theory) | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 10 Hrs. ]**

**Coupling**: - Types of shaft coupling, design of rigid flange coupling, flexible bush coupling

**Flywheel:** - Coefficient of fluctuation of energy and coefficient of fluctuation of speed, energy stored in flywheel, stresses in flywheel, design of flywheel.

**Bearings** :- Surface finish, friction, wear, lubrication, oil seals, design of journal bearings for radial and thrust loads, selection of ball & roller bearings for radial and thrust loads. Failures of anti friction bearing, design of hydrostatic pocket type thrust bearing such as circular step thrust bearing, bearing housing.

**UNIT – II** **[ 10 Hrs. ]**

**Flat belt drive:-** Types of belts & belt material, analysis of belt tension, condition for transmitting maximum power, design of flat belt & flat belt pulley.

**V Belt drive:-** Types of V-belt, analysis of V-belt tension, design of V-belt & pulley.

**Roller Chain drive:-** Velocity ratio, length of chain, chordal action, selection of chain, dimensions of tooth profile & sprocket.

**UNIT – III** **[ 10 Hrs. ]**

**Spur & Helical Gear drive :-** Review of kinematics of gear & terminology, interference, tooth profiles, formative number of teeth etc., Buckingham equation, design of spur gear drive, helical gear drive.

**Worm Gear Drive :-** Types & proportion of worm & worm gear, force analysis, beam strength of worm gear teeth, dynamic tooth load, wear load, thermal rating of worm gear, design of worm & worm gear.

**Bevel Gear drive:-** Types of bevel gear, proportions of bevel gear, force analysis of bevel gear drive, design of bevel gear drive.

**UNIT – IV** **[ 10 Hrs. ]**

Kinematics of friction drives such as brakes & clutches.

**Design of friction clutches**:- Design of single plate, multiple plate, cone & centrifugal clutch.

**Design of brake**: -Design of Shoe brake, band brake & internal expanding brake. Introduction to haulage system, Design of wire rope, sheave and drum. Types of motor like AC, DC, their characteristics, controls & selection of motors.

## TEXT BOOKS


1. Industrial Robotics, -- M. P. Groover, M. Weiss , R.N. Nagel, N.G. Odrey, McGraw Hill International, Koren Robotics, 1986
2. Robotic Technology & -- S. R. Deb, McGraw Hill International, 994 Flexible Automation,
3. Mechanical Design of Machines - Maleev, Hartman
4. Machine Design - P. H. Black
5. Mechanical Engineering Design - Shigley
6. Design of Machine elements - V. B. Bhandari
7. Design Data Book - B. D. Shiwalkar
8. Design Data Book - PSG
9. Machine Design - R. S. Khurmi
10. Machine Design - Pandey & Shah


## REFERENCE S BOOKS:


1. Hand Book of Machine Design - Shigley & Mischke.


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| PEC-MEL-431 | Elective -IV<br>**Engineering Tribology** (Theory) | 3L : 0T : 0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**
Lectures: 3 Hours/Week

**Examination Scheme**
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I : Introduction** [ 8 Hrs. ]

Definition of tribology, friction, wear and lubrication; importance of the tribological studies.
**Surface Topography:** Methods of assessment, measurement of surface roughness-different statistical parameters (Ra, Rz, Rmax, etc.), contact between surfaces, deformation between single and multiple asperity contact, contact theories involved

**UNIT-II: Friction** [ 8 Hrs. ]

Coulomb and Amontons laws of friction, its applicability and limitations, comparison between static, rolling and kinetic friction, friction theories, mechanical interlocking, molecular attraction, electrostatic forces and welding, shearing and ploughing, models for asperity deformation.

