AMRITSAR COLLEGE OF ENGINEERING AND TECHNOLOGY, AMRITSAR

B. Tech. Mechanical Engineering

Syllabus Scheme Structure for 2016 Batch onwards
Total Contact Hours = 30
Total Credits = 28

Course: B. Tech.
Semester: 3rd

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credit
		L	T	P	Internal	External		
ACFE 16311	Functional English-I	1	-	1	50	-	50	2
ACAP 16312	Aptitude-I	1	1	-	50	-	50	2
ACME 16301	Strength of Materials-I	3	1	-	40	60	100	4
ACME 16302	Theory of Machines-I	3	1	-	40	60	100	4
ACME 16303	Applied Thermodynamics-I	3	1	-	40	60	100	4
ACME 16304	Engineering Materials, Metallurgy and Manufacturing-I	4	-	-	40	60	100	4
ACME 16305	Machine Drawing	2	-	4	40	60	100	4
ACME 16306	Engineering Materials, Metallurgy and Manufacturing-I Lab	-	-	2	30	20	50	1
ACME 16307	Strength of Materials Lab	-	-	2	30	20	50	1
ACTR 16308	Workshop Training#	-	-	-	60	40	100	2
	Total	**17**	**4**	**9**	**420**	**380**	**800**	**28**

#Workshop Training will be imparted in the Institution at the end of 2nd semester for Four (04) weeks duration (Minimum 36 hours per week). Industrial tour will also form part of this training.

Total Contact Hours = 30
Total Credits = 27

Course: B. Tech.
Semester: 4th

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credit
		L	T	P	Internal	External		
ACFE 16411	Functional English-II	1	-	1	50	-	50	2
ACAP 16412	Aptitude-II	1	1	-	50	-	50	2
ACAM 16401	Mathematics-III	3	1	-	40	60	100	4
ACME 16402	Strength of Materials-II	3	1	-	40	60	100	4
ACME 16403	Theory of Machines-II	3	1	-	40	60	100	4
ACME 16404	Applied Thermodynamics-II	3	1	-	40	60	100	4
ACME 16405	Engineering Materials, Metallurgy and Manufacturing-II	4	-	-	40	60	100	3
ACME 16406	Engineering Materials, Metallurgy and Manufacturing-II Lab	-	-	2	30	20	50	1
ACME 16407	Theory of Machines Lab	-	-	2	30	20	50	1
ACME 16408	Applied Thermodynamics Lab	-	-	2	30	20	50	1
GF 400	General Fitness	-	-	-	100	-	100	1
	Total	**18**	**5**	**7**	**490**	**360**	**850**	**27**

Syllabus of Functional English for B.Tech (All Branches)- 3rd Semester

ACFE-16311 Functional English I (Theory)

Internal Marks: 30
External Marks: 20
Total Marks: 50

L	T	P
1	1	0

Objectives and Expected Outcome:- In the fast paced world of emerging technologies and social networking tools, spoken aspect of English language has become mandatory for industry-wise placement of a student. There should be special heed given to this and the emphasis should also be laid accordingly on various activities to enhance student participation in the activities of Functional English. Having achieved the target of maximum student participation through the updated syllabus of Functional English, continuous and consistent growth of an individual personality can be expected.

Section - A

Basic concepts of Self Introduction-

Components of Self Introduction, Exemplary Performances, Student Performances on Self Introduction

Body Language –Various Gestures and Postures in Different Real Life Situations through Topic Presentation/ Extempore activities

Section- B

Vocabulary Building- Common Vocabulary and its usage, Board Presentation/ Power Point Presentation/ Chart Presentation of Common Vocabulary

Listening Skills through Case Studies- Concept of Case Studies, Practical Examples & Enactment of Case Studies

Section - C

Reading Sessions-Online Reading Resources, Newspaper, Discussion on certain famous books/ articles, Journals and blogs, Discussion on the basis of Online Reading Resources, Newspaper, Discussion on certain famous books/ articles, Journals and blogs

Section- D

Attitude Building- Introduction to the concept and various components, Attitude Building with special focus on Assertive, Aggressive and submissive attitude through practical examples and enactment i.e. GDs and Mock Interviews

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APTITUDE - I(CSE/IT/ME/CE/EE/ECE)

Subject Code : ACAP - 16312

Internal Marks : 50		**L**	**T**	**P**
External Marks :		**1**	**1**	**0**
Total Marks	**50**			

Objectives: The major purpose of an aptitude test is to examine the basis of abstract reasoning, manual deftness, verbal and numerical skills, clerical work, general awareness, mechanical ability and speed.

Section –A

Number System –I , Number System –II , HCF & LCM , Percentage - I, Percentage - II

Section -B

Average , Ratio & Proportion , Profit & loss & Discount - I, Profit & loss & Discount - II.

Section - C

Time and work – I , Time and work – II , Pipes and Cisterns.

Section - D

Time and Distance , Trains , Boats and streams.

References :

1. Quantitative Maths : Arihant Publishers.
2. Objective Mathematics : R S Aggarwaal.
3. Quantitative Maths : TMH Publications.

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& Technology, Amritsar.

ACME 16301 - Strength of Materials-I

Internal Marks: 40
External Marks: 60
Total Marks: 100

L T P
3 1 0

Course Objectives

Understand the basic concepts of stress, strain and their variations due to different type of loading. Know design considerations of structures subject to wide range of loading including thermal loads. Predict shear forces and bending moments in beams. Solve problems subjected to the simple as well as combined twisting and bending moments. Calculate slope and deflection under different loading and supporting conditions.

