DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Basic Thermal Science
Course No.	:	ME101
Credits	:	4
Course Category	:	DC
Pre-Requisites	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid-Semester Examination (1 hour) 25% End-Semester Examination (3 hours) 60%

Course Objectives

At the end of this course the student will

1. Be able to have the basic concepts of thermal sciences and their application to in formulating the thermal engineering problems.
2. Have a good understanding of first and second laws of thermodynamics and will be in
3. A position to fully understand the analysis to be taught at the higher levels.
4. Be in a position to check the feasibility of proposed processes and cycles using the ideas of second law of thermodynamics and entropy.
5. Have the understanding of basic principles of heat transfer and related simple problems.

Course Outcomes

After taking this course the students shall be able to

1. Define the basic concepts of units and dimensions, systems(open and closed systems and control volumes) and its boundaries, properties, state, process, cycle, quasi-static process etc. required as foundation for development of principles and laws of thermodynamics
2. Develop Intuitive problem solving technique
3. Use & Practice two property rule and hence thermodynamic tables, thermodynamic diagrams and concept of equation of state, also their simple application.
4. Explain heat, work and first law of thermodynamics. Application of energy balance
5. Discuss Second law of thermodynamics and its corollaries viz. absolute (thermodynamic) temperature scale, reversibility, entropy, feasibility of a process based on first law and second law, isentropic efficiency of adiabatic machines.
6. Review introductory concept of power and refrigeration cycles. Their efficiencies and coefficients of performance.
7. Illustrate ideas of heat transfer in conduction, convection and radiation modes and Application of these concepts to heat transfer in single and combined modes.

Syllabus

Unit – I : Dimensions and units, system, boundary, types of systems and boundaries, property, cycle, thermodynamic equilibrium and quasi-static process. Pressure and its measurement, zero'th law of thermodynamics, temperature and its measurement, numerical problems.

Unit – II : Thermodynamic and mechanics, definition of work, displacement work and its expressions, engine indicator and indicated work, introduction to 2-stroke and 4-stroke engines, heat, work and heat as energy interactions, Joule's experiment & mechanical equivalent of heat, first law of thermodynamics for cyclic and non-cyclic processes, definition of energy as a property, internal

energy, enthalpy, specific heats, first law for a control volume, steady flow energy Equation (SFEE), and it's applications, numerical problems.

Unit – III : Pure substance, different phases of pure substance, two-property rule, property diagrams, tables and charts, equation of state of an ideal gas, t~τ , t~p, p~v, and p~h diagrams, phase boundaries, S-L-V region, CP and TP, dryness fraction and its measurement using throttling calorimeter, limitation of throttling calorimeter, separating & throttling calorimeter, numerical problems.

Unit – IV : Limitations of first law , heat engine, heat pump, refrigerator, second law of thermodynamics- Kelvin Planck's and Clausius statements and their equivalence, efficiency of heat engine and coefficient of performance of heat pump and refrigerator, reversible and irreversible processes, Carnot cycle and its efficiency, corollaries of second law, the thermodynamic temperature scale. Inequality of Clausius, entropy, principle of increase of entropy, isentropic process, t~s and h~s diagrams (Mollier chart), second law applications, air standard otto, diesel, dual, simple Brayton and steam power cycles (Rankine cycle), numerical problems.

Unit – V : Modes of heat transfer, Fourier's law of steady state heat conduction (one dimensional conduction), thermal conductivity and its unit, conduction through slab or plane wall, hollow cylinders and spheres conduction through composite walls and hollow cylinders and spheres with multi-layers, convective heat transfer, Newton's law of cooling, electrical analogy and overall heat transfer coefficient, combined conductive and convective heat transfer, radiation and radiation properties of surfaces, black body, emissive power, Stefan Boltzmann's law, emissivity, monochromatic emissive power and monochromatic emissivity, grey body, Kirchoff's law, Wien's displacement law, numerical problems.

Reference Books

1. Thermodynamics, An Engineering Approach by Yunus A. Cengel and Michael A Boles
2. Engineering Thermodynamics by D.B. Spalding and E. H. Cole.
3. Engineering Thermodynamics by R. Joel
4. Engineering Thermodynamics by P.K.Nag.
5. Engineering Heat Transfer by C.P.Gupta and R. Prakash.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Applied Mechanics
Course Number	:	ME111
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% MidSem Examination (1 Hour) 25% EndSem Examination (3 hours) 60%

Course Objectives

1. To give students practice in applying their knowledge of mathematics, science, and engineering and to expand this knowledge into the vast area of Applied Mechanics.
2. To enhance students' ability to design by requiring the solution of open ended problems.
3. To prepare the students for higher level courses such as courses in Mechanics of Solids, Mechanical Design and Structural Analysis.

Course Outcomes

After taking this course students should be able to

1. Classify basic engineering mechanics concepts required for predicting behavior static structures.
2. Identify an appropriate structural system to study a given problem and isolate it from its environment.
3. Model the problem using free-body diagrams and accurate equilibrium equations.
4. Identify and choose various types of loading and support conditions that act on structural systems.
5. Apply pertinent mathematical, physical and engineering mechanical principles to the system to predict the problem.
6. Communicate the solution to all problems in an organized and coherent manner and elucidate the meaning of the solution in the context of the problem.
7. Develop concepts of rigid body kinematics and dynamics with an emphasis on the modeling, analysis, and simulation of how forces produce motion of rigid body systems.
8. Determine simple dynamic variables and solve simple dynamic problems involving kinematics, energy and momentum.
9. Determine internal actions in statically determinate structures and draw internal action diagrams –Shear Force (SFD) and Bending Moment Diagrams (BMD) for these structures.

Syllabus

Unit – I : Fundamental Concepts and principles of Mechanics. Reduction of a system of forces to a force couple system, free body diagrams, equilibrium of rigid bodies in 3 dimensions, reactions, loading indeterminancy and solvability. Friction forces and laws of dry friction. Principle and application of virtual work.

Unit – II : Analysis of Multiple particle system: Application of Newton's laws, linear and angular momentum, kinetic energy and work energy principle, principle of impulse and momentum to a system of particles.

Unit – III : Translation and rotation about a fixed axis, general plane motion, absolute and relative velocity in plane motion, angular momentum of rigid body in plane motion. Problems of motion of rigid bodies and system of rigid bodies, principle of work and energy, conservation of energy for rigid body and a system of rigid bodies.

Unit – IV : Analysis of stress and strain: Mechanical properties, analysis of simple state of stress and strains, elastic constants, example of state of tension, compression and shear.

Unit – V : Bending shear and torsion: Concept of bending and shear forces in simple beams, Relationship between load, bending moment and shear force. Bending and shear stresses in simple beams, concepts of torsion in circular shafts.

Text Books

1. Beer Ferdinand P. and Johnston Jr. E Russel, Vector Mechanics of Engineering: Statics and Dynamics, Metric edition, Mc.Graw Hill, New Delhi.
2. Popov E., Engineering Mechanics of Solids, PHI, Delhi.

Reference Books

1. Merium, JL, Engineering Mechanics (Volume I and II), 3rd edition, (SI version) John Wiley and sons, Inc, NT.
2. Timoshenko S. and Young DH, Elements of strength of materials, DYNC, New York.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Engineering Graphics Lab
Course Number	:	ME193
Credits	:	2
Course Category	:	DC
Pre-Requisites(s)	:	None
Contact Hours	:	3
Type of Course	:	Lab
Course Assessment	:	Course Work 60% End-Sem Examination (2 hours) 40%

Course Objectives

1. To understand and appreciate the importance of Engineering Graphics.
2. To understand the basic principles of Technical/Engineering Drawing.
3. To understand the different steps in producing drawings according to BIS.
4. To learn basic engineering drawing formats.

Course Outcomes

After taking this course students should be able to

1. Classify the theory of plane geometric projection.
2. Narrate Plane/diagonal/isometric scales in engineering graphics.
3. Apply various concepts like dimensioning, conventions and standards related to engineering graphics in order to become professionally efficient.
4. Read and interpret drawings of simple machine parts/ sectional views in first and third angle of projection systems.
5. Explain the conventions and the methods of orthographic projection and isometric projection.
6. Improve their visualization skills so that they can propose these skills in developing new products.
7. Sketch simple machine parts in isometric projections.
8. Communicate ideas and information through engineering drawing.

Syllabus

Unit – I : Introduction to graphic language, Instruments and their use, Conventional Lines and their uses. Printing of letters and numerals, Methods of dimensioning. Construction and use of scales, Construction of cycloidal curves and involutes.

Unit – II : Necessity for orthographic projections 1st & 3rd angle methods of projection. Projection of points & lines on three coordinate planes, Projections of plane surfaces.

Unit – III : Orthographic projections of simple machine parts on different planes. Choice of view, Hidden lines, Preparation of multi view drawings. Necessity of sectional views and their drawings.

Unit – IV : Axonometric Projections. Drawing of isometric projection of simple solids; Development of surfaces of simple solids. Use and methods of drawing.

Books

1. P.S. Gill, "A Test Book of Geometrical Drg., Katson Pub. House, Ludhiana.
2. Warren J. Lucadder, "Fundamentals of Engg. Drg., Pren. Hall, N. Delhi.
3. N.D. Bhatt, Elementary Engg. Drg., Charotar Pub. House, Anand, India.

Web Links : http://nptel.iitm.ac.in/courses.php, www.cognifront.com/engdrawing.html

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Manufacturing Process Laboratory – I
Course Number	:	ME 194
Credits	:	02
Course Category	:	DC
Pre-Requisites(s)	:	None
Contact Hours	:	3
Type of Course	:	Laboratory
Course Assessment	:	Reports/Viva-Voce (60 Marks) & End Semester Examination (40 Marks)

Course Outcomes

After taking this course students should be able to

1. List various types of ferrous and non-ferrous materials used for manufacturing processes.
2. Selection of processes, based upon jobs drawings used for manufacturing.
3. Describe and distinguish hot and cold working processes.
4. List various tools applied for cold and hot working processes.
5. Classify and name machine tools required in various manufacturing processes.
6. Relate the job manufactured from practical relevance point of view.

Syllabus

1. To prepare through tennon and mortise joint.
2. To prepare a funnel of GI sheet.
3. To perform filling, drilling and tapping operations.
4. To perform electroplating.
5. Preparation of green sand mould and to perform casting process.
6. To prepare a square headed bolt.
7. To carry out gear cutting by simple indexing.
8. To prepare a single V-butt joint by arc welding and study of gas welding process.
9. To perform facing, simple turning, taper turning, threading and knurling operations on a lathe machine.
10. To perform plaining and slot cutting operations on shaper and slotter machines.

Books

1. Hajra and Chaudhary, Elements of Workshop Technology, 2010, Dhanpat Rai Publications

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Materials Science
Course Number	:	ME202
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Work	:	Course Assessment 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (3 hours) 60%

Course Outcomes

After taking this course students should be able to:

1. Summarize significance of material science and its role in manufacturing.
2. Classify different engineering material (metals, ceramics, polymers, Semi-conductor).
3. Develop concept of crystal structure and its defects.
4. Describe phase diagram and heat treatment processes.
5. Develop concept of diffusion, mechanical properties and high temperature material problems.
6. Select a material for a specific use based on consideration of cost and performance.

Syllabus:

Unit – I : Introduction Crystal Structure: Crystal, Crystal lattice, crystal system, Bravais space lattices, Types of cubic crystal, crystal directions, crystal planes, Miller indices, Interplaner spacing, planner density, imperfections in crystals-point, line, surface defects and stacking faults, Role of dislocations, grain boundaries and stacking faults on mechanical properties of materials.

Unit – II : Phase Diagrams: Allotropy of iron, Iron-carbon equilibrium diagram, TTT-diagram, types of heat treatment, Annealing, Normalizing, Hardening Tempering, Case-hardening, Surface hardening, Effect of alloying elements in steels and cast iron.

Unit – III : Diffusion in Solids: types of diffusion, Isothermal Transformation, Precipitation hardening, Age-hardening, Aluminum alloys, Brasses, Bronzes, Non-metallic materials-Glasses, Ceramics, Polymers and Composites.

Unit – IV : Mechanical Properties: Elastic and plastic deformations, Engineering stress & Engineering Strain, Relationship, Tension Test, True stress True Strain Curve, Power Curves, Instability in Tension, Effect of strain rate on flow properties, Bauschinger effect, slip by dislocation movement, strain hardening phenomenon, Y.P. Phenomenon, Strain aging effect, Fracture, Mode & types of fracture, Effect of flaw on fracture strength, Fatigue failure, fatigue test, S-N Curve, Presentation of fatigue data, Creep, Creep test, Stress rupture test, Creep Curve, Andrade's theory for creep, Presentation of creep data, ECT Curves.

Unit – V : Behaviour of Materials: Corrosion, Types of Corrosion, Mechanism of Corrosion, Oxidation, Laws of Oxidation, Techniques to Control Oxidation and Corrosion, High Temp. Corrosion,

Books

1. William D. Callister, Jr.; Materials Science & Engg.- An Introduction.
2. Gupta, K.M.; Materials Science & Engineering, Umesh Publications.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Machine Drawing and Computer Graphics
Course Number	:	ME211
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	ME213
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 35% MidSem Examination (1 Hour) 25% EndSem Examination (3 hours) 40%

Course Objectives

1. To develop the technical skills necessary to generate an engineering drawing and an engineering assembly using a modern CAD system
2. To introduce the elements of engineering communications; including graphical representation of Machines end its elements.
3. To model simple assembly drawings and prepare detailed part drawings with geometric dimensioning and tolerancing.

Course Outcomes

After taking this course students should be able to

1. Describe the theory of projections and computer graphics.
2. Apply various concepts engineering graphics like dimensioning, conventions and standards related to machine drawings in order to become professionally efficient.
3. Read and interpret assembly drawings with moderate complexity.
4. Explain the conventions and the methods of assembly drawings.
5. Develop visualization skills so that they can apply these skills in developing new products.
6. Construct simple assembly drawings and prepare detailed part drawings using CAD packages like Solid Works/ AutoCAD.
7. Communicate ideas and information through engineering drawing.

Syllabus

IS and ISO codes. Conventional representation of common features and symbols used in engineering drawing, Fasteners-screws, bolts and nuts, locking devices, assembly drawing and part drawings of simple assemblies and sub-assemblies of machines viz Couplings, Clutches, Toolpost, vises, bearing blocks, Engine components etc. Detailed part drawing from assembly drawings, Production drawings-Limits, Fits and tolerances, dimensional and geometric tolerances. Computer Aided Drafting, sketching and geometric modelling using a software package, Introduction to Solid Modeling.

Books

1. P.S. Gill; Machine Drawing, Katson Publishing House.
2. N.D. Bhatt, Machine Drawing, Charotar Book Stall, Anand, 1996
3. Goutam Pohit, Machine Drawing with AutoCAD, Pearson Education India.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Machine Design I
Course	:	ME 212
Credits	:	5
Course Category	:	DC
Pre-Requisite(s)	:	None
Contact Hours	:	5
Type of Course	:	Theory
Course Assessment	:	End Semester Examination = 60 % Mid Sem Exam+Conti. Assessment = 40%

Course Objectives

This course is designed to help students achieve the following objectives:

1. Understanding types of design and General Considerations and procedures of machine design.
2. Learning types of loading, selecting of materials and its designation.
3. Understanding Design stress & factor of safety.
4. Apply various theories of failure to design.
5. Ability to select the material and configuration of different machine elements under a variety of environmental and service conditions. These includes
   - **a.** Shafts
   - **b.** Screws, bolts and their types, power screws.
   - **c.** Belt Drives: flat and V-belt drives, Rope Drive.
6. Familiarity with analytical methods for estimating the endurance strength of machine elements.
7. Understanding failure modes of machine element
8. Ability to understand different aspects of Belt Drives.

Course Outcome

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

1. List design practices involved in considering various aspects in designing machine component.
2. Design machine elements under various loading types with various material designations.
3. Apply the knowledge of mathematics, mechanics, theory of machines, material science, etc. during solving a design problem.
4. Judge fatigue strength, construct S-N diagrams and design machine element under fluctuating loads.
5. Predict the phenomena of fatigue in parts subjected to cyclic loads and will be able to estimate and communicate
6. The fatigue strength of the component in actual working condition
7. The fluctuating loads that will cause failure in real parts using the Soderberg, Gerber and Goodman techniques.
8. Design shafts under various loading conditions.
9. Design bolted joints.
10. List different applications of power screw and design it to fulfil specific requirement, like self-locking condition.
11. Design various belt-drives according to the requirements for particular application.

Syllabus

Unit – I : Introduction: Types of design, General considerations and procedures of machine design, Types of loading, selection of materials and its designation, Design stress & factor of safety, selection of F.S. Application of theories of failure to design.

Unit – II : Design for fatigue strength; S-N diagrams, Low & High Cycle fatigue, Endurance limit modifying factors, Fatigue strength under fluctuating stresses, Cumulative damage, surface strength.

Unit – III : Design of solid and hollow shafts subjected to torsion, bending and axial load for strength and stiffness. Shafts subjected to dynamic loading, Design of Keys, Splines, pins, cutters and shaft couplings.

Unit – IV : Screws, bolts and their types, bolted joints including eccentrically loaded joint, riveted joint and power screws.

Unit – V : Belt Drives: flat and V-belt drives, effect of centrifugal tension, initial tension, maximum power, Design of flat and V-belt, design of ropes.

Books

1. Joseph E. Shigley; Mechanical Engineering Design, McGraw Hill.
2. M.F. Spott; Design of Machine Element, Prentice Hall.
3. Sharma & Aggarwal; Machine Design, Katria Publications.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Mechanics of Solids
Course Number	:	ME213
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	ME111, AM111, AM112
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid-Semester Examination (1 Hour) 25% End-Semester Examination (3 hours) 60%

Course Objectives

1. To gain a fundamental understanding of the concepts of stress and strain by analysis of solids and structures.
2. To study engineering properties of materials, force-deformation, and stress-strain relationship
3. To learn fundamental principles of equilibrium, compatibility, and force-deformation relationship, and principle of superposition in linear solids and structures
4. To analyze determinate and indeterminate axial members, torsional members, and beams to determine axial forces, torque, shear forces, and bending moments.