**UNIT – III: Lubrication** [ 8 Hrs. ]

Types of lubrication, viscosity, characteristics of fluids as lubricant, hydrodynamic lubrication, Reynold's equation, elasto-hydrodynamic lubrication: partial and mixed,
boundary lubrication, various additives, solid lubrication

**UNIT – IV : Wear** [ 8 Hrs. ]

Sliding wear: Abrasion, adhesion and galling, testing methods pin-on-disc, block-on-ring, etc., theory of sliding wear, un-lubricated wear of metals, lubricated wear of metals, fretting wear of metals, wear of ceramics and polymers.
Wearing by plastic deformation and brittle fracture. Wear by hard particles: Two-body abrasive wear, three-body abrasive wear, erosion, effects of hardness shape and size of particles.

**UNIT – V : Wear and Design** [ 8 Hrs. ]

Introduction, estimation of wear rates, the systems approach, reducing wear by changing the operating variables, effect of lubrication on sliding wear, selection of materials and surface engineering. Principles and applications of tribo design. Introduction to Rolling bearings, Fluid film lubricated bearings, marginally lubricated and dry bearings, gas bearings.

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**REFERENCE S BOOKS:**


1. M. Hutchings, "Tribology, Friction and Wear Engineering Materials", Edward Arnold, London.
2. R. C. Gunther, "Lubrication", Baily Brothers and Swinfen Limited.
3. F. T. Barwell, "Bearing Systems, Principles and Practice", Oxford University Press.
4. B. C. Majumdar, "Introduction to Tribology of Bearings", A. H. Wheeler & Co. Private Limited, Allahabad.
5. D. F. Dudley, "Theory and Practice of Lubrication for Engineers", John Willey and Sons.
6. J. Halling, "Principles of Tribology", McMillan Press Limited.
7. Cameron Alas Tair, "Basic Lubrication Theory", Wiley Eastern Limited.
8. M. J. Neale, "Tribology Handbook", Butterworth's.
9. D. D. Fuller, "Lubrication".


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| PEC-MEL-432 | Elective -IV<br>Renewable Energy Sources<br>(Theory) | 3L :0T :0P | Credit - 03 |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**UNIT – I Introduction to sustainable energy** **[8 hrs]**

Global sustainability, Green energy, Role of Energy Conservation, Economics of Energy Generation and conservation System. Geothermal energy: Availability, Geothermal sources, system development and limitations Ocean thermal energy conversion (OTEC): Methods, OTEC system, energy from tides, Scope and economics.

**UNIT – II Solar energy** **[8 hrs]**

Production and transfer of solar energy, Sun-Earth angles, Availability and limitations of solar energy, Measuring techniques and estimation of solar radiation ,Photovoltaics and Solar pond, Solar thermal collectors, Flat plate collectors .Heat transfer processes, Short term and long term collector performance, Solar concentrators – Design, analysis and performance evaluation. Applications of Solar energy.

**UNIT – III Wind energy** **[8 hrs]**

Introduction, Wind Characteristics, Principles of wind energy conversion, Site selection considerations. Types of Wind machines, Wind power plant design, Wind Farms, Operation, maintenance and economics. Energy storage, applications of Wind Energy, Environmental Aspects.

**UNIT – IV Biomass energy** **[8 hrs]**

Energy from Biomass, Biomass conversion technologies, Biogas Generation, Classification of Biogas plants, Biomass as a source of energy, thermal gasification of Biomass. Energy Storage : Mechanical Technologies, Pumped Hydroelectric storage, Compressed Air Energy Storage, Fundamentals of Battery and Fuel cells, Rechargeable Batteries, Fuel Cells and Hydrogen.

**Unit V - Direct Energy Conversion** **[8 hrs]**

Need for DEC. Carnot cycle, limitations, Principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects.

Text Books:


1. Rai G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi.
2. Thorndike E.H., "Energy and Environment- a primer for Scientist and Engineers", Wesley Publishing Company.