Detailed Contents

Section–I
Simple, Compound Stresses and Strains:
Stress and Strain and their types, Hook's law, longitudinal and lateral strain, Poisson's ratio, stress-strain diagram for ductile and brittle materials, extension of a bar due to without and with self weight, bar of uniform strength, stress in a bar, elastic constants and their significance, Young's modulus of elasticity, modulus of rigidity and bulk modulus. Temperature stress and strain calculation due to axial load and variation of temperature in single and compound bars. Two dimensional stress system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stresses.

Section –II
Bending Moment (B.M) and Shear Force (S.F) Diagrams:
S.F and B.M definitions; relation between load, shear force and bending moment; B.M and S.F diagrams for cantilevers, simply supported beams with or without overhangs, and calculation of maximum B.M and S.F and the point of contra flexure under the following loads:
(a). Concentrated loads
(b). Uniformity distributed loads over the whole span or part of span
(c). Combination of concentrated and uniformly distributed load
(d). Uniformly varying loads
(e). Application of moments

Section –III
Bending Stresses in Beams:
Assumptions in the simple bending theory; derivation of formula and its application to beams of rectangular, circular and channel, I and T- sections. Combined direct and bending stresses in afore-mentioned sections, composite/flitched beams.

Section –IV
Torsion:
Derivation of torsion equation and its assumptions and its application to the hollow and solid circular shafts. Torsional rigidity, combined torsion and bending of circular shafts; principal stress and maximum shear stresses under combined loading of bending and torsion.

Section–V
Columns and struts:
Introduction, failure of columns, Euler's formula, Rankine-Gordon's formula for axially loaded columns and their applications.
Section –VI
Slope and deflection:
Relationship between moment, slope and deflection; method of integration, Macaulay's method, moment area method and use of these methods to calculate slope and deflection for the following:
(a). Cantilevers
(b). Simply supported beams with or without overhang

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Under concentrated loads, uniformly distributed loads or combination of concentrated & uniformly distributed loads.

References:

- R.K. Rajput, **Strength of Materials**, S.Chand & Company.
- E.P. Popov, **Mechanics of Materials**-(SI Version), Prentice Hall India.
- R.S Lehri and A.S. Lehri, **Strength of Materials**, Kataria and Sons.
- R.C. Hibbeler, **Mechanics of Materials**, Pearson.
- Timoshenko and Young, **Elements of Strength of Materials**, East West Press (EWP).
- James M Gere and Barry J. Goodno, **Strength of Materials**, Cengage Learning.

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ACME 16302 - Theory of Machines-I

Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
3	1	0

Course Objectives

Draw velocity and acceleration diagrams of various mechanisms. Understand the working of various primitive components of machine. Determine the physical parameters of power transmission devices, friction devices and different dynamometers. Parameters like fluctuation of speed and energy of a flywheel in a vehicle, moment of governor, dynamometers etc. Understand working of brakes and clutches, belts, chains and rope drives for power transmission.

Detailed Contents

Section –I
Basic Concept of machines:
Link, Mechanism, Kinematic Pair and Kinematic Chain, Principles of Inversion, Inversion of a Four Bar Chain, Slider-Crank-Chain and Double Slider-Crank-Chain. Graphical and Analytical methods for finding: Displacement, Velocity, and Acceleration of mechanisms (including Corliolis Components).

Section –II
Lower and higher Pairs:
Universal Joint, Calculation of maximum Torque, Steering Mechanisms including Ackerman and Davis approximate steering mechanism, Engine Indicator, Pentograph, Straight Line Mechanisms, Introduction to Higher Pairs With Examples

Section –III
Belts, Ropes and Chains:
Material & Types of belt, Flat and V-belts, Rope & Chain Drives, Idle Pulley, Intermediate or Counter Shaft Pulley, Angle and Right Angle Drive, Quarter Turn Drive, Velocity Ratio, Crowning of Pulley, Loose and fast pulley, stepped or cone pulleys, ratio of tension on tight and slack side of belts, Length of belt, Power transmitted by belts including consideration of Creep and Slip, Centrifugal Tensions and its effect on power transmission.

Section –IV
Cams:
Types of cams and follower, definitions of terms connected with cams. Displacement, velocity and acceleration diagrams for cam followers. Analytical and Graphical design of cam profiles with various motions (SHM, uniform velocity, uniform acceleration and retardation, cycloidal Motion). Analysis of follower motion for circular, convex and tangent cam profiles.

Section –V
Flywheels:
Turning moment and crank effort diagrams for reciprocating machines' Fluctuations of speed, coefficient of fluctuation of speed and energy, Determination of mass and dimensions of flywheel used for engines and punching machines.

Section –VI
Governors:
Function, types and characteristics of governors. Watt, Porter, Proell and Hartnell governor. Numerical problems related to these governors. Sensitivity, stability, isochronisms and hunting of governors. Governor effort and power, controlling force curve, effect of sleeve friction.

References:

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- S. S. Rattan, **Theory of Machines**, Tata McGraw Hill, New Delhi.
- Jagdish Lal, **Theory of Mechanisms & Machines**, Metropolitan Book Co.
- Thomas Beven, **Theory of Machines**, Longman's Green & Co., London.
- W. G. Green, **Theory of Machines**, Blackie & Sons, London
- V.P. Singh, **Theory of Machines** Dhanpat Rai.

ACME 16303 - Applied Thermodynamics-I

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Course Objectives

Study of combustion and thermal aspects in I.C. engines, steam power plants. Understanding of properties of the steam, use of Steam tables and mollier charts, vapour power cycles. Working of different types of boilers, mountings and accessories boiler performance and trial. Steam flow through nozzles. Steam turbines, Analysis of performance of turbines, governing of turbines. Working of different types of steam condensers, calculation of cooling loads.