Course Outcomes

After taking this course students should be able to

1. Solve the problems related to the theory of elasticity, concepts of stress and strain, strength and stiffness, deformations and displacements, strain energy, and load carrying capacity.
2. List different materials and structural elements to the analysis of simple structures;
3. Identify and formulate the structural problem and solve using a range of analytical methods.
4. Predict the behaviour of the solid bodies subjected to various types of loading.
5. Design machine elements using theories of deformable bodies.

Syllabus

Unit – I : Stress at a point, Stress tensor and its properties, Equilibrium equations (Cartesian & Polar Co-ordinates), Principal stresses, Strain tensor and its measurements, Strain rosettes.

Unit – II : Compatibility equations, Generalized Hooke's Law and constituting equations, two dimensional elasticity, rotating discs. Disc of uniform strength, Rotating Ring.

Unit – III : Thin cylinders and spherical shells, Cylindrical vessel with hemispherical ends, Wire wound barrels, Lame's Theory, Thick Cylinder, Compound Cylinder, Force Fit.

Unit – IV : Shear Force and Bending moment in simple statically indeterminate beams, Moment Area Theorem, Three moment Theorem, Double integration method, Deflection in fixed and continuous beams.

Unit – V : Strain energy in tension, shear, bending and torsion, Castigliano's and Maxwell's Theorems, Deflection of straight and think curved beams using strain energy, Buckling, Euler's Theory, Empirical Formulae.

Books

1. Popov, E.P. Engg. Mechanics of Solids, PHI Ltd.
2. Kazmi, S.M.A., Solid Mechanics, Tata McGraw Hills.
3. Hearn, E.J.; Mechanics of Materials – Vol- I & II, Pergamon Press

Web Links : http://nptel.iitm.ac.in/courses.php

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Manufacturing Technology-I
Course Number	:	ME214
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	ME194
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Quiz Tests 10% Course Work 5% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives:

1. To equip the graduates with knowledge of the fundamental techniques to manufacture an engineering component.
2. To equip the graduates with the knowledge to manufacture engineering components through foundry, metal forming, welding, non-conventional machining and powder metallurgy techniques.
3. To prepare graduates with a solid foundation to investigate and develop a methodology and establish a manufacturing sequence to fabricate engineering components.
4. To prepare the graduates to find the probable routes to manufacture a particular engineering component.
5. To prepare the graduates to selected the most economical route to fabricate the required engineering component.

Course Outcomes

After taking this course the students should be able to

1. Employ fundamental techniques to manufacture an engineering component.
2. Manufacture engineering components through foundry, metal forming, welding, non-conventional machining and powder metallurgy techniques.
3. Investigate and develop a methodology and establish a manufacturing sequence to fabricate engineering components.
4. Find the probable routes to manufacture a particular engineering component.
5. Selected the most economical route to fabricate the required engineering component.

Syllabus

Unit – I : **Metal casting:** Casting processes, pattern Making, Moulds and cores, Solidification, Casting Inspection and defects, Casting Design and Economics

Unit – II : **Metal Joining:** Fusion and non-fusion welding processes, metallurgy of welding, weld design, testing welded joints, welding defects, soldering, brazing, adhesive bonding and mechanical fastening.

Unit – III : **Metal Working:** Plastic deformation mechanisms, yield criteria, Hot and Cold working processes-rolling, forging, extrusion and drawing, shear metal working, punching, blanking, bending, deep drawing, coining and spinning.

Unit – IV : **Powder Metallurgy:** Production of metal powders, compaction, sintering and finishing operations, Selective laser sintering, Non-traditional machining processes.

Unit – V : **Forming, Shaping Plastics & Composites:** Extrusion, Injection moulding, Blow and rotational Moulding, thermoforming, casting, processing of elastomers and reinforced plastics, Design Consideration, Rapid prototyping, forming and shaping of ceramics and glass

Books

1. Manufacturing Science, A. Ghosh and A.K. Mallick, East-West Press Private Limited.
2. Manufacturing Processes for Engineering Materials, S. Kalpakjain, Addission-Wesley Publishing Company.
3. Manufacturing Engineering and Technology, S. Kalpakjain and S.R. Schmid, Pearson Education.
4. Production Engineering Sciences, P.C. Pandey And C.K. Singh, Standard Publishers Distributors, Nai Sarak, New Delhi.
5. Introduction to Manufacturing Processes, J.A. Schey, McGraw Hills.
6. Fundamentals of Metal Cutting and Machine Tools, B.L. Juneja, G.S. Sekhon, New Age International Private Limited.
7. Materials and Processes in Manufacturing, E.P. Degarmo. J.T. Black and R.A. Kohser, Prentice- Hall of India.
8. Modern Machining Processes, Pandey and Shah, Tata McGraw Hill.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Kinematics and Design of Machines
Course No.	:	ME215
Credits	:	04
Course Category	:	DC
Pre-requisites(s)	:	ME213
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 Hours) 60%

Course Objectives

1. Understanding the motion of the component and the basic geometry of the mechanisms.
2. The kinematics of machines deals with the motion of members of the mechanisms which includes the determination of velocities and acceleration of the machine members.
3. Understanding the process and methods of design of machines and elements.
4. Abilities of developing equations pertaining to the design of machines.
5. Knowledge of different materials and their properties for designing the components of machine elements.
6. Ability to design new machines or modify existing machine according to the need.

Course Outcomes

After taking this course students should be able to

1. Classify different types of links and mechanisms used for different purposes in different machines.
2. Solve the forces, velocities and accelerations in different mechanisms and machines components
3. List, Predict and Design different type of links applied to get the required motion of different types of the parts of machines
4. Prepare for the engineering challenges regarding human needs in daily life about machines and systems which are possible due to the design of machines.
5. Propose the processes, methods and develop equations and relations pertaining to the design of machines and machine elements.
6. Recognize different materials, their properties as well as their applications.
7. Select the Standards used in the design of machine elements.

Syllabus

Unit – I : Link, Pair 7 kinematic chain, constrained criterion, Mechanism, Four link planer mechanisms and its inversion, Simple mechanism (straight line motion mechanism, Pantograph, Engine indicator, Hook's joint and steering gear mechanism)

Unit – II : Velocity analysis in mechanism, relative velocity method, Instantaneous centre method, Acceleration analysis in mechanism, Graphical method, problem involving Corriolis acceleration, Klien's construction, velocity and acceleration, Analysis in simple mechanism by analytical method.

Unit – III : Gear drives, introduction, classification of gear, gear nomenclature, tooth profile, interference on involute gears, path of contact, arc of contact of meshing gears, gear train, simple, compound and epicyclic gear trains.

Unit – IV : **(a)** Introduction, type of design, general considerations and procedures of machine design, types of loadings, selection of materials and its designations, design stress and factor of safety, selection of factor of safety, application of theories of failures to design.

(b) Design for fatigue strength, S-N diagrams, Low cycle fatigue and high cycle fatigue, Endurance limit, modifying factors, fatigue strength under fluctuating stresses, cumulative damage and surface strength

Unit – V : Screws, Bolts and their types, bolted joins including eccentrically loaded joints, Riveted joints and power screws.

Books

1. Joseph E. Shigley; Mechanical Engineering Design, McGraw Hill.
2. M.F. Spott; Design of Machine Element, Prentice Hall.
3. Hall, Holowenko & Laughner; theory & Problems of Machine Design, McGraw Hill.
4. R.s. Khurmi & J.K. Gupta; A Text Book of Machine Design, Eurasia Pub.
5. Mahadevan & Reddy; Design Data Hand Book, CBS Publishers, Delhi.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Experimental Methods and Analyses
Course Number	:	ME220
Credits	:	4
Course Category	:	BS
Pre-Requisites(s)	:	-
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% MidSem Examination (1 Hour) 25% EndSem Examination (3 hours) 60%

Course Objectives

1. To understand the principles of measurement systems and the methods of measuring & analysing physical parameters.
2. The students must be able to analyse the experimental data through class lectures/tutorials and assignments.
3. Analytical methods and principles learned in this courses will be applied to further laboratory and theory courses in forthcoming semesters, higher studies, and experimental studies and also very useful for Industrial applications in measurement and quality control.

Course Outcomes

After taking this course the students should be able to

1. Summarize discrete data graphically and compute measures of centrality and dispersion.
2. Detect Experimental errors and error analysis; general considerations in data analysis; uncertainty analysis; Accuracy and precision.
3. Compute probabilities and conditional probability.
4. Construct the probability distribution of a random variable, based on a real-life problems, and use it to compute expectation and variance.
5. Compute probabilities based on industrial applications using the binomial, poisson and normal distributions.
6. Use normal distribution to test statistical hypotheses and to compute confidence intervals using sampling distributions e.g. Z-distribution, t-distribution, χ^2-distribtuion, f-distribution.
7. Develop generalised measurement system principles and calibration procedures.
8. Predict generalised performance characteristics of instruments; behaviour of measurement systems: zero, first and second order systems.
9. Identify and model, first and second order systems for various input signals
10. List important transducers, signal processing elements and data presentation elements.
11. Define physical principles of specialised instruments for measuring important variables such as temperature, pressure, flow, displacement, force, power and strain.

Syllabus

Unit – I : Basic concepts of measurement: sensitivity, accuracy, precision, calibration etc.
Experimental errors-types, Uncertainty analysis, Problems.
Measure of central tendency dispersion.
Review of basic probability concepts, mathematical expectation.
Discrete and continuous random variables, probability density function, CDF.
Binomial, Poisson and Normal distributions and their applications.
Checking data for normality.

Unit – II : Sampling distribution, Central Limit Theorem, t- distribution, χ^2- distribution and F-distributions
Estimation problems, confidence and significance level.
Point and interval estimation of mean and variance.
Hypothesis testing based on mean and variances.

Unit – III : Linear Regression analyses, Curve fitting, Methods of least square, and its validity using ANOVA.
Coefficient of determination.
Correlation analyses.

Unit – IV : Generalized Measurement System principles: Functional elements, classification.
Performance characteristics of measurement systems:
- Static characteristics, impedance loading effects.
- Dynamic characteristics: Mathematical model of measurement systems, Operational Transfer functions, System response of zero, first and second order instruments.

Unit – V : Transducers
Signal conditioning elements
Data presentation elements

Unit VI : Measuring instruments: Methods and Applications
- Temperature measurement
- Pressure measurement
- Flow and level measurement
- Force, strain and torque measurement

Books

1. Nakra, B. C., and Chaudhury, K. K., " Instrumentation, Measurement and Analysis:, Tata McGraw Hill
2. Holman, J. P., "Experimental Methods for Engineers" 7th Edition, McGraw Hill
3. Doebelin, E.O. "Measurement Systems - Application and Design", 5th Edition, Tata McGraw Hill.
4. Walpole, R. E., Myers, R. L., Myers, S. L. and Ye K., "Probability and statistics for engineers and scientists", Pearson Education
5. Johnson, R.A., "Probability and Statistics for Engineers", PHI.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Applied Thermodynamics
Course Number	:	ME221
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	ME101, AM111, AM112
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (3 hours) 60%

Course Objectives

1. To create the basic awareness for applying the concepts of thermodynamics in processes used in different industrial applications.

Course Outcomes

After taking this course students should be able to

1. Define various concepts of thermodynamics.
2. Apply concepts of thermodynamics for evaluating the properties of fluids used in various industrial systems such as Mechanical Power Production by using engines, air conditioning and refrigeration.
3. Demonstrate and conduct experiments, interpret and analyze data and report results.
4. Design a thermal system or a process that meets desired specifications and requirements.
5. Identify, formulate and solve thermal engineering problems.

Syllabus

Unit – I : Thermodynamic Relations: Maxwell relations, Clapeyron equations, Relations involving enthalpy, internal energy and entropy; Relations involving specific heat; volume expansivity and isothermal and adiabatic compressibility, ideal gas, behavior of real gases, Joule-Thomson coefficient, equations of state, generalized chart for changes of enthalpy at constant temperature, fugacity and generalized fugacity chart, generalized chart for changes of entropy at constant temperature.

Unit – II : Non reactive mixtures: Mixtures of ideal gases, mixtures involving gases and vapors, first law applied to gas-vapor mixtures, adiabatic saturation process, wet-bulb and dry-bulb temperatures, psychrometric chart, psychrometric processes.

Unit – III : Refrigeration: Reversed Carnot, vapor compression and air refrigeration cycle analysis; vapor absorption cycle; refrigerants; domestic refrigerators.

Unit – IV : Thermodynamic cycles: Analysis of Carnot cycle, Otto cycle, Diesel cycle, Dual combustion cycle, Ericsson and Stirling cycles, Brayton cycle, Rankine cycle.

Unit – V : Compressors: Classification, reciprocating and rotary compressors, volumetric efficiency, multistage compression, calculation of cylinder dimensions, axial flow and centrifugal compressors.

Text Book

1. Van Wylen and Sonntag; Fundamentals of Classical Thermodynamics; Wiley International

Reference Books

1. Moran and Shapiro; Engineering Thermodynamics; Wiley International
2. Yunus Cengel; Engineering Thermodynamics; Tata Mc-graw Hill
3. Arora C.P.; Refrigeration and Air Conditioning; Tata Mc-graw Hill
4. Eastop and McConkey; Applied Thermodynamics; Pearson Education Asia

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Fluid Mechanics I
Course Number	:	ME231
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	ME111, AM111, AM112
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. To develop a concept of fluid and an understanding of Continuum model of fluid motion
2. Development of basic concepts of continuum mechanics like localized force distributions, Eulerian and Lagrangian frames of reference, Field and Material derivatives.
3. Development of principles of fluid statics and their applications.
4. To provide knowledge of kinematic aspects of fluid motion and basic methods of flow visualization.
5. Development of tools for analysis of fluid motions using Finite Control Volume approach.
6. To provide basic knowledge of incompressible flow in circular pipes and exposure to design problems involving piping systems.
7. To develop basic concepts of compressible flow and development of Quasi-1D isentropic flow theory for variable area flow passages.
8. Analysis of Normal Shock waves.

Course Outcomes

After taking this course students should be able to

1. Generate mathematical models of fluid motion including steady and unsteady flow.
2. Recite fluid properties and fluid statics.
3. State and visualize fluid kinematics.
4. Predict and design a fluid dynamical system based on inviscid theory.
5. Design piping systems and network
6. Model compressible flow systems like nozzle & diffusers.

Syllabus

Unit – I : Fluid Properties & Fluid Statics: Units & Dimensions, Dimensional Analysis, Significance of non-dimensional numbers as applied to Fluid Mech. Fluid as continuum, Incompressible and compressible Fluids, Stress at a point, Newton's Law of viscosity, Newtonian Fluids, Thermodynamic/ Hydrodynamic pressure, Manometers, Hydro-static forces on submerged plane and curved surfaces, Rigid body motion of fluid.

Unit – II : Fluid Kinematics: Eulerian & Lagrangian description of fluid motion, Velocity & Acceleration, Stream Line, Path Line and Streak Line, 2-D Stream Function in Cartesian & Polar Coordinates, Translation, Vorticity & Angular Velocity, Irrotational Flow, Circulation, Velocity Potential, Relationship between stream function & velocity potential for 2-D potential flows, Flow classification.

Unit – III : Fluid Dynamics: System & Control Volume, Basic & subsidiary Laws, Transport Theorem (no proof), Laws of conservation of mass, momentum & Energy; Integral & Differential Approaches,

Euler's & Bernoulli's Equations, Bernoulli's Equation for Steady Flow of an incompressible Fluid, Applications.

Unit – IV : Pipe Flow: Laminar & turbulent Flows; Friction Factor, Moody's Diagram, Energy Losses through Pipes, Bends & Pipe Fittings; Velocity Distributions in Pipes; Power Transmission through Pipes; Constriction Meters, Pitot & Pitot-Static tubes.

Unit – V : 1-D Steady Compressible Flow:Velocity of sound, Isentropic flow, Stagnation & Critical Conditions, Reference Velocities, Area ratio as a Function of Mach. No., Mass flow rate, Flow through nozzles and Diffusers

Books:

1. Fundamentals of Fluid Mechanics, FM White, McGraw Hills, 6Ed
2. Modern Compressible Flow with Historical Perspective, JD Anderson Jr., 2nd Ed., McGraw Hills, 1990.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Machine Drawing and Computer Graphics
Course Number	:	ME294
Credits	:	2
Course Category	:	DC
Pre-Requisites(s)	:	None
Contact Hours	:	3
Type of Course	:	Practical
Course Assessment	:	Course Work 60% End Sem. Examination (2 hours) 40%

Course Objectives

1. Conventions and symbols as per ISI recommendations.
2. Assembly and sub-assembly drawings of machines.
3. Model simple assemblies and sub-assemblies of machine parts.
4. Sharpen creative skills in developing new ideas.
5. Improve communication skills through technical drawings.

Course Outcomes

At the completion of the course, the students shall be able to

1. Describe conventions, symbols and standards used in engineering drawing as per ISI recommendations.
2. State the importance of mechanical design of machine parts.
3. Construct part and assembly drawings of different machines assemblies and sub-assemblies.
4. Use CADD packages like AutoCAD/Solid Works.
5. Sketch simple assemblies and sub-assemblies of machine parts and prepare part and assembly drawings using soft packages.
6. Visualize and sharpen their creativity skills in developing new ideas efficiently.
7. Improve their communication skills through technical drawings of machine assemblies as a design engineer.

Syllabus

Unit – I : Conventions and symbols used in engineering drawing as per ISI recommendation. Assembly and Part drawings of simple assemblies and sub-assemblies of machines viz. Couplings, clutches, tool post, engine components etc.

Unit – II : Introduction to computer graphics. Solid modelling, Computer aided design and drafting (CADD), Overall organization of CAD software; Drawing, editing, printing, dimensioning commands for 2-D drafting, Basics concepts of 3-D CAD.