Reference Books:


1. Mittal K.M., "Non-conventional Energy Systems-Principles, Progress and Prospects", Wheeler Publications, New Delhi.


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2. Duffie J.A. and Beckman W.A., "Solar Energy thermal processes", John Wiley, New York.
3. Kreith F. and Kreider J.F., "Principles of Solar Engineering", Tata McGraw Hill Education (P) Ltd.
4. Ahmed, "Wind energy- Theory and Practice", PHI Learning (P) Ltd., New Delhi.
5. Kothari, "Renewable Energy Sources and Emerging Technologies", PHI Learning (P) Ltd., New Delhi

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| PEC-MEL-433 | Elective - IV<br>**Finite Element Methods** (Theory) | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 10 Hrs. ]**

Fundamentals of stress & strain, Stress & strain components, Stress strain relationship Elastic constants, Plane stress, Plane strain, Differential equation of equilibrium, Compatibility equations, Boundary conditions, Saint Venant's principle, Airy's stress function. (Only introduction is expected) Fundamental concepts of FEM - Historical background, Scope of FEM in engineering applications, Principles of minimum potential energy, Concept of virtual work, Raleigh- Ritz Method, FEM analysis procedure. Mathematical understanding required for FEM, Matrix algebra & operations, Eigen values & Eigen vectors, Methods for solution of simultaneous equations, like Gauss elimination, Matrix decomposition method. Concept of discritization of body into elements, degrees of freedom, bandwidth. Basic types of 2-D & 3-D elements, Displacement models, Convergence requirements, shape functions. Commercial FE software's.

**UNIT – II** **[ 10 Hrs. ]**

Finite element modeling & analysis using Bar & Beam elements - Stiffness matrix, Assembly, Boundary conditions, Load vector, Temperature effects. Two dimensional plane truss - Local & Global co-ordinate system, element stiffness matrix, assembly, boundary conditions, and load vector, force & stress calculations.

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**UNIT – III** **[ 10 Hrs. ]**

Two dimensional problems using CST & LST - Formulation of CST & LST elements, Elemental stiffness matrix, assembly, boundary conditions, load vector, stress calculations, temperature effect. Axi-symmetric solids subjected to axi-symmetric loading - Axi-symmetric formulation using CST ring element, stiffness matrix, boundary conditions, load vector, calculation of stresses.

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**UNIT – IV** **[ 10 Hrs. ]**

Introduction to Isoparametric & Higher order elements. Introduction to Numerical Integration. Introduction to dynamic analysis, formulation of mass matrix for one dimensional bar element, free vibration analysis using one dimensional bar element. Torsion of prismatic bars using triangular elements. Steady state one dimensional & two dimensional heat conduction problems using I-D & triangular elements respectively. Programming aspects of FEM - Algorithms for, reading Finite Element modeling data, formation of elemental stiffness matrix, formation of elemental load vector, assembly of individual elemental stiffness matrix into global stiffness matrix, assembly of individual elemental load vector into global load vector, application of boundary conditions, solution of equations, determination of stresses & strains. Pre & Post processing in FEA.

**TEXT BOOKS**


1. Introduction to Finite Elements in Engineering - Chandrupatla & Belegundu
2. Theory of Elasticity - S. P. Timoshenko
3. Concept and Applications of Finite Element Analysis - R. D. Cook.
4. The Finite Element Method - A Basic Introduction to Engineers. D. W. Griffiths, D.A. Nethercot, Granada Publishing.


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| PEC-MEL -434 | Elective-IV<br>**Total Quality Management** (Theory) | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

Introduction, Need for quality, Evolution of quality, Product quality and service quality, Basic concepts of TQM, TQM framework

Principles of Quality Management, Pioneers of TQM, Quality costs, Quality system, Customer Orientation & Satisfaction , Quality statements, customer focus

**UNIT – II** **[ 8 Hrs. ]**

TQM principles ,Leadership, Strategic quality planning, Organizational Structure, Team Building, Information Systems and Documentation–Quality Auditing, ISO 9000-QS9000.QMS, Quality circles, Recognition and Reward, Performance Appraisal; Single Vendor Concept, J.I.T., Quality Function deployment, Quality Circles, KAIZEN, SGAPOKA-YOKE, SMED, Kanban system.