Detailed Contents:

Section – I
Thermodynamics of Combustion of Fuel in IC engines:
Principle of Combustion; Stoichiometric and non-stoichiometeric combustion; Calculations of air fuel ratio: analysis of combustion, conversion of volumetric analysis into gravimetric analysis and vice versa, Actual weight of air supplied, use of mole for solution of combustion problems; Calorific value of fuel; Enthalpy of formation; Enthalpy of reaction/combustion; Various stages of combustion in IC engines; Pressure-time/crank - Angle diagrams; various phenomenon such as turbulence, squish and swirl, dissociation, pre-ignition/auto- ignition, and after burning etc.; Theory of knocking (i.e., detonation) in SI and CI Engines; Emission from boilers and IC engines (SI and CI) and methods to reduce/control them.

Section – II
Properties of Steam:
Pure substance; Steam and its formation at constant pressure: wet, dry, saturated and super-heated steam; Sensible heat (enthalpy), latent heat and total heat (enthalpy) of steam; dryness fraction and its determination; degree of superheat and degree of sub-cool; Entropy and internal energy of steam; Use of Steam Tables and Mollier Chart; Basic thermodynamic processes with steam (isochoric, isobaric, isothermal, isentropic and adiabatic process) and their representation on T-S Chart and Mollier Charts (h-s diagrams). Significance of Mollier Charts.

Section – III
Steam Generators:
Classification and Applications of Steam Generators; Working and constructional details of fire-tube and water-tube boilers: (Cochran, Lancashire, Babcock and Wilcox boilers); Merits and demerits of fire-tube and water-tube boilers; Modern high pressure boilers (Benson boiler, La Mont boiler) and Super critical boilers (**Once through boilers-*Tower type***); Advantages of forced circulation; Description of boiler mountings and accessories: Different types of Safety Valves, Water level indicator, pressure gauge, Fusible plug, Feed pump, Feed Check Valve, Blow-off Cock, Steam Stop-Valve, Economiser, Super-heater; Air pre-heater and Steam accumulators; Boiler performance: equivalent evaporation, boiler efficiency, boiler trial and heat balance; Types of draught and Calculation of chimney height.

Section – IV
Vapour Power Cycle:
Carnot Cycle and its limitations; Rankine steam power cycle, Ideal and actual; Effect of pressure, temperature and vacuum on Rankine Efficiency; Rankine Cycle Efficiency and methods of improving Rankine efficiency: Reheat cycle, Bleeding (feed-water-heating), Regenerative Cycle; Ideal working fluid.

Section – V
Steam Nozzles:
Definition, types and utility of nozzles; Flow of steam through nozzles; Condition for maximum discharge through nozzle; Critical pressure ratio, its significance and its effect on discharge; Area of

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throat and at exit for maximum discharge; Effect of friction; Nozzle efficiency; Calculation of Nozzle dimensions (length and diameters of throat and exit).

Section – VI
Steam Turbines:
Introduction; Classification; Impulse versus Reaction turbines.
Simple impulse turbine: pressure and velocity variation, Compounding of impulse turbines: purpose, types and pressure and velocity variation, Velocity diagrams/triangles; Combined velocity diagram/triangle and calculations for force, axial thrust, work, power, blade efficiency, stage efficiency, maximum work and maximum efficiency overall efficiency and relative efficiency, effect of blade friction on velocity diagram, effect of speed ratio on blade efficiency, condition for axial discharge.
Reaction Turbine: pressure and velocity variation, velocity diagrams/triangles, Degree of reaction, combined velocity diagram/triangle and calculations for force, axial thrust, work, power, blade efficiency, stage efficiency, overall efficiency and relative efficiency, maximum work and maximum efficiency; Calculations of blade height; Losses in steam turbines; Co-generation; Economic assessment; Governing of steam turbines.

Section – VII
Steam Condensers:
Function; Elements of condensing unit; Types of condensers; Dalton's law of partial pressures applied to the condenser problems; Condenser and vacuum efficiencies; Cooling water calculations; Effect of air leakage; Method to check and prevent air infiltration; Description of air pump; Cooling towers: function, types and their operation.

References:

- R. Yadav, Sanjay and Rajay, **Applied Thermodynamics**, Central Publishing House.
- Mahesh M Rathore, **Thermal Engineering**, McGraw Hill Education Pvt. Ltd.
- D.S. Kumar and V.P. Vasandani, **Heat Engineering**, Metropolitan Book Co. Pvt. Ltd.
- G. Rogers and Y. Mayhew, **Engineering Thermodynamics**, Pearson.
- W.A.J. Keartan, **Steam Turbine**: Theory and Practice, ELBS Series.
- V. Ganeshan, **Internal Combustion Engines**, Tata McGraw Hill.

ACME 16304 - Engineering Materials, Metallurgy and Manufacturing-I

Internal Marks: 40
External Marks: 60
Total Marks: 100

L T P
4 0 0

Course Objectives

Understand the significance of the metallurgical characteristics of engineering materials. Understand the structural changes in metals with respect to time temperature transformations. Explain the use and significance of various heat treatment processes and their applications for different materials. Understand the role of Fe-C and TTT diagram for controlling the desired structure and properties of the materials. Understand the relationship between material properties and manufacturing processes required during the process of forming.

Detailed Contents

Section–I
Crystallography:
Atomic structure of metals, atomic bonding in solids, crystal structures, crystal lattice of body centered cubic, face centered cubic, closed packed hexagonal; crystalline and non crystalline materials; crystallographic notation of atomic planes; polymorphism and allotropy; imperfection in solids: theoretical yield strength, point defects, line defects and dislocations, interfacial defects, bulk or volume defects. Diffusion: diffusion mechanisms, steady-state and non steady-state diffusion, factors affecting diffusion. Theories of plastic deformation, recovery, re-crystallization.