Books

1. P. S. Gill, Machine Drawing, Katson Publishing House
2. N. Sideshwar, P. Kannaih and V. V. Sastry, Machine Drawing, Tata McGraw
3. R. W. Leigh, Auto CAD Concise Guide to Command Features, Galgotia Publications
4. Tom W. Berghauser, The illustrated auto CAD Book

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Manufacturing Technology Lab. – I
Course Number	:	ME295
Credits	:	02
Course Category	:	DC
Pre-Requisites(s)	:	ME194
Contact Hours	:	3
Type of Course	:	Lab
Course Assessment	:	Course Work 60% End Semester Examination (2 hours) 40%

Course Objectives

1. Students will be able to know manufacturing of sheet metal components with the help of different types of mechanical presses and dies.
2. Impart knowledge of making molds and composition of green sand moulds and its properties in sand mould casting.
3. To have a knowledge of microstructure and its impact on mechanical properties of metals and alloys.

Course Outcomes

After taking this course students should be able to

1. Describe effects of the properties of green sand Grain size, clay content, moisture content, compressive strength, shear strength, ramming effect, permeability, etc.
2. Define application of different types of welding processes and feasibility of that process in individual work.
3. List welding defects during welding and find remedies of these defects.
4. List different operations in sheet metal like shearing, deep drawing and design methods for reducing operation cost, production cost, time, wastage, by using compound dies and use of simple die progressive die, and transfer die and clearance between die and punch used in sheet metal industries.
5. Identify unknown metals and then use appropriate tool for required cutting and machining operations.
6. Learn methods of determination of hardness for materials used in lab and industry.
7. Predict the behavior and performance of metals and understanding the alloy making process by the help of visualization of microstructure of different ferrous and non-ferrous metals and alloys.
8. Conduct tensile test to determine the mechanical properties of engineering materials.

Syllabus:

1) To study ramming effect on the physical properties of green moulding sand by varying ramming intensity and keeping other parameter constant. To draw a graph between no. of rams verses green compressive strength, green shear strength and green permeability.
2) To study the variation in hardness of hand rammed and machine rammed moulds and to compute mean, standard deviation, mean hardness value and permissible limit .To draw frequency curve.
3) To determine the following

    a) Clay content,
    b) Moisture content and
    c) Silica particles. In the sample of green sanding moulds.

4) a) To find out the cumulative percentage related with the help of sieve shaker and then find grain fineness number.
    (b) Determine shatter index with the help of shatter index tester.

5. Study of various welded joints and arc welding processes.
6. Study of gas welding and gas cutting processes and equipment.
7. Study of TIG/MIG and resistance welding.
8. Study of welding defects.
9. Study of various type of presses used for fabrication of sheet metal.
10. Study of press working tools-simple, compound, and progressive & transfer dies etc.
11. Study of various sheet metal fabrication processes – shearing, bending, deep drawing etc.
12. Identification of ferrous material by spark test.
13. Study of various methods of metal hardness determination. Hardness determination by Brinell method.
14. Study of micro structure of ferrous and non-ferrous alloys.
15. Study of tensile properties of plane carbon steel like stress strain curve, yield point phenomenon, offset yield strength, condition of necking, ductility measures, toughness.

Books:

1. Manufacturing Science, A. Ghosh and A.K. Mallick, East-West Press Private Limited.
2. Manufacturing Processes for Engineering Materials, S. Kalpakjain, Addission-Wesley Publishing Company.
3. Manufacturing Engineering and Technology, S. Kalpakjain and S.R. Schmid, Pearson Education.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Thermodynamics Lab.
Course Number	:	ME296
Credits	:	2
Course Category	:	Practical Course
Pre-Requisites(s)	:	ME101, ME221,
Contact Hours	:	3
Type of Course	:	DC
Course Assessment	:	Course Work 60% End Semester Exam (2 hours) 40%

Course Objectives

1. To give students the understanding of the working of different components of steam power plant and the thermodynamic cycle on which it works.
2. To equip students with the knowledge of the initiation of combustion in Internal Combustion Engines, their classification, basic operating cycle and the functioning of various parts like carburetor and fuel injection pump.
3. Definition of absolute and relative humidities and the representation of psychrometric processes on T-s diagram.
4. Making students understand the working of a reversed heat engine (both refrigerator and heat pump).
5. Differentiate between various types of cooling towers and analyse their working.
6. Explanation of the working of reciprocating air compressor (single and two stage) and related concepts like volumetric efficiency, mechanical efficiency.
7. To study the flame structure of premixed flames and generate temperature profiles.
8. Understanding the working of a centrifugal blower.
9. The importance of the bypass factor in air conditioning processes.

Course Outcomes

After taking this course the students should be able to

1. Explain the working of Steam power plant.
2. Distinguish between S.I/C.I, Two- stroke and Four-stroke Internal Combustion Engines.
3. Estimate relative humidity using adiabatic saturator and compare different Hygrometers.
4. Calculate Coefficient of Performance of Vapour compression refrigeration system for Reversed Carnot, Ideal and Actual cycles.
5. Explain the working and estimate the heat transfer rates in a forced draft cooling tower.
6. Determine volumetric efficiency of Two Stage reciprocating Air Compressor.
7. Draw and analyse Temperature profiles of a premixed LPG flame.
8. Solve adiabatic efficiency and draw performance characteristics of a Centrifugal Blower.
9. Calculate the By-pass factor of cooling and heating coils.

Syllabus

Rotor – I
1. Study of Steam Power Plant.
2. Comparative study of two-stroke and four-stroke I.C. Engines.
3. Measurement of relative humidity by adiabatic saturator and comparison of result with other hygrometers.

Rotor – II
1. Measurement of actual and theoretical COP of a vapour compression refrigeration system. To study the cooling and heating processes in the forced draft cooling tower and estimate the rate of heat transfer and evaporation rate of water.
2. Determination of volumetric efficiency of a two stage reciprocating air Compressor.

Rotor – III
1. To draw temperature profiles of a premixed LPG flame.
2. Determination of characteristics of a centrifugal blower.
3. To determine the bypass factor of cooling and heating coils of unit air conditioner.

Books:

1. Holman, J. P., "Experimental Methods for Engineers" 7th Edition, McGraw Hill
2. PK Nag, "Power Plant Engineering" , Tata McGraw Hill
3. Eastop and McConkey, Applied Thermodynamics for Engineering Technologist, Pearson Education Asia, 2003
4. CP Arora, Refrigiration and Air Conditioning, Tata McGraw Hill
5. Obert EF, IC Engine and Air Pollution, Tata McGraw Hill
6. SR Turns, Introduction to Combustion, McGraw Hill

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Fluid Mechanics Lab.
Course Number	:	ME297
Credits	:	2
Course Category	:	Practical Course
Pre-Requisites(s)	:	ME231
Contact Hours	:	3
Type of Course	:	DC
Course Assessment	:	Course Work 60% End Semester Exam (2 hours) 40%

Course Objectives

1. Develop the concept of between velocity and peizometric head are related to each other.
2. Develop the concept of friction in fluids and its impact on design of piping systems.
3. Basic knowledge of different piping system component design.
4. Basic knowledge of pressure inside bends.
5. Develop understanding and use of different flow measurement devices.

Course Outcomes

After taking this course students should be able to

1. Design piping system and its components.
2. Evaluate and compare different flow meters.
3. Predict losses in various fluid dynamical systems.
4. Explain the role of pressure as a driving force.
5. Calibration of flow meters.

Syllabus

1. To verify Bernoulli's Theorem in a non-circular duct.
2. To determine friction factor for a horizontal commercial pipe of uniform section.
3. To determine the head loss coefficient due to sudden expansion and sudden contraction.
4. To calibrate the given venturi-meter.
5. To compare loss of head through different bends.
6. To determine the vane coefficient of flat plate due to water jet impinging on it based on linear momentum principle.
7. To establish pressure distribution along the wall of 90^{o} rectangular bends for air flow through it.
8. To calibrate the given bend meter.

Books:

1. Fundamentals of Fluid Mechanics, FM White, McGraw Hills, 6Ed
2. Holman, J. P., "Experimental Methods for Engineers" 7^{th} Edition, McGraw Hill

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Machinery Dynamics
Course Number	:	ME315
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	ME213
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. Students become familiar with kinematic linkages their types, utility and shapes for various applications.
2. To know about the degrees of freedom for a particular combination of linkages.
3. To be able to analyse the motion, velocity and related parameter for simple planar mechanisms.

Course Outcomes

After taking this course students should be able to

1. Describe common planar mechanisms and transmission of the forces at different points of the components of the mechanism.
2. Design planar mechanisms for specific application.
3. Perform the force analysis of the linkages like slider-crank, four-bar mechanisms etc.
4. Explain the methods of transformation of mechanical power and energy through different types of machine elements, like gear, cam and shaft.
5. Predict and simulate an existing mechanism.
6. Apply scientific theories and laws in designing the control of the fluctuation of speed of the engines for making the system more effective to sustain in real working conditions.
7. Design better mechanical system utilising the concept of gyroscopic couple and improving the existing one according to the need and changes in requirements.

Syllabus

Unit 1: Force analysis in Mechanism: Static and Dynamic force analysis in mechanisms, Inertia force and equivalent Dynamic System problems involving Corioli's acceleration.
Unit 2: Dynamics of reciprocating engines, Piston force and crank effort, Turning moment diagram, Fluctuation of energy and speed, Selection of Flywheel.
Unit 3: Balancing: Static and dynamic balancing of revolving masses in one and different plane, balancing of reciprocating masses, balancing of V-Engine, in–line and radial I.C. Engine, Balancing Machines.
Unit 4: Types of Cams and followers, Motion analysis of followers, Graphical construction of cam profiles for different followers, Pressure angle and Cam size, motion analysis of cams with specified contour. Gyroscope: Gyroscopic forces and couples, Gyroscopic stabilization of aeroplane and ships, Stability of four-wheel drive, Stability of a two wheeler.
Unit 5: Governors: Types of Governors, analysis of governors. Stability Effort, Power, Sensitivity of governors and controlling forces.

Books:

1. JS Rao: Theory of Machine, McGraw Hill
2. SS Rattan: Theory of Machine, Tata McGraw Hill

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Machine Design
Course No.	:	ME 316/317
Credits	:	04
Course Category	:	DC
Pre-requisites(s)	:	ME213
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Sem. Examination (1 Hour) 25% End Sem. Examination (3 Hours) 60%

Course Objectives

1. Understanding the motion of the component and the basic geometry of the mechanisms.
2. The kinematics of machines deals with the motion of members of the mechanisms which includes the determination of velocities and acceleration of the machine members.
3. Understanding the process and methods of design of machines and elements.
4. Abilities of developing equations pertaining to the design of machines.
5. Knowledge of different materials and their properties for designing the components of machine elements.
6. Ability to design new machines or modify existing machine according to the need.

Course Outcomes

After taking this course students should be able to

1. Apply the knowledge of Mathematics, Science and Engineering for designing machine part.
2. Propose the Engineering solutions for global progress, productivity and economic development.
3. List the materials and variety of mechanical components available/used to produce every day goods and services.
4. Identify and solve the engineering challenges regarding the human needs in daily life about machines and systems.
5. List the processes and methods of design of machines and elements.
6. Develop equations and relations pertaining to the design of machines
7. Develop fundamental knowledge of the Standards used in the design of machine elements
8. Design component, machine, workstation and systems etc. for safe working by minimizing accidents and other health hazards.
9. List and define functionality of various parts used in Automobiles, working principles and their design which include brakes, Gears, Clutches, and Springs etc.
10. List different materials and state their properties
11. Design new machines or modify the existing machines according to the need, also use the techniques, skills and modern engineering tools for engineering practice.
12. Communicate effectively through written and oral skills.

Syllabus

Unit – I : (a) Introduction: Problems in Engineering Design, Division of Design Project, testing models, patents and agreements.

(b) Welded Joints: Types of Welded connections, Design of Simple and eccentrically loaded welded connections.

Unit – II : Bearings & Lubrication: Types and laws of friction, Types of Lubrication Hydrodynamic and Hydrostatic bearings, Ball and Roller bearings, Method of load estimation and Selection of bearings.

Unit – III : Clutches & Brakes: Plate, Cone and Centrifugal Clutches, Shoe and Band Brakes, Calculation of Heat Generation.

Unit – IV : Springs: Design of helical springs subjected to static and dynamic loads, design of torsion and leaf springs, elementary idea of rubber springs.

Unit – V : Power Transmission with Toothed Gears: Selection of Gears and Gear Materials, Tooth Forces, Design of Spur, Helical, Bevel and Worm Gears.

Books

1. Joseph E. Shigley; Mechanical Engineering Design, McGraw Hill.
2. M.F. Spott; Design of Machine Element, Prentice Hall.
3. Hall, Holowenko & Laughner; theory & Problems of Machine Design, McGraw Hill.
4. R.s. Khurmi & J.K. Gupta; A Text Book of Machine Design, Eurasia Pub.
5. Mahadevan & Reddy; Design Data Hand Book, CBS Publishers, Delhi.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Energy Conversion Systems
Course Number	:	ME322
Credits	:	4
Course Category	:	DC
Pre-requisites	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15%, Mid Semester Exam (1 Hour) 25%, End Semester Exam (3 Hours) 60%

Course Objectives

1. Understand basic knowledge of the phenomena of Combustion.
2. Grasp the working of Thermal Power Plant and its Cycles of Operation.
3. Functioning of Steam Nozzles.
4. Classification of Steam Turbines and their characteristics.
5. Working of Steam Condensers and Cooling Towers.

Course Outcomes

This course shall be beneficial to those students who are interested in Thermal Power Plant Operation. After taking this course students should be able to:

1. Calculate Equivalence ratio and Adiabatic flame temperature.
2. Explain methods of improving Rankine cycle efficiency. Analyse Reheat , Regeneration and Binary vapor cycles.
3. Calculate Critical pressure and Critical temperature. Draw Performance curves of convergent – divergent nozzles. Explain Supersaturated expansion.
4. Evaluate Force, Power, Efficiency through Graphical as well as Analytical methods for Steam turbines.
5. Calculate Make-up water required in Cooling towers, Number of Tubes and Passes in Surface Condensers.

Syllabus:

Unit – I : Fundamentals of Combustion: Review of laws of thermodynamics; Stoichiometry of reactions; Enthalpies of formation reaction and combustion; Adiabatic flame temperature; Equilibrium considerations.

Unit – II : Vapour Power Cycles: Steam boilers and their classification; Introduction to vapour power cycles; Rankine cycle and its modification; Reheat & regenerative cycles; Binary vapour and supercritical cycles; Nuclear reactors and power cycles.

Unit – III : Nozzles**:** Flow through varying area; Convergent divergent nozzle and diffuser; Critical pressure ratio; Effect of variation of back pressure on nozzle performance; Effect of friction; Equilibrium and super saturated steam flow through nozzles.

Unit – IV : Steam Turbines*:* Introduction to steam turbines; Impulse and reaction turbines and compounding; Axial and radial flow steam turbines; Velocity diagrams & blade design; Turbine control/governing.

Unit – V : Steam Condensers : Classification of steam condensers and their analysis; Cooling ponds/ Cooling towers analysis; Environmental aspects of power plant operation.

Reference Books

1. Applied Thermodynamics for Engineering Technologists, Fifth Edition, by T.D.Eastop and A McConkey, Pearson Education Ltd, 2003.

2. Engineering Thermodynamics with Applications, Second Edition, by M. David Burghardt, Harper and Row Publishers Inc, 1982.

3. Fundamentals of Thermodynamics, Seventh Edition, by Claus Borgnakke and Richard Sonntag, Wiley India Pvt. Ltd, 2008.

4. Basic Engineering Thermodynamics, Fifth Edition, by Rayner Joel, Pearson Education Ltd, 2008.

5. Power Plant Engineering, Second Edition, by P.K. Nag, Tata McGraw-Hill Publishing Company Ltd, 2001.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Heat and Mass Transfer
Course Number	**:**	ME 323
Credits	**:**	4
Course Category	**:**	DC
Pre-Requisites (s)	**:**	ME221
Contact hours	**:**	4
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 Hour) 60%

Course Objectives

To equip graduates with the heat and mass transfer process that continuously takes place in buildings and human bodies and in various equipments employed in automobiles, electrical and electronic devices, chemical and process industries, power plants and refrigeration systems like condensers, evaporators, boilers, intercoolers, regenerators, etc. and to formulate simple problems and estimate rates of heat and mass transfer, temperature variation and efficiency of such equipments.

Course Outcomes

After taking this course the students should be able to

1. Formulate and predict heat conduction problems with and without heat generation in composite walls and extended surfaces subjected to convective boundaries. Analyze 1D unsteady and 2D steady conduction problems.
2. Develop concept of boundary layer formation over heated surfaces during forced and free convection, formulation of momentum and energy equations of the laminar boundary layers and their solution by approximate method.
3. Describe filmwise and dropwise condensation in condensers, Pool, forced, sub-cooled and saturated boiling in boilers and evaporators, bubble formation and critical heat flux. Model laminar film condensation and its application in the design of condensers. Evaluation of Reynolds and Nusselt numbers for boiling and condensation.
4. Develop concept of monochromatic and total radiations, intensity of radiation, shape factor, radiation shields, solar radiation and estimation of radiative heat exchange between two or more surfaces of different geometries.
5. Calculate fluid temperatures, mass flow rates, pressure drops, heat exchange and effectiveness during parallel, counter and cross flow in simple and baffled–shell and tube type heat exchangers, condensers, evaporators, etc.
6. Evaluate diffusion and convective Mass transfers occurring in different applications.