**UNIT – III** **[ 8 Hrs. ]**

Six sigma manufacturing concepts, Six-sigma philosophy, Quality strategy and policy, Motivation andleadershiptheories,Continuousvs.breakthroughimprovements,Bench marking Process; Management of change, DMAIC Methodology, Lean manufacturing, FMEA- stages, types

**UNIT – IV** **[ 8 Hrs. ]**

TQM tools and techniques, Control charts, Process capability, Quality Function Development (QFD), Taguchi Methods, Taguchi quality loss function; Improvement needs, Performance measures.

**UNIT – V** **[ 8 Hrs. ]**

TQM implementation in manufacturing and service sectors, controlcharts,SPCTechniques–ProcessCapabilityAnalysis.AcceptanceSamplingProblem,SingleSamplingPlansforattributes,double, multiple and sequential sampling.

**TEXT BOOKS**


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


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3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

**REFERENCE S BOOKS:**

1. HarvidNoori and Russel, Production and Operations Management –Total Quality and Responsiveness ,McGraw Hill Inc.1995

2.. N. Logothetis, Managing for Total Quality ,Prentice Hall of India Pvt.Ltd.,1998

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| OEC-4021 | Open Elective-IV<br>Research Methodology and<br>Intellectual Property Rights (Theory) | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**
Lectures: 3 Hours/Week

**Examination Scheme**
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

**Introduction:**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Motivation and objectives of research problem. Types of Research, Research Process.

Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

**UNIT – II** **[ 8 Hrs. ]**

Effective literature studies approaches, analysis Plagiarism, and Research ethics.

Methods of Data Collection: Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection

**UNIT – III** **[ 8 Hrs. ]**

Effective technical writing, how to write report / paper, Paper Developing a Research Proposal, Research proposal and its elements,

Formulation of research problem-criteria of sources and definition,

Development of objectives and characteristics of objectives,

Development hypotheses and applications. Format of research proposal, a presentation and assessment by a review committee, Evaluation of research report.

**UNIT – IV** **[ 8 Hrs. ]**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

**UNIT – V** **[ 8 Hrs. ]**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

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**REFERENCE S BOOKS:**


1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008


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| OEC-4022 | Open Elective-IV<br>Material Handling System (Theory) | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours

University Assessment: 80 Marks

College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

Definition and Scope of materials handling, importance of materials handling, objectives and benefits of better material handling, principles and features of material handling system, systems concept, characteristics and classification of materials, principles of materials handling, unit load concept, classification of materials handling equipment.

**UNIT – II** **[ 8 Hrs. ]**

Industrial vehicles/trucks, Hand Trucks, Power Trucks, Fork Lift Trucks, Tractors, Conveyors, Belt Conveyors, Chain Conveyors, Haulage Conveyors, Cable Conveyors, Bucket Conveyors, Roller Conveyors, Screw Conveyors, Pneumatic Conveyors, Hydraulic Conveyors, HOISTING EQUIPMENT, Parts of Hoisting Equipment, Hoists, Winches, Elevators, Cranes.

**UNIT – III** **[ 8 Hrs. ]**

Bulk handling equipment and systems, Storage of Bulk Solids, Bulk Handling Equipment, robotic handling, materials handling at the workplace, robots and their classification, robotic handling applications, auxiliary equipment, gates, feeders, chutes, positioners, ball table, weighing and Control Equipment, Pallet Loader and Unloader, Organisation, Maintenance, Safety in Materials Handling

**UNIT – IV** **[ 8 Hrs. ]**

Design of Mechanical Handling Equipments:-

Design of Hoists:- Drives for hoisting, components, and hoisting mechanisms; rail traveling components and mechanisms; hoisting gear operation during transient motion; selecting the motor rating and determining breaking torque for hoisting mechanisms.

Design of Cranes:- Hand-propelled and electrically driven EOT overhead traveling cranes; Traveling mechanisms of cantilever and monorail cranes; design considerations for structures of rotary Cranes with fixed radius; fixed post and overhead traveling cranes; Stability of stationary Rotary and traveling rotary cranes.