Section–II
Phase Transformation:
General principles of phase transformation in alloys, phase rule and equilibrium diagrams, Equilibrium diagrams of Binary systems. Iron carbon equilibrium diagram and various phase transformations. Time temperature transformation curves (TTT curves): fundamentals, construction and applications.

Section–III
Heat Treatment:
Principles and applications. Processes viz. annealing, normalizing, hardening,
tempering. Surface hardening of steels: Principles of induction and oxyacetylene flame hardening. Procedure for carburising, nitriding and cyaniding. Harden-ability: determination of harden-ability. Jominy end-quench test. Defects due to heat treatment and their remedies; effects produced by alloying elements. Composition of alloy steels.

Section–IV
Ferrous Metals and Their Alloys:
Introduction, classification, composition of alloys, effect of alloying elements (Si, Mn, Ni, Cr, Mo, W, Al) on the structures and properties of steel.

Section–V
Metal Forming:
Introduction and classification. Rolling process: introduction, classification, rolling mills, products of rolling, rolling defects and remedies. Forging: open and closed die forging, forging operations, hammer forging, press forging and drop forging, forging defects, their causes and remedies. Extrusion: classification, equipment, defects and remedies. Drawing: drawing of rods, wires and tubes, draw benches, drawing defects and remedies. Sheet metal forming operations: piercing, blanking, embossing, squeezing, coining, bending, drawing and deep drawing, and spinning. Punch and die set up. Press working: press types, operations, press tools, progressive and combination dies, Process variables.

Section-VI
Powder Metallurgy:

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Introduction, advantages, limitations, and applications methods of producing metal powders, briquetting and sintering.

References:

- B. Zakharov, **Heat Treatment of Metals,** University Press.
- T. Goel and R.S. Walia, **Engineering Materials & Metallurgy.**
- Sidney H Avner, **Introduction to Physical Metallurgy,** Tata Mcgraw-Hill.
- V. Raghavan, **Physical Metallurgy: Principles and Practice,** PHI Learning.
- H.S. Shan, **Manufacturing Processes,** Vol. I&II, , Pearson Publishers
- PC Sharma, **A Text Book of Production Technology,** S. Chand & Company Ltd.
- Serope Kalpakjian and S R. Schmid, **Manufacturing Engineering & Technology,** Pearson Publishers.

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ACME 16305 - Machine Drawing

Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
2	0	4

Course Objectives

Read the blue prints with detail of dimension, section, tolerance and machining symbols. Find t appropriate thread for nut and bolt as per the application. Draw the bill of material for engineeri drawing of some mechanical components/assembly. Draw the views of assembly with the given deta of various components. Recommend the appropriate pipe joint as per position and application. Concep of limits, fits and tolerances.

Detailed Contents:

Unit –I
Introduction: Principles of Drawing, Requirements of production drawing, Sectioning and conventiona representation, Dimensioning, symbols of standard tolerances, Machining Symbols, introduction an Familiarization of Code IS: 296

Unit –II
Fasteners: Various types of screw threads, types of nuts and bolts, screwed fasteners, welding joints and riveted joints

Unit –III
Assembly and Disassembly:

(a). Couplings: Solid or Rigid Coupling, Protected Type Flange coupling, Pin type flexible coupling, muff coupling, Oldham, universal coupling, claw coupling, cone friction clutch, free hand sketch of single plate friction clutch.
(b). Knuckle and cotter joints
(c). Pipe and Pipe Fittings: flanged joints, spigot an socket joint, union joint, hydraulic an expansion joint
(d). IC Engine Parts: Piston, connecting rod
(e). Boiler Mountings: Steam stop valve, feed check valve, blow off cock.
(f). Bearings: Swivel bearing, thrust bearing, Plummer block, angular plumber block
(g). Miscellaneous: Screw Jack, , Crane hook,

NOTE:

I. Drawing Practice is to be done as per code IS: 296.
II. First angle projection to be used. Drawings should contain bill of materials and should illustrate finish.
III. The syllabus given above indicates the broad outlines and the scope of the subject to be covered. It is not necessary to cover all the drawing exercises of the types of machine tools mentioned above.

References:

- Ajit Singh, **Machine Drawing (including Auto CAD),** Tata McGraw Hill.
- N.D. Bhatt, **Machine Drawing,** Charotar publications.
- N. Sidheshwar, **Machine Drawing,** Tata McGraw Hill.
- P.S. Gill, **Machine Drawing,** BD Kataria and Sons.
- V Lakshmi Narayanan and Mathur, **Text-book of Machine Drawing.**

ACME 16306 - Engineering Materials, Metallurgy and Manufacturing Lab - I

Internal Marks: 30	**P**
External Marks: 20	**2**
Total Marks: 50	

List of Experiments

1. Preparation of models/charts related to atomic/crystal structure of metals.
2. Annealing the steel specimen and study the effect of annealing time and temperature on hardness of steel.
3. Hardening the steel specimen and study the effect of quenching medium on hardness of steel.
4. Practice of specimen preparation (cutting, mounting, polishing, and etching) of mild steel, aluminium and hardened steel specimens.
5. Study of the microstructure of prepared specimens of mild steel, Aluminium and hardened steel.
6. Identification of ferrite and pearlite constituents in given specimen of mild steel.
7. Determination of hardenability of steel by Jominy End Quench Test.