Syllabus

CONDUCTION

Basic laws of heat transfer, thermal conductance and resistance, combined heat transfer processes; Thermal conductivity of solids, liquids and gases. General heat conduction equation in Cartesian, cylindrical and spherical co-ordinate systems; One dimensional steady state heat conduction through composite walls. Variable thermal conductivity; Critical thickness of insulation. 1-D heat conduction with internal heat generation in plane wall, cylinder and sphere. Extended surfaces, Generalized equation for fins, Fin of uniform cross section: heat transfer rate, temperature distribution & fin efficiency for different conditions at fin tip. 1-D unsteady heat conduction; lumped heat capacity method, temperature-time response of thermocouples; Unsteady conduction with negligible surface resistance. Two dimensional (2-D) steady heat conduction

CONVECTION

Viscous flow, hydrodynamic and thermal boundary layers, Momentum and energy equations of the laminar boundary layer over a flat plate. Integral momentum analysis of the hydrodynamic boundary layer and thermal boundary layer for forced convection. Liquid metal heat transfer. Free convection heat transfer. Dimensional analysis applied to forced and free convection. Empirical equations for laminar and turbulent flows over surfaces of various geometries; simplified equations for air. Heat transfer during condensation, film condensation over a vertical surface. Phenomenon of boiling, Pool boiling over a heated nichrome wire.

RADIATION

Introduction to thermal radiation, Plank's distribution law. Monochromatic and total emissive power, Emissivity, Stefan-Boltzmann law, Weins displacement law. Kirchoff's law; Proof of Kirchoff's law for monochromatic and total radiations. Solid angle, Intensity of radiation, Radiative heat exchange between two black surfaces, Shape factor, shape factor fo simple geometries. Radiative heat exchange between non- black surfaces, Radiation shields. Radiation through gases and flames; Solar radiation

HEAT EXCHANGERS

Classification of heat exchangers and their temperature distributions; Overall heat transfer coefficient and fouling factors; Log mean temperature difference (LMTD). Heat exchanger effectiveness, NTU-method. Compact heat exchangers; Baffled shell and tube type heat exchangers. Heat exchangers design considerations. Heat Pipe

MASS TRANSFER

Introduction, diffusion and convective mass transfers, Ficks law of diffusion. Generalized equation of mass diffusion, steady state diffusion of gasses and liquids through solids, Isothermal evaporation of water into air. Convective mass transfers, mass transfer coefficients, mass transfers through boundary layer, analogy between momentum, heat and mass transfer. Heat and mass transfer analysis of wet bulb thermometer, Evaporation process in the atmosphere

Text Book

1. Heat transfer by J. P. Holman, McGraw Hill Pub. Co.

Reference Books

1. Fundamentals of Engineering Heat & Mass transfer by R. C. Sachdeva
2. Engineering Heat transfer by C. P. Gupta and R. Prakash
3. Heat and Mass transfer by R. K. Rajput
4. Fundamentals of Heat & Mass transfer by F. P. Incropera & D. P. Dewitt
5. Heat transfer- A Practical Approach by Yunus A. Cengel

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	I.C. Engines
Course No.	:	ME324
Credits	:	4
Course Category	:	DC
Pre-requisites	:	ME221
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Exam. (1 Hour) – 25% End Semester Exam. (3 Hours) – 60%

Course Objectives

1. To give an overview of Internal Combustion Engines, their classification, applications, operation and processes.
2. To carry out thermodynamic analysis of various cycles of operation.
3. To give complete knowledge of type of fuels used in IC engines and the fuel supply systems
4. To describe combustion phenomena in IC engines
5. To explain the Gas Turbine and Jet Propulsion systems.

Course Outcomes

After taking this course the students should be able to

1. Classify various types of I.C. Engines and Cycles of operation.
2. Express the effect of various operating variables on engine performance
3. Discuss fuel metering and fuel supply systems for different types of engines
4. Distinguish normal and abnormal combustion phenomena in SI and CI engines
5. Justify the suitability of conventional and non-conventional fuels for IC engines
6. Solve the performance of Gas Turbine and Jet engines

Syllabus

Unit – I :
- IC Engines-classification and major applications
- Engine performance parameters, Design and performance data
- Comparison of Otto, Diesel and Dual cycles
- Two-stroke engines- operation, advantages and disadvantages
- Scavenging-methods and parameters
- Engine emissions

Unit – II :
- Fuel-Air cycles and their significance
- Effects of specific heat variation, dissociation and number of moles
- Effect of operating variables, idealized Intake and Exhaust processes
- Actual cycles, Various losses encountered in SI and CI engines
- Combustion charts and tables

Unit – III :
- Mixture requirement in SI engines for steady state end transient operation
- Carburetion
- Fuel injection in CI and SI engines
- Supercharging and Turbocharging
- Types of combustion chambers in SI and CI engines

Unit – IV :
- Combustion in SI engines, effect of engine variables on detonation

- Combustion in CI engines, effect of engine variables on delay period
- Comparison of knock in SI and CI engines
- Conventional fuels for SI and CI engines-requirements and their knock rating
- Alternative fuels and fuel additives

Unit – V :
- Gas turbines- thermodynamic analysis of actual gas turbine cycles
- Gas turbine cycles with Intercooling, Regeneration and Reheating
- Jet propulsion- Turbojet, Turboprop, Turbofan, Ramjet and Scramjet engines
- Rocket engines

Books

1. Internal Combustion Engine Fundamentals by J.B.Heywood
2. Internal Combustion Engines and Air Pollution by E.F.Obert
3. Internal Combustion Engines by C.R.Ferguson & A.T.Kirkpatrick
4. Fundamentals of Gas Turbines by Bathie

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Manufacturing Technology- II
Course Number	:	ME325
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	ME194
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. To have the knowledge of the fundamental techniques to manufacture engineering components through metal cutting processes.
2. To be able to analyse the mechanism of chip formation and manufacture engineering components accordingly.
3. To have a solid foundation to investigate the power required during metal cutting and develop a methodology and establish a manufacturing sequence to fabricate engineering components.
4. To able to justify the processes suggested to manufacturing a component.
5. To able to select the most economical route to fabricate the required engineering component.
6. To be able to design a standard limits and fits for a particular engineering component.
7. To be able to use particular measuring tool for a particular surface of an engineering component.
8. To be able to use a modern machine tool for the fabrication of an engineering component.

Course Outcomes

After taking this course the students should be able to

1. Graduates will have the knowledge of the fundamental techniques of metal cutting and dimensional measurements.
2. Graduates will have the knowledge of the mechanism of chip formation.
3. Graduates will be able to estimate the forces involved and power required during metal cutting.
4. Graduates will be able to design and conduct experiments as well as to analyze and interpret the metal cutting processes of manufacturing engineering component.
5. Graduates will have an ability to compute the most economical method of metal cutting to manufacture a particular engineering component.
6. Graduates will have an ability to measure the dimensions of an engineering component.
7. Graduates will have the knowledge of various types of limits and fits.
8. Graduates will have an ability to compute the limits for a typical type of fits.
9. Graduates will be able to utilize numerically controlled (NC) and computerized numerically controlled (CNC) machine tools to manufacture an engineering component.
10. Graduates will be able to design and conduct experiments as well as to analyze and interpret the metal cutting processes through NC and CNC machines.
11. Graduates will be able to select the most economical route to fabricate the required engineering component.

Syllabus

Unit – I : Fundamental of metal cutting, Chip formation, Mechanics of metal cutting, Single point cutting tool signature, Temperature in cutting, Tool life and Tool wear, Tool Materials, Cutting Fluids, Economics of Machining.

Unit – II : Machine tools and machining operations for Turning, Boring, Shaping, Milling, and Grinding. Calculation of MRR, Power required and Cutting time, Finishing operations, Surface treatment, Coating and cleaning. Design of Jigs and Fixtures, Design of press working tools.

Unit – III : NC machine tools, Automation and NC; CNC; Programming for NC; Industrial robots.

Unit – IV : Engineering metrology, Principles of measurements, Standard of length, Linear and angular measurements, Limits, Fits and Tolerances, Gauge Design.

Unit – V : Comparators, Interferometry, Form and Finish measurement of Gears and screw threads, Machine tool alignment test.

Books

1. Manufacturing Science, A. Ghosh and A.K. Mallick, East-West Press Private Limited.
2. Manufacturing Processes for Engineering Materials, S. Kalpakjain, Addission-Wesley Publishing Company.
3. Manufacturing Engineering and Technology, S. Kalpakjain and S.R. Schmid, Pearson Education.
4. Production Engineering Sciences, P.C. Pandey and C.K. Singh, Standard Publishers Distributors, Nai Sarak, New Delhi.
5. Introduction to Manufacturing Processes, J.A. Schey, McGraw Hills.
6. Fundamentals of Metal Cutting and Machine Tools, B.L. Juneja, G.S. Sekhon, New Age International Private Limited.
7. Materials and Processes in Manufacturing, E.P. Degarmo. J.T. Black and R.A. Kohser, Prentice-Hall of India.
8. Modern Machining Processes, Pandey and Shah, Tata McGraw Hill.
9. Grover and Zimmer, CAD/CAM, Prientice Hall Pvt Ltd.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Fluid Mechanics II
Course Number	:	ME332
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	ME221, ME231
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. Knowledge of Governing equations for incompressible potential flows, their solution methods and applications to flows of practical interest.
2. Knowledge of Governing Equations for viscous flow of Newtonian fluids, their scaling / dimensionless representation and the dynamic similarity principle.
3. Learning to obtain exact solutions of Navier-Stokes equations for parallel flows, stagnation-point flows.
4. Development of the concept of Boundary-Layer, derivation of its governing equations and their self-similar solutions for flow along a flat plate.
5. Knowledge and application of approximate methods of obtaining integral Boundary-Layer parameters using Von-Karman Momentum Integral equation.
6. Learning about Shock waves (Oblique and Normal) and related phenomenon (reflection, intersection) and their analysis using local 1D theory.
7. Analysis of effects of friction and heat transfer on compressible flow in a constant area passage and their applications in designing such flow systems.
8. Learning facts about Turbulent flows and knowledge of Governing equations for statistical description of turbulent flows (RANS approach).
9. Understanding the closure problem in the RANS approach, the concept of Reynold's stresses and development of basic ideas in Turbulence modelling.

Course Outcomes

Specific

After taking this course the students should be able to

1. Describe the fluid flow phenomenon of Newtonian fluids
2. Apply the knowledge of basic governing equations for development of a prediction model for a specific flow system
3. Explain flow aspects which are largely governed by inviscid / potential / viscous flow theory.
4. Design compressible flow piping systems incorporating the effects of friction / heat transfer
5. Predict, analyze and design compressible flow systems involving shock waves
6. Interpret Turbulent flows and approaches towards their statistical prediction

Generic

1. Apply the knowledge of Mathematics, Mechanics and Thermodynamics for the analysis and design of fluid flow systems

Syllabus

Unit – I : Potential Flow: Potential Flow around 2-D half body, Circular Cylinder, Airfoil; Lift & Drag; Potential Flow through Rotor; Kutta-Joukouski's Theorem, Thin Airfoil Theory; Pressure Distribution Around Airfoil Surfaces.

Unit – II : Viscous Flow: Relationship between Stresses & Rate of Strains, Stoke's Hypothesis, N-S Equations in 3-D Cartesian Coordinates, Reynolds' similarity Principle, Limiting cases of very small & very large "Re", Exact solutions of N-S Equations in case of parallel Flows, Flow through Circular Pipes, Flow over a suddenly accelerated Oscillating Plate, Hiementz Flow, Flow Between Two Rotating Cylinders.

Unit – III : Two Dimensional Boundary Layer Flow: Prandtl B.L. Equation, B.L. along a flat plate, Blasius Solution, Von-Karman Integral Momentum Equation, Skin Friction, Flow Separation and its Control.

Unit – IV : Turbulent Flow: Time averaging of N-S Equations for Turbulent Flow, Reynolds' Stresses, Turbulence Modeling and Velocity Profiles for Turbulent Flow in Pipes, Turbulent Boundary Layer.

Unit – V : Compressible Flow: Flow with friction or Heat Transfer, Fanno & Rayliegh Lines, Expansion waves, Normal Shock Waves, Use of Gas Tables.

Unit – VI : Fluid Flow Measurement: Experimental Facilities, Wind Tunnel, Test Rigs, Flow Visualisation Equipments, Optical Techniques & Instruments; Measurement of Velocity, Hot-Wire, Hot Film & Laser Doppler Anemometers.

Books

1. FM White, "Viscous Fluid Flow" , McGraw Hills, 2Ed
2. Schilisting H, Boundary Layer Theory, McGraw Hill
3. J. D. Anderson, Compressible Fluid Flow with Historical Perspectives, McGraw Hills, 2Ed
4. J. D. Anderson, Fundamentals of Aerodynamics, McGraw Hills
5. IG Curie, Fundamentals Fluid Flow, McGraw Hills

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Economics and Management
Course Number	:	ME340/ME240
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. Prepare engineering students to analyse cost/revenue data and carry out economic analysis for decision making and to justify or reject alternatives/projects on an economic basis.
2. To familiarize the student with the basic concepts of management issues related to the management of contemporary organizations.

Course Outcomes

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

1. Set up technically and financially sound decisions by comparing and analysing alternative projects.
2. Assemble and optimize the resources available in a given situation.
3. Develop a working knowledge of money management.
4. Define and Apply techniques, skills and modern engineering tools necessary for engineering management practice in contemporary organisations.
5. Choose and manage resources using different operation strategies with a view to stay ahead in offering competitive products/services
6. List and exercise social responsibility and ethics in the practical context.

Syllabus

Unit – I : Introduction to Engineering economics; Time value of money; Present worth, future worth and annual worth comparisons.

Unit – II : General replacement studies; Benefit cost analysis; Depreciation-purpose and use; Inflation and its effects.

Unit – III : Introduction to management; Environmental and ethical issues in decision making; Management of information.

Unit – IV : Planning and strategic management; Organising; Leadership and motivation; Controlling

Unit – V : Operations management; Marketing management; Financial management; Human resource management; Management of international business

Books

1. DeGarmo, E. P., Sullivan, W. G. and Bontadelli, J. A., 1988, Engineering Economy, ed.viii, Macmillan.
2. Riggs, J. I., Bedworth, D. B. and Randhawa, S. U., 1996, Engineering Economics, ed. iv, TMH.
3. Stoner, J. A. F., Freeman, R.E. and Gilbert, D. R., 2003, Management, ed. vi, PH

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Industrial Engineering
Course Number	:	ME 341
Credits	:	04
Course Category	:	DC
Pre-Requisites(s)	:	ME194
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Outcomes

After taking this course the students should be able to

1. List, justify and interpret productivity models in manufacturing and service organization.
2. Judge product development and industrial process design.
3. Predict facility location and network models.
4. Interpret and solve data from aggregate output planning models. Knowledge of human factors in engineering and various jobs designs.
5. Select and analyze an inventory control model based upon given data. Understanding of manufacturing resource and just-in-time planning.
6. Predict and control the quality of an end product.
7. Design and model industrial systems using linear and non-linear programming approaches.

Syllabus

Unit – I : Overview of Industrial Engineering. Introduction to productivity. Productivity measurement in manufacturing and service organization. Operations strategies. Product development, liability and process design. Introduction to Value Engineering.

Unit – II : Facility location and layout, group technology, cellular manufacturing, flexible manufacturing system. Project management, network models, PERT.

Unit – III : Scheduling systems, capacity planning, aggregate planning, operations scheduling. Introduction to human factor engineering, errors and safety. Job design, methods study and work measurement. Environmental considerations in work place design.

Unit – IV : Inventory control. Inventory concepts, costs and modeling. Deterministic and stochastic inventory models. Material Requirement Planning (MRP) and Manufacturing Resource Planning (MRP II). Introduction to JIT.

Unit – V : Introduction to quality, quality controls and tools. Statistical process control charts. Acceptance sampling. Introduction to inspection. Introduction to Operation Research, transportation and assignment models. Elementary models in single and multi-variable unconstrained non-linear programming.

Books:

1. Ebert and Adams, Production and Operations Management, Wiley, 2011
2. Martand Telsang, Industrial Engineering and Production Management, S Chand Company, 2002

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	**:**	Manufacturing Technology Lab II
Course Number	**:**	ME391
Credits	**:**	2
Course Category	**:**	DC
Pre-Requisites (s)	**:**	ME194
Contact hours	**:**	3
Type of Course	**:**	Laboratory
Course Assessment	**:**	Course Work 60% End Semester Examination (2 Hour) 40%

Course Outcomes

After taking this course the students should be able to

1. Discuss and Operate different metrological instruments and various machine tools.
2. Calculate and derive metal removal rate (MRR), power consumption, cutting forces, and specific cutting energy in turning and drilling environments.
3. Describe Computerized Numerically Controlled (CNC) machine tools and Programming of a CNC machine tool.
4. Classify various machine tool's Alignment system.
5. List and propose various tools applied for quality control.
6. Predict effect of various cutting parameters on surface roughness in a machine tool environment and the quality of machining.
7. Develop communication and self-learning skills through viva-voce and experiments.

List of Experiments

1. To perform Alignment tests on: (a) Lathe Machine (b) Milling Machine
2. i) To study the working of optical projector and to measure the outside and root diameters of the given gear.
   ii) To measure the tooth thickness of the given gear with the help of tooth caliper.
3. i) To find angle of the given wedge by means of: (a) Bevel Protractor (b) Sine Bar
   ii) To study the flatness of the slip gauges by using optical flat.
4. To study the effect of cutting speed, feed rate on surface finish of a turned specimen.
5. To determine the cutting force in a turning environment. Plot the graph between specific cutting energy and cutting speed.
6. To construct process control charts for variables (X & R charts) and study the variability (due to assignable causes) in a quality of a manufacturing process.
7. To study the working principle of CNC lathe/CNC milling machine and to write the NC program for a given job.
8. To determine the MRR and power consumption during drilling operation.
9. To study the principle of differential indexing on a milling machine.