**UNIT – V** **[ 8 Hrs. ]**

Material Handling / Warehouse Automation and Safety considerations:-

Storage and warehouse planning and design; computerized warehouse planning; Need, Factors and Indicators for consideration in warehouse automation; Levels and Means of

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Mechanizations.
Safety and design; Safety regulations and discipline.

**TEXT BOOKS:**


1. Material Handling Equipments, N. Rudenko, Peace Publishers.
2. Material Handling System Design, James M. Apple, John-Willey and Sons Publication.
3. Material Handling, John R. Immer, McGraw Hill Co. Ltd.
4. Material Handling in Machine Shops, Colin Hardi, Machinery Publication Co. Ltd.
5. Material Handling Equipment, M .P. Nexandrn, MIR Publishers.
6. Conveying Machines - Volumes I and II, Spivakovsy A.O. and Dyachkov V.K., MIR Publishers.
7. Design Data Book, PSG.
8. Introduction to Material handling Siddhartha Ray, New Age International Ltd, Publishers.


**REFERENCE BOOKS:**


1. Bulk Solid Handling, C. R. Cock and J. Mason, Leonard Hill Publication Co. Ltd.
2. Material Handling Hand Book, Kulwiac R. A., John Wiley Publication.


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| OEC-4023 | Open Elective-IV<br>**Industrial Management** (Theory) | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**
Lectures: 3 Hours/Week

**Examination Scheme**
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** [ 8 Hrs. ]

**Principles of Management:**

Meaning of management, Characteristics of management, Process of management, Levels of management, Managerial skills, Scientific management, development of scientific management, Principles of Management.

**UNIT – II** [ 8 Hrs. ]

**Functions of Management:**

Functions such as planning, organizing, leading, motivating, communicating, controlling, decision making. Each function objectives, stages, advantages & limitations, Areas of management.

**UNIT – III** [ 8 Hrs. ]

**Personnel Management:**

Meaning, functions of personnel management, manpower planning, collective bargaining, wages & salary administration, labor welfare, training, trade unions, Introduction to Industrial Factories Act, Industrial Boils Act, Trade Union Act.

**UNIT – IV** [ 8 Hrs. ]

**Marketing Management:**

Definition, Importance & scope, selling & modern concepts of marketing, market research, product launching, sales promotion, pricing, channels of distribution, advertising, market segmentation, marketing mix.

**UNIT – V** [ 8 Hrs. ]

**Financial Management:**

Sources of finance, financing organizations, types of capital, elements of costs & allocation of indirect expenses, cost control, budgets & budgetary control, balance sheet, ratio analysis, profit & loss statement.

**REFERENCE S BOOKS:**


1. Principles of Management - Koontz & O. Denial
2. Industrial Organization & - T. R. Banga & S. C. Sharma.
3. Elementary Economic Theory – Dewett K.K., Varma J.D.
4. Financial Management - Kuchal
5. Principles of Marketing Management - Philip Kotler & William Stau


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| OEC-4024 | Open Elective-IV<br>Process Planning and Cost Estimation<br>(Theory) | 3L:0T:0P | 3 Credits |
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**Teaching Scheme**

Lectures: 3 Hours/Week

**Examination Scheme**

Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

**SYLLABUS:**

**UNIT – I** **[ 8 Hrs. ]**

**Introduction of Process Planning-** Methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection.

**UNIT – II** **[ 8 Hrs. ]**

**Process planning activities-** Process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies.

**UNIT – III** **[ 8 Hrs. ]**

**Introduction to cost estimation-** Importance of costing and estimation, methods of costing, elements of cost estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost.

**UNIT – IV** **[ 8 Hrs. ]**

**Machining time estimation-** importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planing and Grinding.

**UNIT – V** **[ 8 Hrs. ]**

**Production costs-** different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost

**TEXT BOOKS**


1. Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci. & Tech. 2002.
2. Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.


**REFERENCE S BOOKS:**


1. Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley 1998.
2. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., Prentice Hall 2002.