ACME 16307 - Strength of Materials Lab

Internal Marks: 30 **P**
External Marks: 20 **2**
Total Marks: 50

List of Experiments:

1. To perform tensile test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.
2. To perform compression test on Cast Iron.
3. To perform any one hardness tests (Rockwell, Brinell or Vicker's test).
4. To perform impact test to determine impact strength.
5. To perform torsion test and to determine various mechanical properties.
6. To perform Fatigue test on circular test piece.
7. To perform bending test on beam and to determine the Young's modulus and modulus of rupture.
8. To evaluate the stiffness and modulus of rigidity of helical coil spring.

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ACME 16402 - Strength of Materials-II

Internal Marks: 40	**L T P**
External Marks: 60	**3 1 0**
Total Marks: 100	

Course Objectives

Understand the concepts of strain energy, resilience, stress under impact loading. Know about the general theories of failure for complex loading, stresses and strain energy in coiled springs, leaf and spiral springs. Calculate stress and strains in thin, thick cylinder and spherical vessels subjected to internal pressure. Calculate stresses in curved sections of various cross sections due to applied bending moment. Calculate stresses in rotating elements.

Detailed Contents

Section –I
Strain energy:
Introduction to strain energy, energy of dilation and distortion. Resilience, stress due to suddenly applied loads. Castigliano's and Maxwell's theorem of reciprocal deflection.

Section –II
Theories of failure:
Maximum principal stress theory, maximum shear stress theory, maximum principal strain theory, total strain energy theory, shear strain energy theory. Derivation of equation for these theories and their application to problems related to two dimensional stress systems.

Section –III
Springs:
Open and closed coiled helical springs under the action of axial load and/or couple. Flat spiral springs- derivation of formula for strain energy, maximum stress and rotation. Leaf spring; deflection and bending stresses.

Section –IV
Thin cylinders and spheres:
Calculation of Hoop stress, longitudinal stress in a cylinder, effects of joints, change in diameter, length and internal volume. Principal stresses in sphere, change in diameter and internal volume.

Section –V
Thick cylinders:
Derivation of Lame's equations, calculation of radial, longitudinal and hoop stresses and strains due to internal pressure in thick cylinders, compound cylinders, hub shrunk on solid shafts, shrinkage allowance and shrinkage stress.

Section –VI
Bending of curved beams:
Calculation of stresses in cranes or chain hooks, rings of circular and trapezoidal section, and chain links with straight sides.

Section –VII
Shear stresses in beams:
Shear stress distribution in rectangular, circular, I, T and channel section; built up beams. Shear centre and its importance.

Section –VIII
Rotational discs:
Stresses in rotating discs and rims of uniform thickness; disc of uniform strength.

References:

- R.K. Rajput, ***Strength of Materials,*** S. Chand & Company.
- E.P. Popov, ***Mechanics of Materials-(SI Version),*** Prentice Hall India.
- R.S Lehri and A.S. Lehri***, Strength of Materials,*** Kataria and Sons.
- R.C. Hibbeler, ***Mechanics of Materials,*** Pearson.
- Timoshenko and Young, ***Elements of Strength of Materials,*** East West Press (EWP).
- James M Gere and Barry J. Goodno, ***Strength of Materials,*** Cengage Learning.

ACME 16403 - Theory of Machines–II

Internal Marks: 40	**L T P**
External Marks: 60	**3 1 0**
Total Marks: 100	

<u>Course Objectives</u>

Analyze the static and dynamic balancing of forces acting on machine members. Have knowledge of gears, gear trains, gyroscopic motion and couples, methods of static force analysis of simple mechanisms, analytical and graphical method for Dynamic force analysis. Ensure balancing of various dynamic parts like rotating and reciprocating masses as in case of V-engines etc.

<u>Detailed Contents</u>

Section –I
Static force analysis:
Concept of force and couple, free body diagram, condition of equilibrium, static equilibrium of mechanism, methods of static force analysis of simple mechanisms. Power transmission elements, considerations of frictional forces

Section –II
Dynamic force analysis:
Determination of forces and couples for a crank, inertia of reciprocating parts, dynamically equivalent system, analytical and graphical method, inertia force analysis of basic engine mechanism, torque required to overcome inertia and gravitational force of a four bar linkage.

Section –III
Balancing:
Necessity of balancing, static and dynamic balancing, balancing of single and multiple rotating masses, partial unbalanced primary force in an engine, balancing of reciprocating masses, and condition of balance in multi cylinder in line V-engines, balancing of machines, rotors, reversible rotors.

Section –IV
Gears:
Toothed gears, types of toothed gears and its terminology. Path of contact, arc of contact, conditions for correct gearing, forms of teeth, involutes and its variants, interference and methods of its removal. Calculation of minimum number of teeth on pinion/wheel for involute rack, helical, spiral, bevel and worm gears. Center distance for spiral gears and efficiency of spiral gears

Section –V
Gear Trains:
Types of gear trains, simple, compound and epicyclic gear trains, problems involving their applications, estimation of velocity ratio of worm and worm wheel.

Section –VI
Gyroscopic motion and couples:
Effect on supporting and holding structures of machines. stabilization of ships and planes, Gyroscopic effect on two and four wheeled vehicles.

Section –VII
Kinematic synthesis of Mechanism:
Freudenstien equation, Function generation errors in synthesis, two and three point synthesis, Transmission angles, least square techniques.

References:

- S.S. Rattan, ***Theory of Machines,*** Tata Mc. Graw Hill.
- John, Gordon, and Joseph, ***Theory of Machines and Mechanisms,*** Oxford University Press.
- Hams Crone and Roggers, ***Theory of Machines.***
- Shigley, ***Theory of Machines,*** Mc Graw Hill.
- V.P. Singh, ***Theory of Machines,*** Dhanpat Rai and Sons.