Books

1. Manufacturing Science, A. Ghosh and A.K. Mallick, East-West Press Private Limited.
2. Manufacturing Processes for Engineering Materials, S. Kalpakjain, Addission-Wesley Publishing Company.
3. Manufacturing Engineering and Technology, S. Kalpakjain and S.R. Schmid, Pearson Education.
4. Production Engineering Sciences, P.C. Pandey and C.K. Singh, Standard Publishers Distributors, Nai Sarak, New Delhi.
5. Introduction to Manufacturing Processes, J.A. Schey, McGraw Hills.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Heat and Mass Transfer Lab.
Course Number	**:**	ME392
Credits	**:**	2
Course Category	**:**	DC
Pre-Requisites (s)	**:**	ME221
Contact hours	**:**	3
Type of Course	**:**	Laboratory
Course Assessment	**:**	Course Work 60% End Semester Examination (2 Hour) 40%

Course Outcomes

1. Practical knowledge of operating various heat transfer equipments, like supply of controlled heat through current and voltage and supply of cooling water and air at controlled speed.
2. Use of different types of thermocouples and temperature indicators (including their calibration via voltmeters); measurement of current, voltage, temperature, flow rate/velocity, etc.
3. Prediction of transient behavior of various equipments during start–up period and finding heat transfer rates, heat transfer coefficients, efficiency, effectiveness, etc. in free and forced convection.
4. Evaluating radiation heat exchange between black and real surfaces, emissivity and Stefan Boltzmann constant; experiments on solar cooker and solar water heater with measurement of global radiation.
5. Finding critical heat transfer during pool boiling and visualization of the phenomena.
6. Determining thermal conductivity of insulating material and conductance of a heat pipe.

List of Experiments

1. To determine thermal conductivity of an insulating material by two slabs guarded Hot Plate method.
2. Calibration of Temperature Indicator and a Thermocouple.
3. To determine the thermal conductance of a Heat pipe (a superconducting device) and other identical pipes.
4. To determine heat transfer coefficients of air flowing across the extended surface. Also, find the rate of heat transfer, efficiency and effectiveness of the surface used.
5. To determine emissivity of a plate and the Stefan Boltzmann constant.
6. To study the transient behavior of the solar cooker and determine its time constant.
7. To determine the film coefficient of air flowing over a heated body during the transient heat conduction.
8. Experimental study on Pool Boiling of water over a heated Nichrome wire and determine the Critical Heat Flux at different temperatures of the pool water.
9. To determine overall heat transfer coefficient, heat removal factor and efficiency of a solar water heater.

Text Book

1. Heat transfer by J. P. Holman, McGraw Hill Pub. Co.

Reference Books

2. Fundamentals of Engineering Heat & Mass transfer by R. C. Sachdeva
3. Engineering Heat transfer by C. P. Gupta and R. Prakash
4. Heat and Mass transfer by R. K. Rajput
5. Fundamentals of Heat & Mass transfer by F. P. Incropera & D. P. Dewitt

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Kinematics & Stress Analysis Lab
Course Code	:	ME393
Credits	:	2
Course Category	:	DC
Pre-Requisite(s)	:	ME213
Contact Hours	:	3
Type of Course	:	Practical
Course Assessment	:	Course Work 60% End Semester Practical Exam. (2 Hours) 40%

Course Objectives

1. Develop an understanding of the working of various machines and mechanism of common applications.
2. Apply scientific theories, mathematics and laws of mechanics in real life problem.
3. To be able to perform the kinematic analysis on various machines and stress analysis of various machine elements.

Course Outcomes

At the end of the course the student will be able to

1. Describe kinematics of machines and perform kinematic analysis.
2. Distinguish the behavior of the materials and fluids under different loading conditions.
3. Illustrate stress analysis using strain gauges and material testing using Universal testing machine.
4. Operate and handle mechanical systems comprising mechanisms of different usage.
5. Outline theoretical analysis and to compare it with experimental results and analyze the source of error, deviating with the theoretical.
6. Develop skills to communicate the experimental work performed in the laboratory by submitting proper technical/lab reports.

Syllabus

1. Observation of pressure profile in journal bearing.
2. To measure the strain in a cantilever beam of Aluminium by the means of Strain gauge.
3. To perform the tension and compression test for a mild steel rod and brick sample respectively using a Universal Testing Machine.
4. To determine the co-efficient of friction of lubricating oil used in the Thurston Pendulum Tester for friction test.
5. To draw follower's displacement, velocity and acceleration versus cam rotation angle curves for different cam and follower pairs.
6. Verification of gyroscopic torque equation.
7. Verification of the analytically determined positions of the balancing masses in a rotating mass system.
8. To find out the input, output and holding torque in an epicyclic gear train and verify the torque equation.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Machine Design Practice
Course Code	:	ME398
Credits	:	2
Course Category	:	DC
Pre-Requisite(s)	:	ME213
Contact Hours	:	3
Type of Course	:	Practical
Course Assessment	:	Course Work 60 % End Semester Examination (2 hours) 40 %

Course Objectives

This course is designed to help students achieve the following objectives

1. Understanding of the uncertainties and remedial approach pertaining to material properties and engineering analysis as a real-world engineering application.
2. Ability to select the material and configuration of different machine elements under a variety of environmental and service conditions. These includes

    a) Joints (Cotter, Knuckle)
    b) Shafts (Solid & Hollow)
    c) Keys, Splines, Pins
    d) Couplings
    e) Belt Drives (Flat & V - Belt), Rope Drive

3. Familiarity with analytical methods for estimating the transverse and torsional deflections of machine elements.
4. Understanding of the concepts of factor of safety
5. Ability to conduct a failure analysis for the design of machine element
6. Ability to describe the advantages and disadvantages of Belt Drives over other drives.

Course Outcomes

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

1. Describe design practices involved in machine component design.
2. Design machine elements in an optimised domain for specific application.
3. Apply the knowledge of mathematics, mechanics, theory of machines, material science, etc. during solving a design problem.
4. Plan and select different parameters available viz. material, hardness etc which is best suited for that case. The selection may be made on the information based on the standards already made also from the manufacture's catalogue.
5. Predict the design criterion involved with different failure modes of a machine component for satisfactory performance.
6. Apply classical scientific theories and laws in real life problems of design incorporating factor of safety, stress concentration etc. for making the design more effective to sustain in real working conditions.
7. Design better machine component and improving the existing one, according to the need and changes in requirements.

Syllabus

Unit – I : Joints: Different Types of joints like Cotter, Knuckle etc.

Unit – II : Design of Solid & Hollow Shaft subjected to different types of loads (Torsion, Bending, Axial and Dynamic).

Unit – III : Design of Keys, Splines, Pins Coupling.

Unit – IV : Belt Drives (Flat, V- Belts), design of Ropes.

Books:

1. Machine Design, Joseph E Shigley
2. Sharma & Aggarwal, Machine Design, Kataria Publications

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Manufacturing Engineering
Course Number	:	ME404
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. Integration of technology with management in planning and controlling the operation of manufacturing system.
2. Rapid advances in manufacturing technology, e.g., computer controlled processes, flexible manufacturing system, computer integrated manufacturing systems, group technology, cellular manufacturing etc., are reinforcing the recognition of technological, organizational, economic and human factors.
3. To understand the economic viability of jigs and fixtures and design shearing and drawing dies and single point cutting tools.
4. Use modern statistical quality control tools, such as control charts and process capability measures, to monitor quality characteristics of manufacturing processes

Course Outcomes

After taking this course the students should be able to

1. Investigate and list new and ongoing developments in the area of automated manufacturing systems.
2. Use data communication for the integration of different components of manufacturing systems.
3. Develop simple part programs using APT language and G-M codes for simple machining operations.
4. Discuss the importance of jigs and fixtures and their types and analyze their economic viability.
5. Interpret the construction and design principles of the shearing and drawing dies and single point cutting tools.
6. Paraphrase modern statistical quality control tools, such as control charts and process capability measures, to monitor quality characteristics of manufacturing processes
7. Examine the scope and importance of human factors in engineering and their responsibility, as engineers, for the protection of worker health in the industrial environment as well as the surrounding community.

Syllabus

Unit – I : N.C. Machine tools, Automation and N.C., CNC, DNC and AC, Programming for NC, Industrial Robots, CIMS, GT, Cellular Manufacturing, FMS & AI.

Unit – II : Tool Engineering, Principles of Work Holding, Design of Jigs and Fixtures, Design of Single Point Multipoint and Press working Tools.

Unit – III : Human Factors Engineering Introduction, Safety and Design, Environmental considerations, Product Liability.

Unit – IV : Inspection and Quality Control, Product Quality, Quality Assurance, TQM, SQC, Acceptance Sampling and Control, Reliability, Non-Destructive Testing, Automated Inspection.

Books:

1. M.P. Groover & E.W. Zimmers Jr.; CAD/CAM-Computer Aided Design & Manufacturing, PHI, 2000.
2. Pandey & Singh; Production Engg. Sciences, Std. Pub. New Delhi, 1992.
3. B. S. Pabla & M. Adithan; CNC Machines
4. Serope Kalpakjian; Manufacturing Engineering and Technology

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Powder Metallurgy
Course Number	:	ME406
Credits	:	4
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Outcome

After taking this course the students should be able to

1. Describe different aspects of powder metallurgy and its significance as a manufacturing process.
2. Outline different steps of powder metallurgy process.
3. Recite sintering and sintering atmospheres.
4. List post sintering treatments.
5. Explain the applications of powder metallurgy in different areas.
6. Paraphrase newer processes like liquid phase sintering and rapid solidification techniques.

Syllabus

Unit – I : Basic Manufacturing Methods: Introduction to Powder Metallurgy, Scope and Limitations, Powder Manufacture: Reduction, Electrolysis, Atomization, Comminution, Rapid Solidification Techniques.

Unit – II : Powder Compaction: Die Design, Friction and Wear Considerations during Compaction, Single and Double Action Compacting, Isostatic Pressing, Cold and Hot Consolidation.

Unit – III : Sintering: Fundamental of Sintering Theory, Rate Laws, Time Temperature Cycle, Sintering Atmospheres and their Control, Liquid-phase and activated sintering.

Unit – IV : Post Sintering Treatments: Coining, Sizing & Machinability consideration, Steam Treatment, Heat Treatment of Sintered Parts, Solid and Liquid Phase Sintering, Dimensional Control.

Unit – V : Application of Powder Metallurgy Parts: Sintered Bearings, Filters, Sintered Carbides, Iron and Steel Components, Light Metal Alloys, Composites; MMC, PMC & CMC, Smart Materials by PM Processing, Automobile, Household and Business Machines, Defence, Nuclear Industries, P/M Preform Forging, Hot Isostatic Compaction, Powder Rolling, Powder Extrusion.

Books

1. G.S. Upadhaya; Sintered Metallic & Ceramic Materials-Preparation, Properties & Applications, John Wiley & Sons Ltd., UK, 2000.
2. G.S. Upadhaya; Powder Metallurgy Technology, Cambridge Int. Sc. Pub., Cambridge, UK, 1997.
3. R.M. German; Powder Metallurgy Science, Princeton, MPIF.
4. S.A. Tsukerman; Powder Metallurgy.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	PROCESSING OF PLASTICS, POLYMERS AND CERAMICS
Course Number	:	ME407
Credits	:	4
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Outcome

1. List polymers, their different types and properties.
2. List different thermoplastic and thermosetting polymers.
3. Discuss various polymer fabrication techniques.
4. Recognize the application of polymers in different areas (electrical, structural and corrosion control etc.).
5. Recite ceramics, their manufacturing techniques, properties and applications.
6. Propose appropriate plastics for different application.

Syllabus

Unit – I : Introduction to Polymers, Basic type of Polymers, Strengthening Mechanisms, Linear Polymers, Crystallinity, Plasticization, Fillers, Blending and Alloying, mechanical and Physical Properties of Polymers.

Unit – II : Polymer Chemistry, Thermo Plastic Commodity, Thermoplastics Engineering, Ethenic Polymer, Polyamides, Thermoplastic Polyesters, Liquid Crystal Polymer, Thermosetting Polymers, Phenolics, Alkyds, Unsaturated Polymers, Elastomers, Special Purpose Elastomers.

Unit – III : Polymer Fabrication Techniques, Injection Moulding, Compression Moulding, Transfer Moulding, Blow Moulding, Thermoforming, Extrusion, Calendaring, Casting, Reaction Injection Moulding (RIM), Roam Moulding Rotational Moulding, Solid Phase Forming, Stereo Lithography, Design Considerations.

Unit – IV : Selection of Plastics, Plastics for Structural Components, Plastics for Corrosion Control, Plastics For Electrical Applications, Polymer Coating, Adhesive Recycling of Plastics.

Unit – V : Nature of Ceramics, Manufacturing of Ceramics, Glasses, Cemented Carbides for Structural Applications, Ceramics for Wear Applications. Electrical and Magnetic Properties of Ceramics

Books

1. Kenneth, G. Budinsiki; Engineering Materials, Properties & Selection, Prentice Hall.
2. Serope Kalpakjian; Manufacturing Engg. & Tech., Addison Wesley.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Mechanical Vibrations
Course Number	:	ME411/417
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

At the end of this course, the students will

1. Fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions.
2. Be able to obtain linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF)
3. Be able to write the differential equation of motion of vibratory systems.
4. Be able to make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi-degree of freedom linear systems.

Course Outcomes

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

1. Discuss the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions.
2. Compose linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF), and of real life engineering systems.
3. Formulate free and forced (harmonic, periodic, non-periodic) vibration response of single and multi-degree of freedom systems.
4. Use and Design various vibration measuring instruments.
5. Predict free and forced (harmonic, periodic, non-periodic) vibration of continuous systems.
6. Design machines which should not vibrate or vibrate within limits.
7. Design machines which should use vibration for useful purposes.

Syllabus

UNIT – I : Introduction to vibrations, basic concepts, equivalent systems, Fourier analysis. Free damped and undamped vibrations of single degree of freedom systems, Coulomb and structural damping.

UNIT – II : Forced vibrations of single degree of freedom systems, transmissibility. Excitation due to eccentrically rotating masses. Vibration measuring instruments. Whirling of shafts.

UNIT – III: Free and forced vibrations of two degree of freedom systems, Semi-definite systems, close and far coupled systems. Introduction to matrix method, vibration absorbers.

UNIT – IV: Introduction to multi-degree of freedom systems, Eigen-value problems. Determination of fundamental frequency by Dunkerley's and Rayleigh's methods.

UNIT – V : Approximate methods of determination of natural frequencies by Holzer's method, matrix iteration method. Vibration analysis of continuous systems. Lateral vibration of beams.

Books

1. S. S. Rao : Mechanical Vibrations, Adisson Wesley Publishing Company,
2. J. S. Rao & Gupta : An introductory course on Theory & Practice of Mechanical Vibrations, Wiley Eastern Ltd,
3. William P. Thomson; Elements of Mechanical Vibrations, Prentice Hall.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	ADVANCED SOLID MECHANICS
Course Number	:	ME418
Credits	:	4
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. To gain understanding of advanced concepts of 3D stress and strain by analysis of solids and structures.
2. To study engineering properties of materials, force-deformation, and stress-strain relationship
3. To learn advanced principles of equilibrium, compatibility, and force-deformation relationship, and principle of superposition in linear solids and structures
4. To analyze problems related to stresses in composite tubes, thermoelastic stress and strain, buckling, and asymmetric bending etc.

Course Outcomes

After taking this course students should be able to

1. Solve the advanced practical problems related to the theory of elasticity, concepts of stress and strain, strength and stiffness, deformations and displacements, strain energy, and load carrying capacity.
2. Propose materials and structural elements to the analysis of complex structures
3. Identify, formulate and solve the structural problems using a range of analytical methods.
4. Analyze the behaviour of the solid bodies subjected to various types of loading and boundary conditions.
5. Design machine elements using theories of deformable bodies.

Syllabus

Unit – I : Three dimensional stresses and strains, stress and strain at a point, Principal stresses in 3-D Mohr's circle for three dimensional stress, Octahedral stresses, Cauchy's stress quadric, Generalized Hook's law, Displacement equation of equilibrium.

Unit – II : Hooke's Law and Principle of superposition, Maxwell-Betti-Rayleigh reciprocal theorem, Generalized force & displacement, Bregg's deformeter, Fictitious load method, Virtual work.

Unit – III : Asymmetric bending, Euler Bernoulli hypothesis, Shear Centre, Shear Centre for different section, Bending of curved Beams, Torsion of general prismatic bars, Torsion of elliptical bars, Torsion of rectangular bar.

Unit – IV : Stresses in composite tubes, shrink fit, sphere with purely radial displacements, stresses due to gravitation, Disk of variable thickness, Rotating shaft and cylinder.

Unit – V : Thermoplastic stress strain relation, Thermal stress in thin circular disc, long circular cylinder, sphere, Theorem of stationary potential energy, Energy & Stability, consideration for buckling, Rayleigh Ritz method.

Books

1. L.S. Srinath; Advanced Mechanics of Solids, TMH Publisher, New Delhi.
2. E.J. Hearn; Mechanics of Material-Vol. I & II, Pergamon Press
3. Dally & Riley; Experimental Stress Analysis.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Fuels and Combustion Engineering
Course Number	:	ME420
Credits	:	4
Course Category	:	Elective
Pre-Requisite(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work/Quizzes (15%) Mid Semester Exam (1 Hour) 25% End Semester Exam (3 Hour) 60%

Course Objectives

1. To give students the basic understanding of the thermodynamics of combustion process.
2. To equip students with the knowledge of the important chemical reactions occurring in combustion engines their rates and control.
3. To study the flame structure of premixed and diffusion flames.
4. Enabling them to know the use of different techniques for determination of thermal and transport properties of commercial fuels.

Course Outcomes

This course is designed to offer basic knowledge to the students in the area of applied combustion. By studying this course, the student shall be able work in industrial power plants and automobile sector. He/she shall be able to calculate:

1. The flame temperature of commercial fuels burning in the combustion chambers of internal combustion engines.
2. The rate of chemical reactions and emission characteristics of hydrocarbon fuels used in power plants and transportation sector.
3. The burning velocity of premixed flames and important combustion characteristics of diffusion flames.
4. Thermodynamic and transport properties of fuels at elevated pressures and temperatures prevalent in the combustion chambers of actual engines.

Syllabus

Unit – I : *Thermodynamics of Combustion*: Stoichiometry; Fundamentals of Combustion Heats of formation, and reaction; Adiabatic flame temperature; Equilibrium constant; Second law analysis of reacting systems.

Unit – II : *Chemical Kinetics*: Elementary Reactions, Reaction order and molecularity; Arrhenius law; Relation between rate coefficient and equilibrium constant; Chain reactions, Global reactions; Nitrogen oxides kinetics.