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| PCC-ME-4061 | Thermal Engineering Laboratory-I (Laboratory) | 0L:0T:2P | Credit - 01 |
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**Teaching Scheme**

Practical: 2 Hours/Week

**Examination Scheme**

University Assessment: 25 Marks

College Assessment: 25 Marks

**LIST OF PRACTICALS:**

**Minimum Eight out of following shall be performed. (Minimum 4 each from part A and B )**

**Part-A**

1. To study / demonstration of tools and equipment used by a Refrigeration / A/C mechanic.
2. To study / demonstration of a Window Air-conditioner and Split A/C
3. To study the evacuation, dehydration and charging of a refrigeration system.
4. To determine COP of a Vapor Compression Refrigeration System
5. To determine the cooling efficiency of a Desert Cooler
6. Technical report on Industrial visit to Refrigeration and Air-conditioning application.

**Part- B**

7. Trial on reciprocating air compressor.
8. Assembly& dis-assembly of internal combustion engine.
9. Performance testing of single cylinder internal combustion engine (diesel).
10. Morse test on Multi-cylinder petrol engine.
11. Heat balance on Multi-cylinder diesel engine.
12. Demonstration on pneumatic and hydraulic circuit trainer.

A Journal / Report on practical is required to be submitted by each Student. University Practical examination shall be of viva-voce 10 marks and Practical performance / test 15 marks.

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| PCC-ME-4062 | Design of Mechanical Drives (Laboratory) | 00:00:2P | Credit - 01 |
|---|---|---|---|

**Teaching Scheme**

Practical: 2 Hours/Week

**Examination Scheme**

University Assessment: 25 Marks

College Assessment: 25 Marks

**LIST OF PRACTICALS:**

**Part-A**

**Minimum six to Eight designs out of following shall be carried out.**

1. Design of Rigid flange coupling drive / Design of Flexible bush pin coupling drive
2. Design of Flat belt drive / Design of V-Belt drive
3. Design of Chain drive
4. Design of Journal Bearing
5. Design of Spur / Helical gear drive
6. Design of Bevel gear drive / Design of Worm gear drive
7. Design of Single / Multiple plate clutch
8. Design of Cone clutch drive / Design of Centrifugal clutch drive
9. Design of Flywheel
10. Design of Wire Rope, Sheave & Drum

**Part-B**

Student shall submit one assembly design report along with the drawing for assembly / sub-assembly for any mechanical system consisting of not less than four machine element included in the syllabus.

A Journal / Report on practical is required to be submitted by each Student. University Practical examination shall be of viva-voce 10 marks and Practical performance / test 15 marks.

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| PROJ-ME-404 | Project-IV | 0L:0T:6P | 3 Credits |
|---|---|---|---|

**Teaching Scheme**

Practical: 12 Hours/Week

**Examination Scheme**

University Assessment:75 Marks

College Assessment: 75 Marks

**Course Content:**

The project work may consist of an extensive work, study, or analysis of field/industrial problems with appropriate solutions or remedies. It includes like:

1. Fabrication of model, machine, prototype based on innovative ideas.
2. Modeling and / or simulation of a system and improvements in the system.
3. Design of experiments, experimental setups, fabrication of test equipment, experimentation.
4. Statistical analysis, comparison with the existing data.
5. Renovation of machines, testing equipment and extensive analysis of some problems solved with the help of suitable software.
6. Design, modeling, analysis and so on as deemed fit.

**Evaluation Scheme for College Assessment:**

1. The evaluation shall be carried out on continuous basis. There shall be at least two presentations during the semester, by the students as per the progress of the work. Each of these presentations shall be evaluated in presence of supervisor and expert and accordingly graded – 15 marks.

2. Publication based on work carried out on selected topic – 15 marks

3. The end-term presentation shall be in presence of panel of examiners – 30 Marks

Dr. L.P. Dhole
member, BOS
Mechanical Engineering

Dr. S. H. Kolekar
BOS, Chairman,
Mech.

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