ACME 16404 - Applied Thermodynamics-II

Internal Marks: 40	**L T P**
External Marks: 60	**3 1 0**
Total Marks: 100	

Course Objectives

Understand the constructional & design features, working principles & performance parameters and conduct thermodynamic analysis of reciprocating, centrifugal and axial flow compressors. Blading design, velocity triangles and estimate the performance of centrifugal and axial flow compressors. Conduct thermal analysis of gas turbines. Conduct thermal analysis of jet propulsion and rocket propulsion systems.

Detailed Contents

Section–I
Air Compressors- Introduction:
Classification of Air Compressors; Application of compressors and use of compressed air in industry and other places; Stagnation and static values of thermodynamic properties.

Section–II
Reciprocating Air Compressors:
Single stage single acting reciprocating compressor (with and without clearance volume): construction, operation, work input and best value of index of compression, Isentropic, polytropic and isothermal efficiencies and their representation in terms of ratio of areas representing various energy transfers on T-s coordinates, heat rejected to cooling medium, isothermal, overall thermal, isentropic, polytropic, mechanical efficiency, Clearance Volumetric efficiency, Overall volumetric efficiency, effect of various parameters on volumetric efficiency, free air delivery; **Multistage compressors:** purpose and advantages, construction and operation, work input, heat rejected in intercoolers, minimum work input, optimum pressure ratio;

isothermal, *overall thermal*, *isentropic, polytropic* and *mechanical* efficiencies; Performance curves.

Section–III

Positive Displacement Rotary Compressors Introduction:

Comparison of rotary positive displacement compressors with reciprocating compressors; Classification of rotary compressors; Construction, operation, work input and efficiency of positive displacement type of rotary compressors like Roots blower, Lysholm compressor and Vane type Blower. Complete representation of compression process on P-v and T-s coordinates with detailed description of areas representing total work done.

Section – IV

Centrifugal Compressors:

Stagnation and static values of pressure, Temperature and enthalpy etc. for flow through dynamic rotary machines; Thermodynamic analysis of centrifugal compressor: Stage, polytropic, isentropic and isothermal efficiencies, velocity vector diagrams for centrifugal compressors, power calculation, , pre-guided vanes, pre-whirl, Slip factor, power input factor. Modes of energy transfer in impeller and diffuser. Degree of reaction and its derivation; energy transfer in backward, forward and radial vanes; surging and choking in centrifugal compressors. Various losses occurring in centrifugal compressors and application of centrifugal compressors.

Section – V

Axial Flow Compressor:

Components of axial flow compressor, aerofoil blading, angle of attack, coefficients of lift and drag, turbine versus compressor blades, velocity vector diagrams, thermodynamic analysis and power calculations. Modes of energy transfer in rotor and stator blade flow passages. Work done factor, Degree of reaction and Blade efficiency, Isentropic polytropic and Isothermal Efficiencies. Surging, choking and stalling in axial flow compressors, characteristic curves for axial flow compressor, flow parameters of axial flow compressor pressure coefficient, flow coefficient, work coefficient and temperature rise coefficient ,specific speed etc. Comparison of axial flow compressor with centrifugal compressor and reaction turbine. Application of axial flow compressors.

Section – VI

Gas Turbines:

Classification and comparison of the Open and Closed cycles; Classification on the basis of combustion (at constant volume or constant pressure); Comparison of gas turbine with a steam turbine and IC engine; Fields of application of gas turbines; Position of gas turbine in power industry; Thermodynamics of constant pressure gas turbine cycle (Brayton cycle); Calculation of net output, work ratio and thermal efficiency of ideal and actual cycles; Cycle air rate; Thermal refinements like regeneration, inter-cooling and re-heating and their different combinations in the gas turbine cycle and their effects on gas turbine cycle; Closed and Semi-closed gas turbine cycle; Requirements of a gas turbine combustion chamber; Blade materials. Gas turbine fuels.

Section – VII

Jet Propulsion:

Principle of jet propulsion; Description of different types of jet propulsion systems like rockets and thermal jet engines, like (i) Athodyd (ramjet and pulsejet), (ii) Turbojet engine, and (iii) Turboprop engine. Thermodynamics of turbojet engine components; Development of thrust and methods for its boosting/augmentation; Thrust work and thrust power; Propulsion energy, Propulsion and thermal (internal) efficiencies; Overall thermal efficiency; Specific fuel consumption; Rocket propulsion, its thrust and thrust power; Propulsion and overall thermal efficiency; Types of rocket motors (e.g. solid propellant and liquid propellant systems); Various common propellant combinations (i.e. fuels) used in rocket motors; Cooling of rockets; Advantages and disadvantages of jet propulsion over other propulsion systems; Brief introduction to performance characteristics of different propulsion systems; Fields of application of various propulsion units.

References:

1. R. Yadav, Sanjay and Rajay, ***Applied Thermodynamics***, Central Publishing House.
2. Mahesh M Rathore, ***Thermal Engineering***, McGraw Hill Education Pvt. Ltd.
3. D.S. Kumar and V.P. Vasandani, ***Heat Engineering***, Metropolitan Book Co. Pvt. Ltd.
4. K. Soman**,** ***Thermal Engineering***, PHI Learning Pvt. Ltd.
5. D.G. Shephered, ***Principles of Turbo machinery,*** Macmillan.
6. H. Cohen, G.F.C. Rogers and M. Sarvan, ***Gas Turbine Theory***, Longmans.

ACME 16405 - Engineering Materials, Metallurgy and Manufacturing-II

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

<u>Course Objectives</u>

Fundamental principles related to different types of casting and welding processes. Identify various defects during casting and welding processes. Knowledge of Destructive and non destructive testing; suitable metal casting and metal joining processes to fabricate an engineering product. Understand the concepts of various machines. Able to select important process parameters for minimum time and cost.