Unit – IV : *Flames*: Laminar premixed flames; Burning velocity; Effect of Stoichiometry, pressure and temperature on burning velocity; Methods of its measurements; Explosion limits; Diffusion flames; Gaseous jet diffusion; Single droplet combustion.

Unit – V : *Estimation of Fuel Properties and Emissions:* Gaseous, liquid and solid Fuels; Estimation o thermodynamic properties of liquid fuels; Fundamentals of combustion generated pollutants and minimum pollutants considerations.

References Books

1. An Introduction to Combustion by Stephen R. Turns, McGraw Hill, 1996.
2. Principles of Combustion, Second Edition, by Kenneth K. Kuo, John Wiley and Sons, Inc, 2005.
3. Combustion Engineering by Borman and Ragland, McGraw Hill, 1998.
4. The Properties of Gases and Liquids, Fourth Edition, by R.C. Reid, J.M. Prausnitz and B.E. Poling, 1989.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Air Pollution Technology
Course No.	:	ME425
Type of Course	:	Theory
Credits	:	4
Pre-requisites	:	None
Contact hours	:	4
Course Assessment	:	Home Assignment/quiz - 15% Mid Semester Exam. (1 hour) - 25% End Semester Exam (3 hours) - 60%

Course Objectives

1. To impart complete knowledge of causes, effects and control of Air Pollution due to combustion systems.
2. To discuss pollutant monitoring techniques and control strategies.
3. To analyze the automotive emissions, their reduction technologies and emission standards.

Course Outcomes

After taking this course the students should be able to

1. List and explain the global consequences of air pollution, effect of meteorological conditions on pollutants dispersion and vice versa.
2. Calculate the air pollution severity in terms of PINDEX
3. Assess the formation mechanism and control strategies of combustion generated pollutants
4. Practice sampling and derive combustion generated pollutants using modern on-line techniques/instruments.
5. Identify the type and extent of emissions from mobile sources.
6. Select and design pollutant control devices for various applications.

Syllabus

Unit 1 : **Introduction**

- Introduction, Theories on the Global Consequences of Pollution
- Global Oxygen-Carbon Dioxide Balance
- Atmospheric & Meteorological effect, Lapse rate & Stability considerations
- General Characteristics of Stack Plume
- Assessment of Air Pollution Severity (PINDEX Scheme)

Unit – II : Pollutant Formation & Control

- General considerations of Combustion Generated Pollutants & their Control
- Formation & Control of Oxides of Nitrogen (Thermal, Prompt and Fuel Bound)
- Formation & Control of Oxides of Sulphur
- Formation & Control of Carbon Monoxide
- Formation & Control of UHC, soot/Particulate
- Photochemical Smog

Unit – III : Sampling & Analytical Techniques

- Methodology for Sampling and Analysis of Combustion Generated Pollutants
- Principles of Operation of emission instrumentation used for NOx, CO, SOx, CO_2 UHC and O_2 analysis

Unit – IV : Pollution from Mobile Sources

- Emission Standards for Automobiles
- Emission from Gasoline Engines
- Crank case & Evaporative Emissions
- External (Catalytic) Reactors
- Emissions from Diesel Engines
- Emissions from Gas Turbines & Jet Engines
- Emissions Reduction Technologies

Unit – V : Air Pollution Control Techniques

- Types of Air Pollution Control Equipment & Source Correction
- Mechanical Fabric Filters
- Wet Scrubbers
- Electrostatic Precipitators
- Afterburners / Incinerators
- Catalytic Combustion
- Flare System

1

Extra Topics

- The effect of Air Pollution on Weather and Climate Changes 1
- An assessment of the fact that "Clean Air Costs Money-Dirty Air Cause More Money
- Ambient Air Quality Standards 1
- Indoor Air Quality 1

Text Book

1. "Air Pollution Control Engineering" by Noel de Nevers. Mc Graw Hill Int. Edition

References

1. "Air Pollution", by Wark & Warner, Harper & Collins Publishers
2. "Air Pollution", by Rao and Rao, Tata Mc Graw Hill
3. "Air Pollution Control Theory", by Crawford , Tata Mc Graw Hill

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	AUTOMOTIVE ENGINEERING
Course Number	:	ME426
Credits	:	4
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

The purpose of this course is to impart adequate knowledge in both practically and theoretically, covering the various types of power-driven vehicles and to familiarize the students with the fundamentals of Automotive Engine System, Chassis and suspension system, braking and transmission system, and cooling system. The students are acquainted with the operation, maintenance and repairs of all components of the various transportation vehicles.

Course Outcomes

After taking this course the students should be able to

1. List different types of Engine and their classifications.
2. Judge firing order for multi-cylinder engines for igniting of fuels.
3. Develop concept and define working of Automobile Engine cooling and lubrication system.
4. Describe functioning of Transmission train, conventional and non-conventional drives, Clutches, Gear boxes, Synchromesh device, Propeller shaft, Differential axle, braking system and Suspension systems.
5. Calculate fuel air ratio in Carburetor and knowledge & describe working of different types of fuel injection and fuel ignition systems for modern gasoline and diesel engine.
6. Describe functioning of steering system, steering geometry wheel alignment and wheel angles for modern Automobile.
7. Explain the need of Catalytic converter and their functioning.

Syllabus

Unit – I : Introduction of engines and their classifications, Firing order and its determination for multi-cylinder engines, cooling system and lubrication system and their classification, Braking systems and their types.

Unit – II : Carburetor and their different types and determination of fuel air ratio and problems, fuel pump, fuel injector. Introduction to fuel injection system in gasoline engines.

Unit – III : Types of ignition system, Battery ignition and Magneto ignition systems their basic requirements and their standard wiring diagram. Types of spark plug, Hot plug and cold plug, Ignition timing, Spark advance and Retard and their control by different mechanisms, types of fuel injection systems.

Unit – IV : Transmission train, conventional and non-conventional drives, Clutches, Gear boxes, Synchromesh device, Propeller shaft, Differential axle.

Unit – V : Suspension system and its types, steering system, steering geometry wheel alignment, wheel angles, Differential, Catalytic converter.

Books

1. Automotive Engineering by Joseph Heitner.

Reference Books

1. Automotive Maintenance & Trouble Shooting by Frazee Bedell
2. Automotive Fundamentals by Frazee Bedell
3. Automotive Mechanics by William H. Crouse.
4. Automotive Engineering by Newton & Steed.
5. Automobile engineering by R.K. Rajput.

Reference to Additional Learning Resources

1. National Programme on Technology Enhanced Learning (NPTEL)
2. Links : http://nptel.iitm.ac.in/

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Computational Aerodynamics
Course Number	:	ME427
Credits	:	4
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. The students will be able to perform subsonic potential flow computations.
2. They will become conversant with programming aspects of panel methods in 2D potential flows.
3. They will be able to numerically solve linear advection equations using Godunov, vector splitting approaches.
4. They will learn numerical techniques to solve Euler equations in 2D flows.

Course Outcomes

After taking this course the students should be able to

1. Execute subsonic potential flow computations.
2. Implement 2D panel methods on lifting and non-lifting bodies.
3. Design components which require compressible flow computations.
4. Design Converging nozzles, C&D nozzles and diffusers using Euler equations.
5. Tell and write numerical solvers from scratch for 2D compressible flow computations.

Syllabus

Unit – I : **Review of Basic Aerodynamics and its Models** : Compressible flow Models and its governing equations; Non Dimensional flow parameters, Flow Regimes, Euler's equation and its different forms, Compressible potential flow model.

Unit – II : **Classical Approach**: Introduction to Panel method: Basic formulation, Boundary Conditions, Steps towards construction of numerical solution and aerodynamics loads. Viscous-inviscid Interaction, Coupling between boundary layer solvers and potential flow, influence of viscous flows effects on foil design.

Unit – III : **Wave based Approach**: Wave Equation, scalar and vector model problem, characteristic form of the Euler Eq^{n} and its physical Interpretation, Riemann Problem and its solutions.

Unit – IV : **Basic Computational Method**: Finite Difference Methods for Model Wave Equations (Linear advection, Viscous Burgers), upwinding, CFL number, Application of Boundary Condition, Consistency, Convergence, Dispersion, Dissipation.

Unit – V : Numerical Method for Euler's Equation/Navier Stokes Equation: Flux approach, Wave Approach: Flux vector splitting, Reconstruction Evolution, Boundary treatments.

Books

1. Low-speed Aerodynamics by J. Katz & A. Plotkin
2. Computational Gas Dynamics by Culbert B. Laney
3. Compressible Fluid Flow with Historical Perspectives by J. D. Anderson

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Power plant Engineering
Course Number	:	ME428
Credits	:	4
Course Category	:	DE
Pre-requisites	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Home Assignment 15%, Mid Semester Exam (1 Hour) 25%, End Semester Exam (3 Hour) 60%

Course Objectives

1. Basic knowledge of Different types of Power Plants, site selection criteria of each one of them.
2. Understanding of Thermal Power Plant Operation, turbine governing, different types of high pressure boilers including supercritical and supercharged boilers, Fluidized bed combustion systems.
3. Design of chimney in thermal power plants, knowledge of cooling tower operation, numerical on surface condenser design.
4. Basic knowledge of Different types of Nuclear power plants including Pressurized water reactor, Boiling water reactor, gas cooled reactor, liquid metal fast breeder reactor.
5. Understanding of Power Plant Economics, Energy Storage including compressed air energy and pumped hydro etc.
6. Discussing environmental and safety aspects of power plant operation.

Course Outcomes

After taking this course the students should be able to

1. Select the suitability of site for a power plant.
2. Calculate performance of thermal power plant.
3. Propose ash handling, coal handling method in a thermal power plant.
4. Explain working principle of different types of nuclear power plant.
5. Calculate load factor, capacity factor, average load and peak load on a power plant.
6. Indicate safety aspects of power plants

Syllabus

Unit – I : Energy sources for the generation of electric power, Principal type of power plants, their special features and application. Direct energy conversion systems. Selection of site, Major Power Plants in India and future development scheme.

Unit – II : Modern steam power station and its layout: Classification of steam generator, their special features, performance and efficiencies, Steam separators, economizers, air pre-heaters, super heaters and super heat control, Draft system, Furnaces and combustion equipment, Steam turbines and their governing. Fluidized bed Combustion System, Introduction to Cogeneration.

Unit – III : Coal and ash handling. Condensers, Cooling towers and spray ponds, Deaerators, Feed heaters, Water conditioning plants.

Unit – IV : Nuclear fuels. Generation of nuclear energy by fission. Moderators, reflectors, coolants. Nuclear reactors, their types and application. Radioactive waste disposal and safety aspects.

Unit – V : Power Plant economics, Load duration and load curves. Influence of load factor, capacity factor, utilization and diversity factors and Energy storage methods. Energy management. Instrumentation in power plants. Environmental aspects of power plant operation.

Books

1. El-Wakil; Power Plant Technology, Mc Graw Hills.
2. Skrotzki & Vopat; Power Station Engineering & Economy, McGraw Hills.
3. Weisman & Eckart; Modern Power Plant Engineering, Prentice Hall.
4. P.K. Nag; Power Plant Engineering, Tata McGraw Hills.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Refrigeration and Air Conditioning
Course Number	:	ME429
Credits	:	4
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work/Quiz 15%, Mid Semester Examination (1 Hour) 25%, End Semester Examination (3 Hours) 60%

Course Objectives

1. The purpose of this course is to impart adequate knowledge in both practice and theory.
2. The course structures covers various types of Refrigeration Systems to familiarize the students with the fundamentals of Refrigeration and Cryogenic Systems.
3. After the completion of this course the students will be acquainted with the operation and maintenance/repair of different components of Refrigeration Systems.

Course Outcomes

After taking this course the students should be able to

1. Students will be able to know about different types of Basic Refrigeration cycles and its applications in multi compressor and multi evaporator systems.
2. Students will be able to know the psychometric processes applied to air-conditioning.
3. Students will be able to know about the selection and design of different components of Refrigeration and air-conditioning systems.
4. Student will be able to know about the functioning of different kind of heat energy operated vapour absorption systems.
5. Student will be able to know the selection and application of suitable/eco-friendly refrigerants.

Syllabus

Unit – I : Vapour Compression & Air Refrigeration Systems: Analysis of V.C. System, Multipressure System, Cascading V.C. Systems, Stean Jet Refrigeration, Cold preservation of food, cold storage.

Unit – II : Vapour Absorption Refrigeration System: Properties of binary mixture, processes executed by binary mixture, processes executed by binary mixtures, Acqua-Ammonia and LiBr Absorption systems; rectification. Non-conventional refrigeration systems: vortex tube, thermo electric, pulse-tube, thermo-acoustic refrigeration

Unit – III : Refrigerants: Primary& secondary refrigeration, properties and selection of refrigerants. Impact of CFC's on Ozone layer and global warming, Alternatives of CFS's.

Components of conventional refrigeration systems: Evaporators, Condensers, Compressors, Expansion devices, Generator and Absorber, their types and selection.

Unit – IV : Psychrometry of A.C. processes, Thermal comfort and Comfort chart, A.C. Systems, Cooling and heating loads.

Unit – V : A.C. duct sizing, air distribution, fans, air cleaning, pipe sizing and layout.

A.C. controls: elements of basic control systems, thermostats, humidistats dampers, sequencing of control operations.

Books

1. Roy J. Dossat; Principles of Refrigeration, Wiley and Sons.
2. W.F. Stoecker and J.F. Jones; Refrigeration and Air Conditioning, McGraw Hills
3. C.P. Arora; Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi
4. Manohar Prasad; Refrigeration and Air Conditioning, New Age Publishers

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Fluid Machinery
Course Number	:	ME433
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	ME231
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. Impart knowledge of basic principles of operation of various types of Turbomachines (Turbines and Pumps).
2. Providing knowledge of classification of Turbomachines on the basis of (i) principle of operation (ii) type of flow and (iii) their intended usage.
3. Illustrating the use of Dimensional Analysis in the identification of the relevant dimensionless performance parameters.
4. Elucidating the role of Dimensionless performance parameters in design and selection of the turbomachines.
5. Imparting knowledge of working / operation of axial flow compressors and demonstration of application of principles of fluid flow and thermodynamics in prediction of their performance.

Course Outcomes

After taking this course the students should be able to

1. Define basic principles of operation of different types of Hydraulic Turbines along with their classification.
2. List different Non-Dimensional groups and its use in Model and Similitude.
3. Design and model Impulse and Reaction Turbines.
4. Discuss Rotodynamic Pumps and basic aspects of its design.
5. Explain working of axial flow compressors and predict its performance.
6. Discuss different types of Positive displacement pumps.
7. Judge performance of Hydraulic Ram system.

Syllabus:

Unit – I & II : Hydraulic Turbines: Classification; Energy Transfer between rotor and fluid in Turbomachines; Impulse and Reaction Turbines-Pelton, Francis, Kaplan and Tubular Turbines – Theory, Losses, Efficiencies, Performance Curves; Draft Tube, Cavitations, Governing. Similarity Laws: Similarity Laws, Specific Speed, Model Testing, Instrumentation for Testing of Hydraulic Machines.

Unit – III : Pumps: Classification; Centrifugal & Axial Flow Pumps –Theory, Working Principle, Heads, Losses, Efficiencies, Performance Curves, Surging, Cavitations.

Unit – IV : Compressors: Classification; Axial Fans, Multistage Axial Flow Compressors, Stage Efficiency, Performance Curves, Surging, Choking and Stalling.

Unit – V : Positive Displacement Pumps: Reciprocating Pump, Gear Pump, Vane Pump and Screw Pump. Hydraulic Systems: Accumulator, Intensifier, Hydraulic Lift, Fluid Coupling, Torque Converter, Fluidics.

Books

1. Shepherd DJ, Principles of Turbo-Machines, McGrawHill, 1990
2. Jagdish Lal, Hydraulic Machines, S Chand Publishers
3. Cherkasky, Pump, fan and Blowers, Mir Publications,1960
4. Stephonov ,Axial Flow Compressors, Mir Publications,1965

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	FINITE ELEMENT METHODS
Course Number	:	ME435
Credits	:	4
Course Category	:	OE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

The objectives of this course are to

1. Equip the students with the Finite Element Analysis fundamentals.
2. Enable the students to formulate the design problems into FEA.
3. Enable the students to perform engineering simulations using Finite Element Analysis software (ANSYS & ABAQUS).
4. Enable the students to understand the ethical issues related to the utilization of FEA in the industry.

Course Outcomes

After taking this course the students should be able to

1. Identify mathematical model for solution of common engineering problems.
2. Formulate simple problems into finite elements.
3. Solve structural, thermal, fluid flow and impact problems.
4. Solve complicated 2D structural problems for stress analysis under various loads.
5. Solve Fluid Structure Interaction problems.
6. Appraise the importance of ethical issues pertaining to the effective utilization of FEA.

Syllabus

Unit – I : Basic concept of finite element method, approximate solution; Basic principle of structural dynamics, boundary, initial and Eigen value problems, Integral relations, functional, the variational symbols; Weak formulation of boundary value problems; Rayleigh-Ritz method, Galerkin's method and method of weighted residuals.

Unit – II : Finite element analysis of one dimensional problems-second order boundary value problems, basic steps of finite element analysis e.g. modelling of boundary value problems, Discretisation of domain, derivation of element equations, connectivity of elements, imposition of boundary conditions, solution of equations; Application of finite element analysis to heat transfer, fluid mechanics and solid mechanics.

Unit – III : Bending of beams. Finite element error analysis, approximation errors, various measures of errors, conversions of solutions, accuracy of solutions, problems based on error analysis, Eigen value and time dependant problems.

Unit – IV : Isoperimetric formulations and numerical integration, natural coordinates, approximation of geometry, Pre-processor, calculation of element matrices, assembly of element equations, imposition of boundary conditions, solution of equations and post-processing.

Unit – V : Finite element analysis of two dimensional problems. Interpolation functions, numerical integration and modeling considerations. Application of finite element 2-D analysis to heat transfer, fluid mechanics and solid mechanics.