<u>Detailed Contents</u>

Section–I
Introduction:
Classification of manufacturing processes, selection criteria for manufacturing processes, general trends in manufacturing.

Section–II
Casting Processes:
Introduction to metal casting. patterns: types, materials and allowances. Moulding materials: moulding sand compositions and properties, sand testing, types of moulds, moulding machines. Cores: function, types, core making process, core-prints, chaplets. Elements of gating system and risers and their design. Design considerations of castings. Melting furnaces, cupola furnace, charge calculations, induction furnaces. Casting processes: sand casting, shell mould casting, investment casting, permanent mould casting, full mould casting, vacuum casting, die casting, centrifugal casting, and continuous casting. Metallurgical considerations in casting, Solidification of metals and alloys, directional solidification, segregation, nucleation and grain growth, critical size of nucleus. Cleaning and finishing of castings.

Section–III
Welding Processes:
Introduction and classification of welding processes, to welding processes, weldability, welding terminology, general principles, welding positions, and filler metals. Gas welding: principle and practice, oxy-acetylene welding equipment, oxy-hydrogen welding. Flame cutting. Electric arc welding: principle, equipment, relative merits of AC & DC arc welding. Welding processes:

manual metal arc welding, MIG welding, TIG welding, plasma arc welding, submerged arc welding. Welding arc and its characteristics, arc stability, and arc blow. Thermal effects on weldment: heat affected zone, grain size and its control. Electrodes: types, selection, electrode coating ingredients and their function. Resistance welding: principle and their types i.e. spot, seam, projection, up-set and flash. Spot welding machine. Advanced welding processes: friction welding, friction stir welding, ultrasonic welding, laser beam welding, plasma arc welding, electron beam welding, atomic hydrogen welding, explosive welding, thermit welding, and electro slag welding. Considerations in weld joint design. Other joining processes: soldering, brazing, braze welding.

Section–IV
Inspection and Testing:
Casting defects, their causes and remedies. Welding defects, their causes and remedies. Destructive and non destructive testing: visual inspection, x-ray radiography, magnetic particle inspection, dye penetrate test, ultrasonic inspection, eddy current testing, hardness testing, and micro hardness testing.

Section–V
Metal Cutting:
Introduction to machining processes, classification, Mechanics of chip formation process, concept of shear angle, chip contraction and cutting forces in metal cutting, Merchant theory, tool wear, tool life, machinability. Cutting tools: types, geometry of single point cutting tool, twist drill and milling cutter, tool signature. Cutting tool materials: high carbon steels, alloy carbon steels, high speed steel, cast alloys, cemented carbides, ceramics and diamonds, and CBN. Selection of machining parameters. Coolants and lubricants: classification, purpose, function and properties.

Section-VI
Machine Tools:
Lathe: classification, description and operations, kinematic scheme of lathe, and lathe attachments. Shaping and planing machine: classification, description and operations, drive mechanisms. Milling machine: classification, description and operations, indexing devices, up milling and down milling. Drilling machine: classification, description and operations. Boring machine: classification, description and operations. Grinding machines: classification, description and operations, wheel selection, grinding wheel composition and nomenclature of grinding wheels, dressing and truing of grinding wheels. Speed, feed and machining time calculations of all the above machines.

References:

- B. L. Juneja and G. S. Sekhon, ***Fundamentals of Metal Cutting & Machine Tools,*** New Age International (P) Ltd.
- H.S. Shan, ***Manufacturing Processes,*** Vol. I&II, , Pearson Publishers
- PC Sharma, ***A Text Book of Production Technology,*** S. Chand & Company Ltd.
- M. P. Groover, ***Fundamentals of Modern manufacturing,*** Wiley
- A. Manna, ***A Textbook of Manufacturing Science and Technology,*** PHI Publishers.
- P. N. Rao, ***Manufacturing Technology, Foundry, Forming & Welding,*** Tata McGraw Hill.
- R.S. Parmar, ***Welding Engineering & Technology,*** Khanna Publishers.
- Serope Kalpakjian and Steven R. Schmid, ***Manufacturing Engineering and Technology,*** Pearson Publishers.

ACME 16406 - Engineering Materials, Metallurgy and Manufacturing Lab-II

Internal Marks: 30 **P**
External Marks: 20 **2**
Total Marks: 50

<u>List of Experiments</u>

Casting:

1. To determine clay content, moisture content, hardness of a moulding sand sample.
2. To determine shatter index of a moulding sand sample.
3. To test tensile, compressive, transverse strength of moulding sand in green condition.
4. To determine permeability and grain fineness number of a moulding sand sample.

Welding:

1. To make lap joint, butt joint and T- joints with oxy- acetylene gas welding and manual arc welding processes
2. To study MIG, TIG and Spot welding equipment and make weld joints by these processes.

Machining and Forming

1. To study constructional features of following machines through drawings/ sketches:
   a. Grinding machines (Surface, Cylindrical)
   b. Hydraulic Press
   c. Draw Bench
   d. Drawing and Extrusion Dies
   e. Rolling Mills
2. To grind single point and multipoint cutting tools
3. To prepare job on Lathe involving specified tolerances; cutting of V- threads and square threads.
4. To prepare job on shaper involving plane surface,
5. Use of milling machines for generation of plane surfaces, spur gears and helical gears; use of end mill cutters.
6. To determine cutting forces with dynamometer for turning, drilling and milling operations.

Note: At least one industrial visit must be arranged for the students for the live demonstration of Casting, Welding, Forming and Machining processes.