Books

1. Tripathi R. Chandrupatla & Ashoke D. Belegundu; Introduction to Finite Element in Engineering, Prentice Hall of India, Pvt. Ltd.
2. O.C. Zienkiewiez & K. Morgan; Fnite Elements & Approximations, John Willey & Sons, New York.
3. C.S. Krishnamorthy, Finite Element Analysis, Theory & Programming, Tata McGraw Hills.
4. J.N. Reddy; An introduction to Finite Element Methods 2nd

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Computational Fluid Dynamics
Course Number	:	ME436
Credits	:	4
Course Category	:	OE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. To impart knowledge of different types of fluid flow models and physical boundary conditions.
2. Illustrating the use of Dimensional Analysis in the identification of the relevant dimensionless performance parameters.
3. Providing knowledge of classification of second order Quasi-linear Partial Differential Equations and character of their solutions.
4. To impart knowledge of basic discretization approaches for the partial differential equations.
5. Illustrating the use of Finite Difference Method for the discretization of standard hyperbolic, parabolic and elliptic partial differential equations.
6. Development of concepts of discretization errors and their characteristics for different discretization schemes of 1D linear advection equation and 1D diffusion equation.
7. To impart knowledge of schemes and their performance for the unsteady convection-diffusion type equations.
8. Providing knowledge of iterative solution methods for large, sparse, linear, algebraic systems.
9. To provide a working knowledge of numerical schemes for the discrete solution of incompressible viscous flow equations.

Course Outcomes

After taking this course the students should be able to

1. Classify different types of flow models and boundary conditions.
2. Express the discretization process and various approaches to discretization.
3. Predict discretization errors and their control.
4. Design of Numerical Schemes for 1D model equations
5. Describe large scale linear system solvers (iterative and direct)
6. Propose concepts of numerical schemes for unsteady viscous incompressible flows.

Syllabus

Unit – I : Classification of Pde's: Linear & Non Linear Pde's, Elliptic, Parabolic and Hyperbolic pde's. System of first order pde's Initial and Boundary conditions, Discretization by finite difference approach, Mixed partial derivatives.

Unit – II : Parabolic partial differential equation: Finite difference formulations, Explicit and implicit methods, Parabolic equations in two space dimensions, Various explicit and implicit schemes, Approximate factorization, Tridiagonal system of equations, Extension to three space dimensions, Consistency analysis.

Unit – III : Elliptic pde's & stability analysis, Finite difference formulations, solution procedures, Applications, Von Neumann Stability Analysis, Discrete Petrubation stability analysis, Multi-dimensional problems, Modified equations.

Unit – IV : Hyperbolic pde's Finite difference formulations, Explicit and implicit formulations, Applications, Non-linear problems, Flux corrected schemes, Upwind schemes.

Unit – V : Incompressible Navier Strokes equations, Primitive variable formulations, Vorticity stream function formulations, Poission equation for pressure, Boundary conditions, stability considerations. Applications to various problems.

Books

1. Introduction to Computer fluid dynamics by J.D.Anderson Jr.
2. C.A.J. Fletcher; Computational Fluid Dynamics, Vol1 & 2
3. Hirsch; Numerical internal and external flows Vol1 & 2
4. Pletcher & Tannehill; Computational Fluid Dynamics & Heat Transfer.
5. Computational Fluid Dynamics by Ferziger & Peric, Springer.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Pumps, blowers and compressors
Course Number	:	ME437
Credits	:	4
Course Category	:	OE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. The students will be able understand the basics working of rotodynamics machines
2. The will be able to undertsand the design of positive displacement pumps.
3. They will learn the basic design analysis of axial flow compressors and their performance characteristics.
4. They will learn the design principles of blowers, both centrifugal and axial type.

Course Outcomes

After taking this course the students should be able to

1. Describe basic working of single and multi-stage centrifugal pumps and blowers.
2. Calculate performance and design positive displacement pumps.
3. Perform basic design analysis of axial flow compressors and calculate their performance characteristics.
4. Paraphrase physics of the internal rotating flows.
5. Propose turbo-machines based on their applications.

Syllabus

Unit – I : Pumps: Classification, Centrifugal and Axial Flow Pumps, Working Principle, Heads, Efficiencies, Cavitations, Performance; Multi-stage Pumps; Applications.

Unit – II : Positive Displacement Pumps: Reciprocating Pump, Gear Pump, Vane Pump, Screw Pump; Industrial & General Applications of Pumps.

Unit – III : Blowers: Centrifugal Blowers, Single & Multi-stage theory, adiabatic efficiency, performance; Applications.

Unit – IV : Compressors: Axial Flow Multi-stage compressors, Overall efficiency stage efficiency, symmetrical blading, aerofoil blades; surging, choking and stalling, performance; Applications.

Unit – V : Similarity Laws : Specific Speed, Model Testing of Pumps and Compressors in Laboratory, Predicting Performance of Prototype, Scale Effect.

Books

1. Jagdish Lal; Hydraulic Machines.
2. Cherkarsky; Pumps, Fans, Compressors, Mir Publishers.
3. Vasandani; Heat Engineering.
4. Govinda Rao, T.M.H.; Fluid Flow Machines.
5. Stepanoff; Turboblowers, John Wiley / Chapman & Hall

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Gas Dynamics
Course Number	:	ME438
Credits	:	4
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. The students will be able to learn design internal and external supersonic diffusers
2. They will be able to learn basics of Fanno and Rayleigh flows
3. They learn the basics of normal and oblique shocks.
4. They are conversant with design of converging-diverging nozzles.
5. They learn the basics of subsonic (linear) and transonic (non-linear) velocity potential approach.

Course Outcomes

After taking this course the students should be able to

1. Design internal and external supersonic diffusers
2. Design ramjet and scramjet combustors and nozzles using Fanno and Rayleigh flows
3. Explain design process of supersonic airfoils using shock wave theory.
4. Explain design of converging-diverging nozzles.
5. Describe the basics of acoustics theory based on linearized velocity potential approach.

Syllabus

Unit – I : Introduction to Compressible flow and its applications, Review of Basic Equation in Differential and Integral Form (Mass, Momentum and Energy) for a viscous compressible flow and equations of states. Review of concepts of speed of sound in a stationary compressible medium and the Mach. No Basic differential equations for an inviscid compressible flow Dynamic similarity parameters in a compressible viscous flow.

Unit – II : Steady One Dimensional Flow Model-Basic Equations, Normal Shock Waves (Stationary), Oblique Shock Waves, Reflection & Interaction of Oblique Shock Waves, Expansion Waves Adiabatic Flow in a Constant area passage with friction, frictionless flow in a constant area passage with heat addition/removal.

Unit – III : Quasi-ID Steady Flows-Adiabatic Flow in a variable area passage without friction, Convergent-divergent nozzles and their operating characteristics. Convergent-divergent Supersonic Diffusers, Generalized Quasi-ID Flow Governing Equations.

Unit – IV : Unsteady wave motion Moving normal shocks, reflected shock waves, Physical aspects of wave propagation, Basic elements of acoustic theory. Finite (Non-Linear) waves, Shock-tube relations, Finite compression waves.

Unit – V : Introduction to 2-Dimentional Compressible Flow Velocity considerations, velocity potential, linearized solutions, method of characteristics, numerical solutions.

Books

1. Compressible Flow, SM Yahya, Wiley Eastern, New Delhi.
2. Gas Dynamics, Zucrow & Hoffman, Wiley, New York.
3. Dynamics & Theordynamics-Vol-1, Shapiro, Ronald Press New York.
4. Compressible Fluid Flow, Patrick H. Oosthuizen & William E. Carscallen, McGraw Hills, 1997.
5. Modern Compressible Flow with Historical Perspective, JD Anderson Jr., 2nd Ed., McGraw Hills, 1990.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Manufacturing Systems Engineering
Course Number	:	ME443
Credits	:	04
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Syllabus

Unit 1:

Types of manufacturing systems, Introduction to modeling of manufacturing systems. Queuing theory. Serial manufacturing systems-assembly lines, and transfer lines, paced and unpaced lines.

Unit 2:

Flexible Manufacturing Systems-System Components System Design, System Setup, Scheduling & Control, Flexible assembly Systems, Group Technology- Principles of groups, Coding schemes, Assignment of machines to groups and parts to machines.

Unit 3:

Inventory models MRP & MRPII. Planning, scheduling, sequencing. Integrated production management systems.

Unit 4:

Material handling systems. Storage and retrieval systems.

Unit 5 :

Modeling of manufacturing systems-analytical modeling simulation modeling. JIT production systems.

BOOKS:

1. *Askin & Standridge: Modeling & Analysis of Manufacturing Systems.*
2. *Hitomi; Manufacturing Systems Engineering*
3. *Chary; Production & Operations Management*

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Operation Research
Course Number	:	ME445
Credits	:	04
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Mid Semester Examination (25 Marks), Assignments & Project (15 Marks) & End Semester Examination (60 Marks)

Course Outcomes

After taking this course the students should be able to

1. Identify necessity and development of mathematical models for various industries.
2. Describe basic optimization and simulation techniques applied to various industries.
3. Recall investment analysis and game theory.
4. Predict the industrial systems under the conditions of certainty, uncertainty and risk.
5. Propose a queuing model based upon given data.
6. Derive the network models and understanding of reliability concept.

Syllabus

Unit – I : Overview of Operation Research: Development, Definition, Characteristics and Necessity in Industry, Art of Modeling, Types of Mathematical Models, Approximation and Applications.

Unit – II : Introduction to Optimization : Linear Programming (LP), General Mathematical Formulation for LP, Canonical and Standard forms of LP, Development and Application of Simplex Method, Degeneracy in Simplex Method, Transportation and Assignment Models.

Unit – III : Decision Theory, Games and Investment Analysis: Steps in Decision Theory Approach, Decision making under conditions of certainty, Uncertainty, and Risk. Theory of Games, Competitive Games, Simple applications of Game Theory, Introduction to Investment Analysis, Methods of Investment analysis.

Unit – IV : Queuing Models: Simple Applications of Queuing Models, Waiting time and idle time costs, Transient and Steady State Models, Simulation.

Unit – V : Project Management and Reliability: Phases of Project Management, Work Breakdown Structure (W.B.S.), Network logic, PERT and CPM, Introduction and Concept of Reliability, Methods of increasing Reliability.

Books:

1. Hamidy A Taha, Operational Research: An Introduction, Prentice Hall of India, Pvt Ltd, 2000
2. Ellier and Leibermann,

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Ergonomics
Course No.	:	ME 446
Credits	:	04
Course Category	:	DE
Pre-requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Mid Semester Examination 40 marks End Semester Examination (3 Hours) 60 marks

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Course Objectives

After taking this course the students should be able to

1. Understand and apply ergonomic principles to the creation of safer, healthier and more efficient and effective activities in the workplace.
2. Understand ergonomic risk assessments and appropriate control measure
3. Understand the causes of upper and lower limb disorders and how to reduce them
4. Appreciate workplace layout and equipment design
5. Appreciate environmental aspects of good ergonomic design
6. Understand and exercise social responsibility and ethics in the industrial context

Course Outcomes

After taking this course the students should be able to

1. Describe the best combinations of man, machine and working stations in industries to enhance production and efficiency.
2. Outline different communication systems like Man-Man and Man-Machine systems and different information processes.
3. List different software for the analysis.
4. Recite the human physiology like Muscles, tendons and ligaments etc.
5. Design workstation and work surface etc.
6. Control the effect of Environmental stressors like Noise, vibration, Heat and illuminations etc.
7. Explain the Human factors in Automobiles like Human errors in accidents and safety against them.
8. Accept the engineering challenges regarding the needs of human beings in daily life about machines and systems which are possible for the discomforts in machines and systems.
9. Explain the processes, methods and develop experimental setups for the measurements of working conditions, environment, postures and space etc.
10. List different materials, their properties as well as their applications according to the requirement.
11. Minimize the discomforts and provide the maximum possible comforts to the working conditions, workstations and best suited postures etc.
12. Paraphrase International standards used in ergonomics.

Syllabus

Unit – I : Introduction to Ergonomics, Information Theory, Model of Information Processing, Signal Detection Theory, Man-Man and Man- Machine Communications.

Unit – II : Human Physiology, Work measurement, Motor activities, Cognitive abilities, Compatibility.

Unit – III : Anthropometry: static and Dynamic, Work space, design of work surface, Work station and task, Dynamic loading.

Unit – IV : Effect of Environmental stressors like Noise, vibration, Heat and illumination, International standards related to those.

Unit – V : Human error Accident and safety, Human factors in Automobiles, Working with computers and other systems, Recent trend in the Field.

Books

1. Mark S. Senders & E J MacCormic: Human Factors in Engineering & design, McGrawHills- Text Book
2. D J Oborne: Ergo at work, John Wiley & sons- Rference book
3. Stephen Pheasant: Ergonomics, work & Health. MacMillan Press- Reference Book
4. Encyclopedia of Human Factors and Ergonomics- Reference Book

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Computer Aided Design
Course Number	:	ME451
Credits	:	4
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. To impart knowledge of topics addressing the impact of CAD in engineering design and analysis,
2. To develop the ability to establish the CAD techniques appropriate for mechanical engineering applications.
3. To apply knowledge of interdisciplinary nature of computer graphics, geometric modelling and engineering design in the wide variety of applications.
4. To develop knowledge of theoretical principles in optimization and artificial intelligence.

Course Outcomes

After taking this course students should be able to

1. Describe contemporary graphics hardware.
2. Select and use appropriate engineering computer graphics and geometric modelling techniques for mechanical engineering applications.
3. Write programs that demonstrate geometrical transformations, computer aided analysis and synthesis of mechanisms.
4. List various applications of FEM in Engineering.
5. Propose FEM techniques on basic structural analysis.
6. Propose the appropriate coordinate and shape functions in FEM formulation of Solid Mechanics Problems.
7. Develop knowledge of theoretical principles in optimization and artificial intelligence.
8. Formulate and solve basic engineering optimization problems.

Syllabus

Unit – I : Introduction to computer aided design (CAD), Hardware for CAD, Introduction to programming, programming language for CAD, Modeling techniques, geometric modeling techniques and its functions. Review of Computer Graphics, Transformation, Segmentation, Graphics programming. CAD Model and Drafting of 2-D and 3-D models. Integration of CAD Analysis and Design.

Unit – II : Computer aided linkage synthesis: Animation of machine parts, linkage displays and synthesis, interactive acceleration analysis.Concept of optimal design, deterministic design options problems; the probalistic design option problems, value curves, interaction curves and trade off curves.

Unit – III : Techniques of optimizations, classical methods, linear and non-linear programming in reference to various mechanical design problems, use of tables, charts, interactive optimization.

Unit – IV : Finite Element Method (FEM), direct and variational approach, coordinate transformation, 1-D and 2-D linear and triangular element, isoparametric elements, FEM formulation of solid mechanics problems, CAD application to FEM, interfaces to CAD.

Unit – V : Introduction to Expert systems for CAD, Artificial intelligence in CAD, applications of AI in CAD, components of an expert system, structure and building of an expert systems, knowledge representation, inference mechanisms.

Books

1. Andrew Tizzar;, Computer Aided Engg,. McGraw Hills.
2. David F. Rogers & J.A. Adam; Mathematical elements for Computer Graphics, McGraw Hills.
3. Ryan; Computer Aided Kinetics for Machine Design, Marcel Dekker, Inc.NY.
4. Johson; Mechanical Design Synthesis, Van Nos Band Reinhold Co., NY.
5. Cook; Fundamentals of FEM, McGraw Hill.

Web Links : http://nptel.iitm.ac.in/courses.php

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Numerical Control of Machine Tool
Course Number	:	ME453
Credits	:	4
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. This is a departmental elective course designed to provide necessary knowledge for the operation and programming of numerical control machines.
2. Instruction in Programming using G-Code will be provided. Demonstrations using both onboard programming software and CAM software (Swansoft CNC) willl be given to the students.
3. Use will be made of the MTAB MAXTURN PLUS lathe

Course Outcomes

1. Investigate; understand new and ongoing developments in the area of numerical control of machine tool.
2. Understand basic concepts of machines operated through numerical control.
3. Understand the principles of computer numerical control (CNC) and machine Structures.
4. Be able to interpret a component specification and produce an operational plan for its manufacture.
5. Develop simple part programs with the help of programming languages and manufacture a component.

Syllabus

Unit – I : Numerical Control: Basic Concept, point to point and controlling system, Axis standards, program control, NC components, Testing.

Unit – II : NC Machine Tools, Structure, Drives, Actuation system, Tool and Work handling devices, controller unit.

Unit – III : CNC, DNC and Adaptive Controls, Manual Part Programming, Preparatory & Miscellaneous function, formats, Coding.

Unit – IV : Drilling, Milling and Lathe programming, Parametric solutions.

Unit – V : Programming language, Geometry, Motion and Part processor statements.

Books

1. Barry Leathem Jones, Introduction to Computer Numerical Contro, Pitman/ John Wiley
2. Thyzer. G.E, Computer Numerical Control of Machine Tools, Heinemann Profnl. Pub., Oxford.
3. Kundra Rao & Tiwari, Numerical Control & Computer Aided manufacturing, Tata Mc Graw Hill Pub. New Delhi.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Applied Computational Fluid Dynamics
Course Number	:	ME455
Credits	:	4
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 35% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 40%

Course Objectives

1. Set up the most appropriate CFD model (in terms of boundary conditions, material properties, solution control parameters, solution monitor, etc.) for the problem in hand
2. Set up the most appropriate turbulence model for their particular applications
3. Explain how to conduct both Steady state and Transient (time dependent) fluid flow simulations
4. Explain how to solve for both isothermal and non-isothermal thermo-fluid applications, by including all the necessary modes of heat transfer i.e. conduction, convection and radiation, in their CFD model set up.
5. Explain how to solve for both Incompressible and Compressible fluid flow applications
6. Explain how to solve for Fluid Structure Interactions
7. Describe how and extract the required results and plots from the wealth of information available at the solution stage

Course Outcomes

After taking this course the students should be able to

1. Propose the most appropriate CFD model for the problem in hand and use commercial CFD packages.
2. Model most appropriate turbulence prediction methodology for their particular applications.
3. Conduct both Steady state and Transient fluid flow simulations.
4. Evaluate design data for both isothermal and non-isothermal thermo-fluid applications, by including all the necessary modes of heat transfer and coupled structure problems
5. Propose numerical simulation to design and improve experiments and equipments.
6. Generate, describe, present and derive numerical data faithfully.

Syllabus

Unit – I : **Review of Fluid Mechanics Fundamentals**: Basic Governing Equation of Mass, Momentum and Energy, Boundary Conditions, Modelling of Fluid Flow and coupled problems.

Unit – II : **Numerical Methods:** Fundamentals of Finite Difference and Finite Volume Approaches, Fundamentals of time stepping, General description of solution to ODE's.

Unit – III : **CFD Fundamentals**: Principles, Model set up procedures including Grid Considerations and requirements, Boundary Conditions types and the user input for each boundary type, Physical properties of materials and the required user input, Turbulence modelling, solution control parameters and discretization schemes

Unit – IV : **Case studies of Model Problems on Incompressible flows:** Fluid Flow and heat transfer of a uniform flow past bodies; Modelling periodic flow and heat transfer in a channel**.**

Unit – V : **Case studies of Model Problems on Compressible flows:** Fluid Flow on a uniform flow Airfoil and other bodies.

Unit – VI : **Case studies of Model Problems on Multi-physics:** 1way and 2 way Fluid structure interaction problems transient as well as steady.

Books

1. J.D.Anderson Jr., Introduction to Computer fluid dynamics, Mc Graw Hill
2. CH, Hirsch; Numerical internal and external flows Vol1 & 2, Mc Graw Hill
3. ANSYS User Manual R-14.2

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Heating Ventilation and Air Conditioning
Course Number	:	ME 461
Credits	:	4
Course Category	:	OE
Pre- Requisites	:	None
Contact Hours	:	4
Course Type	:	Theory
Course Assessment	:	Home Assignment 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60 %

Course Objectives:

At the end of this course, the students

1. Will understand well, the importance of maintaining the thermal environment for human comfort which ultimately enhances the working efficiency.
2. Will be in a position to understand the necessity of maintaining the temperature and humidity for various processes in process and pharmaceutical industries.
3. Will become fully aware of the techniques for controlling the contamination of environment which is a must for modern A C systems.

Course Outcomes:

After taking this course, the student shall be able to

1. Define the need and importance of HVAC, handling of different HVAC systems.
2. Describe thermal comfort, its principles and practices, clothing and activities and their impact on comfort and productivity
3. Interpret ventilation impact on human comfort, productivity and health.
4. Propose psychrometry application to HVAC engineering and design different HVAC systems.
5. Explain air and water/refrigerant flow in ducts and pipes, duct and piping design, air distribution in rooms.
6. Paraphrase control of HVAC systems- automatic and manual, different control systems used.

Syllabus:

Unit – I : Human Comfort, requirements of comfort, comfort chart applied psychrometrics of air conditioning systems, components of A.C. System, Central and Unitary A.C. Systems, Industrial and human comfort air conditioning, Cogeneration of power and refrigeration.

Unit – II : Heat transmission in buildings, building survey and locations of equipment, considerations for heating and cooling loads, load calculation procedures.

Unit – III : Air Transmission and distribution systems, fans, pressure losses in ducts and duct sizing methods, Natural supply and extraction systems of ventilation and their combinations. Selection of Air distributions and extraction systems for ventilation, Air Cleaners and Scrubbers.

Unit – IV : Fluid distribution System; open loop & close loop, pipe sizing and layout, Hot water and Steam Heating Systems.

Unit – V : A.C. Controls: Elements of basic control system, pneumatic, electric and electronic control, Thermostats and humidistat, Building-up of control system, Summer-Winter Changeover, Dampers, freeze protection, sequencing of operations, Temperature reset based on zone load.

Books

1. W.F. Stocker & J.w. Jones; Refrigeration & Air Conditioning, McGraw Hills Inc. Intl. Student's Edition.
2. F.C. Quiston & Jerald J. Parker; HVAC Analysis & Design, John Wiley & Sons.
3. HVAC Systems & Equipment, 1992, ASHRAE Handbook.
4. HVAC Fundamentals, 1993, ASHRAE Handbook.
5. Carrier's Handbook of A.C. System, Design, Carrier D/c Co.
6. C.P. Arora; Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Non-Conventional Energy
Course Number	:	ME462
Credits	:	4
Course Category	:	OE
Pre-Requisites (s)	:	None
Contact hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 Hour) 60%

Course Objectives

To impart knowledge of the conventional and non-conventional sources, role of energy in the development of society and its impact on the environment, solar collectors, solar heating and cooling of buildings, solar refrigeration, power generation from solar energy, solar ponds and solar stills, solar energy storage, photovoltaic and solar cells, wind energy resources, MHD Power generation, biomass conversions, geothermal, Ocean and tidal energies; Analysis of flat plate collectors for air and water heaters and aerodynamic design of wind turbines.

Course Outcomes

After taking this course the students should be able to

1. Describe the conventional and non-conventional sources of energy, role of energy in the development of society and its impact on the environment and economy.
2. Calculate direct and diffuse radiation on different dates, times and locations.
3. Formulate flat plate collectors for air and water heaters.
4. Explain concepts, working principles and use of solar heating and cooling in buildings, solar refrigeration, power generation from solar energy, solar ponds and solar stills, solar energy storage, photovoltaic and solar cells
5. Propose site selection for wind energy resources and aerodynamic design of wind turbines.
6. Outline the potential and utilization of biomass, geothermal, Ocean and tidal energies and principles of MHD Power generation.

Syllabus:

Unit – I : Role of energy in the development of society, Indian Energy Scenario, Conventional and Non-Conventional Sources, Energy demand and availability, Impact of energy use on the environment, Economic aspects.

Unit – II : Solar energy as an alternative source, Solar energy collectors, Focusing collectors, Estimation of direct and diffuse radiation, Analysis of flat plate collectors for air and water heaters.

Unit – III : Solar heating and cooling of buildings, solar refrigeration, power generation from solar energy, solar ponds and solar stills, solar energy storage, principles of photovoltaic and solar cells.

Unit – IV : Wind Energy resources, global wind circulations; Indian sites for wind power; Aerodynamic design of wind turbine, Darreus rotor design, propeller type rotor design, blade loads, Governor and Yaw control; Economics of wind power.

Unit – V : MHD (Magneto-Hydro-Dynamic) Power generation system; Biomass Conversions; Geothermal Energy; Energy from Ocean (Ocean Thermal Energy Technology and Energy from Tides).

Books

1. Solar Energy and Applications by S. *P. Sukhatme and J. K. Nayak* (Tata McGraw Hill Pub. Co Ltd.)
2. Non-Conventional Energy Resources by *B H Khan* (Tata McGraw Hill Pub. Co Ltd)

Reference Books

1. Solar Energy Thermal Processes by Duffie and Beckman (Willey & Sons)
2. Power Plant by MM El Wakil (Tata McGraw Hill Pub. Co Ltd.)
3. Non-Conventional Energy Sources by G.D. Rai Khanna Pub., Delhi.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Propulsion Technology
Course Number	:	ME463
Credits	:	4
Course Category	:	DE
Pre-Requisites(s)	:	None
Contact Hours	:	4
Type of Course	:	Theory
Course Assessment	:	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (3 hours) 60%

Course Objectives

1. The students will be able to perform thermodynamic analysis on various air-breathing engines.
2. They will become conversant with design of supersonic and subsonic intakes and nozzles.
3. They will be able to design chemical rockets based on liquid and solid propellant.
4. They will learn propulsion techniques used in space crafts based on electric and MPD thrusters.

Course Outcomes

After taking this course the students should be able to

1. Illustrate the thermodynamic analysis on various air-breathing engines.
2. Explain design of supersonic and subsonic intakes and nozzles.
3. Explain the Design of chemical rockets based on liquid and solid propellant.
4. Design propulsion rockets used in space crafts based on electric and MPD thrusters.
5. Propose relevant propulsion system based on application of aircraft/missile.

Syllabus

Unit – I : Fundaments of jet propulsion, Performance characteristics of propellers, fans and jets for propulsion. Basic configuration and analysis of turbojet, turboprop, turboshaft, turbofans, ramjet and scramjet engines

Unit – II : Aero-thermodynamics of Subsonic, Supersonic Inlets and nozzles, Combustors and after-burners for different propulsion systems using Rayleigh and Fanno flow. Introduction to Stoichiometry in the combustion.

Unit – III : Off-design performance analysis of turboshaft, turbojet and turbofan engines, primarily of single-spool engines.

Unit – IV : Basic Configuration and constructional detail of solid and liquid propellant rocket engines. static performance of rocket engine. Concept and requirement of multistaging. desirable properties and performance of solid and liquid propellants. Basic design consideration of rocket nozzles and combustion chambers.

Unit – V : Non-Conventional rocket propulsion systems and their basic design considerations. Electric, Electrothermal, Electromagnetic and Electrostatic rocket engines. General applications of electro-propulsion systems, nuclear propulsion systems.

Books

1. P.P. Hill & C.R. Peterson; Mechanics & thermodynamics of Propulsion, Addison Wesley Publishing Company (Text Book)
2. Cohen, Rogers and Saravanamuttoo; Gas turbine theory, PHI
3. Sutton & Ross; Rocket Propulsion, John Wiley & Sons.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Energy Conversion Systems Lab.
Course Number	:	ME496
Credits	:	2
Course Category	:	Practical Course
Pre-requisites	:	ME296
Contact Hours	:	3
Type of Course	:	DC
Course Assessment	:	Sessional (60%) End Semester Exam (40%)

Course Objectives

1. How Morse test is performed and the procedure of getting the mechanical efficiency.
2. To give an understanding of the formation and measurement of important pollutants like NOx, CO, CO_2 and UHCs.
3. To equip the students in obtaining and analysing data on a two stroke engine.
4. Carrying out energy balance on a CI Engine to know the utilization of the fuel energy.
5. Importance of carrying out the constant throttle test on a multi cylinder, four stroke S.I. Engine.
6. Energy balance on a gas turbine type 'Continuous Combustion Unit' using Kerosene/LPG and to study its flame structure.
7. Measurement and study of fuel injection timing of a C.I. Engine.
8. Importance of performing motoring test on a two stroke S. I. Engine

Course Outcomes

After taking this course the students should be able to

1. Calculate Mechanical Efficiency of Four stroke SI Engine by Morse Test.
2. Discuss Pollutant monitoring system.
3. Evaluate performance data on two stroke SI engine.
4. Demonstrate Energy balance on CI engine.
5. Demonstrate Constant Throttle test on four cylinders, four stroke SI engine.
6. Calculate Energy Balance on Hilton Combustion Unit using Kerosene/LPG.
7. Calculate fuel injection timing on a CI engine.
8. Perform Motoring Test on a two stroke SI engine.

Syllabus

ROTOR – I :
1. Determination of mechanical efficiency of a four stroke spark ignition engine by Morse test.
2. Study of pollutant monitoring system.
3. To study and obtain performance data on a two stroke spark ignition engine.

ROTOR – II :
4. To carry out energy balance on a compression ignition engine.
5. To perform constant throttle test on a four cylinder four stroke spark ignition engine.
6. To study and measure fuel injection timing on a compression ignition engine.

ROTOR – III :
7. To study flame structure and perform energy balance using Kerosene / LPG on Hilton combustion unit.
8. To perform motoring test on a two stroke spark ignition engine.

Books

1. Holman, J. P., "Experimental Methods for Engineers" 7th Edition, McGraw Hill
2. PK Nag, "Power Plant Engineering" , Tata McGraw Hill
3. Eastop and McConkey, Applied Thermodynamics for Engineering Technologist, Pearson Education Asia, 2003
4. CP Arora, Refrigiration and Air Conditioning, Tata McGraw Hill
5. Obert EF, IC Engine and Air Pollution, Tata McGraw Hill
6. SR Turns, Introduction to Combustion, McGraw Hill

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Manufacturing Technology Lab -III
Course Number	:	ME497
Credits	:	2
Course Category	:	DC
Pre-Requisites(s)	:	ME194
Contact Hours	:	3
Type of Course	:	Lab
Course Assessment	:	Report / Viva 60% End Semester Examination (40%)

Course Objectives

1. To equip the graduates with knowledge of the fundamental techniques to manufacture an engineering component.
2. To equip the graduates with the knowledge to manufacture engineering components through foundry and powder metallurgy techniques.
3. To prepare graduates with a solid foundation to investigate and develop a methodology and establish a manufacturing sequence to fabricate engineering components.
4. To prepare the graduates to find the probable routes to manufacture a particular engineering component.

Course Outcomes

After taking this course the students should be able to

1. Describe manufacturing of engineering components through foundry, machining and powder metallurgy techniques.
2. Propose, investigate and develop a methodology and establish a manufacturing sequence to fabricate engineering components.
3. Suggest the probable routes to manufacture a particular engineering component.
4. Fabricate components through die casting technique.
5. Improve the surface quality of a metallic component.
6. Propose the modern machine tools to enhance the productivity.

Syllabus:

1. a) Fabrication of a pattern for a hollow component (i.e. a pattern needs core/cores).
   b) Develop a core box for the above component.
   c) Cast the pattern developed in pattern making shop.

2. Analyse the cutting parameters of an oblique cutting process.

   a) Signature of cutting tool by using optical projector.
   b) Analysis of cutting forces at various cutting speed, feed and depth of cut.
   c) Measurement of chip thickness of the obtained by using optical projector

3. Fabrication of product through die casting process.

   a) Die casting at various pressures.
   b) Finishing of the product.
   c) Measurement of surface finish, shrinkage, mechanical properties.

4. Fabrication of product through powder metallurgy process.

    a) Study the properties of the metal powder e.g. density etc.
    b) Compaction of metal powder at various pressures
    c) Sintering of the pressings.
    d) Studies the sintered properties of powder components.

5. Study the effect of a) temperature b) quenching media c) time on the properties heat treated metallic component.

6. Fabrication of product CNC production lathe.

    a) Develop programmes for components.
    b) Fabrication of the components.

Books:

1. Manufacturing Processes for Engineering Materials, S. Kalpakjain, Addission-Wesley Publishing Company.
2. Manufacturing Engineering and Technology, S. Kalpakjain and S.R. Schmid, Pearson Education.
3. Grover and Zimmer, CAD/CAM, Prientice Hall Pvt Ltd.

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Fluid Mechanics and Machinery Lab.
Course Number	:	ME498
Credits	:	2
Course Category	:	Practical Course
Pre-Requisites	:	ME231
Contact Hours	:	3
Type of Course	:	DC
Course Assessment	:	Sessional (60%) End-Sem Exam (40%)

Course Objectives

1. Knowledge of Pressure distribution &viscous effect.
2. To study the Performance characteristics of Turbines.
3. To study the Performance characteristics of Pumps.

Course Outcomes

After taking this course the students should be able to

1. Describe pressure distribution around a 2D Circular Cylinder, Naca Airfoil, Turbulent jet etc.
2. Predict performance characteristics of Impulse Turbine.
3. Explain working of Roto-dynamic Pumps.
4. Measure Boundary Layer and analyzing different regimes.
5. Predict performance of different Reaction Turbines.
6. Derive performance characteristics of Positive displacement Pumps.

Syllabus

1. To experimentally determine coefficient of pressure on a uniform flow past a circular cylinder
2. To determine lift and drag characteristics of a NACA airfoil.
3. To determine turbulent boundary layer thickness on flat plate with and without pressure gradient.
4. To determine performance characteristics of a Pelton Turbine.
5. To determine performance characteristics of a Francis Turbine.
6. To determine performance characteristics of a Reciprocating Pump.
7. To determine performance characteristics of a Gear Pump.
8. To determine performance characteristics of a Kaplan turbine.

Books

1. Shepherd DJ, Principles of Turbo-Machines, McGrawHill, 1990
2. Jagdish Lal, Hydraulic Machines, S Chand Publishers
3. FM White, “Viscous Fluid Flow” , McGraw Hills, 2Ed
4. Schilisting H, Boundary Layer Theory, McGraw Hill

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	:	Mechanical Vibration Lab
Course Number	:	ME499
Credits	:	2
Course Category	:	DC
Pre-Requisites(s)	:	ME213
Contact Hours	:	3
Type of Course	:	Lab.
Course Assessment	:	Course Work 60% End Semester Examination (3 hours) 40%

Course Objectives

1. To make the students familiar with the importance of vibrations in various machines and structural systems
2. To develop mathematical model for various mechanical systems and perform vibration analysis theoretically and experimentally
3. To design mechanical systems which can use vibration for useful purposes.
4. To make aware the students about uses of various vibration measuring instruments
5. To suggest the means for vibration reduction in a live problem

Course Outcomes

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

1. List basic aspects of vibrational analysis, considering both single and multi-degree-of-freedom systems.
2. Derive the equations of motion for vibratory systems.
3. Calculate the natural frequency (or frequencies) of vibratory systems and determine the system's modal response.
4. Solve the overall response based upon the initial conditions and/or steady forcing input.
5. Design and use various vibration measuring instruments.
6. Justify the use of exact and approximate methods in the analysis of complex systems.
7. Use application software to solve, predict and analyse vibration problems.

Syllabus

1. Determination of radius of gyration of given bar by using bi-filar suspension,
2. Determination of the frequency of torsional vibration of single rotor shaft system.
3. To study the damped torsional oscillations and to determine the damping coefficients.
4. Verification of displacement curves at various forcing frequencies and to find the response frequency.
5. Study of the un-damped free vibration of an equivalent spring mass system.
6. To study the free vibration of two rotor system and to determine the frequency of vibration theoretically and experimentally.
7. Study of the damped forced vibration of an equivalent spring mass system.
8. Verification of the whirling speeds for different end conditions.

Books/Manuals

1. S.S.Rao, Mechanical Vibration, Prentice Hall.
2. J.S. Rao & K. Gupta; An introductory Course on Theory & Practice of Mech. Vibration, Wiley Eastern Ltd.
3. Laboratory Manual