ACME 16407 - Theory of Machines Lab

Internal Marks: 30 **P**
External Marks: 20 **2**
Total Marks: 50

<u>List of Experiments</u>

1). To study the various inversions of kinematic chains.
2). To study the various types of dynamometers.
3). Conduct experiments on various types of governors and draw graphs between height and equilibrium speed of a governor.

4). Determination of gyroscopic couple (graphical method).
5). Balancing of rotating masses (graphical method).
6). Cam profile analysis (graphical method)
7). Determination of gear- train value of compound gear trains and epicyclic gear trains.
8). To draw circumferential and axial pressure profile in a full journal bearing.
9). To determine coefficient of friction for a belt-pulley material combination.
10). Determination of moment of inertia of flywheel.

ACME 16408 - Applied Thermodynamics Lab

Internal Marks: 30	**P**
External Marks: 20	**2**
Total Marks: 50	

List of Experiments

1. To study the construction and operation of 2 stroke and 4 stroke Petrol and Diesel engines using actual engines or models.
2. To study the actual valve timing diagram of a 4 stroke petrol and diesel engines and learn its impact on the performance of engine.
3. To perform a boiler trial to estimate equivalent evaporation and efficiency of a fire tube boiler.
4. To determine dryness fraction of steam using Seperating Calorimeter.
5. To determine the brake power, indicated power, friction power and mechanical efficiency of a multi-cylinder petrol engine running at constant speed (Morse Test).
6. To conduct performance testing of a single-cylinder diesel engine from no load to full load (at constant speed) in terms of brake power, indicated power, mechanical efficiency, specific fuel consumption, break thermal efficiency and volumetric efficiency, and to make the heat balance sheet.
7. To conduct the experiment on two stroke air compressor and to find out its volumetric efficiency and isothermal efficiency.
8. To determine the volumetric and isothermal efficiency of two stage air compressor.

Total Contact Hours = 32
Total Credits = 29

	Course: B.Tech Semester: 5th									
Course Code	**Course Name**	**M Code**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credit**
			L	**T**	**P**	**Internal**	**External**		
ACFE 16511	Functional English-III	40081	1	1	-	50	-	50	2
ACAP 16512	Aptitude-III	40082	1	1	-	50	-	50	2
ACME 16501	Automobile Engineering	40571	4	-	-	40	60	100	4
ACME 16502	Design of Machine Elements-I	40572	3	-	-	40	60	100	3
ACME 16503	Fluid Mechanics	40573	3	1	-	40	60	100	4
ACME 16504	Mechanical Measurement and Metrology	40574	3	-	-	40	60	100	3
ACME 16505	Computer Aided Design and Manufacturing	40575	4	-		40	60	100	4
ACME 16506	Automobile Engineering Lab	40576	-	-	2	30	20	50	1
ACME 16507	Mechanical Measurement and Metrology Lab	40577	-	-	2	30	20	50	1
ACME 16508	Fluid Mechanics Lab	40578	-	-	2	30	20	50	1
ACME 16509	Computer Aided Design and Manufacturing Lab	40579	-	-	2	30	20	50	1
ACME-16510	Design of Machine Elements-I Practice	40580	-	-	2	30	20	50	1
ACTR 16510	Institutional/Industrial Training##	40581	-	-	-	60	40	100	2
	Total		**19**	**3**	**10**	**510**	**440**	**950**	**29**

##The marks of Industrial/Institutional Training imparted at the end of 4th Semester will be included here.

Total Contact Hours = 31
Total Credits = 28

	Course: B.Tech Semester: 6th									
Course Code	**Course Name**	**M Code**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credit**
			L	**T**	**P**	**Internal**	**External**		
ACFE 16611	Functional English-IV	40092	1	1	-	50	-	50	2
ACAP 16612	Aptitude-IV	40093	1	1	-	50	-	50	2
ACME 16601	Design of Machine Elements-II	40582	4	1	-	40	60	100	5
ACME 16602	Heat Transfer	40583	3	1	-	40	60	100	4
ACME 16603	Fluid Machinery	40584	3	1	-	40	60	100	4
ACME 16604	Industrial Automation and Robotics	40585	4	-	-	40	60	100	4
ACME/DE--	Department Elective	40586	4	-	-	40	60	100	4
ACME 16606	Heat Transfer Lab	40587	-	-	2	30	20	50	1
ACME 16607	Fluid Machinery Lab	40588	-	-	2	30	20	50	1
ACME 16608	Industrial Automation and Robotics Lab	40589	-	-	2	30	20	50	1
GF 16600	General Fitness	40590	-	-	-	100	-	100	-
	Total		**20**	**5**	**6**	**490**	**360**	**850**	**28**

Total Contact Hours = 24
Total Credits = 20

	Course: B.Tech **Semester: 7/8th**								
Course Code	**Course Name**	**M-Code**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credit**
			L	**T**	**P**	**Internal**	**External**		
ACME 16701	Industrial Engineering and Management	40617	3	-	-	40	60	100	3
ACME 16702	Refrigeration and Air Conditioning	40618	3	1	-	40	60	100	4
ACME 16703	Mechanical Vibrations	40619	3	1	-	40	60	100	4
ACME 16704 (Open Elective)	Operation Research	40620	3	-	-	40	60	100	3
ACME 16705	Refrigeration and Air Conditioning Lab	40621	-	-	2	30	20	50	1
ACME 16706	Mechanical Vibrations Lab	40622	-	-	2	30	20	50	1
ACME 16707	Major Project	40623	-	-	4	100	100	200	2
ACTP-16701	Pre Placement Activity	40624	-	-	2	50	-	50	1
GF 16700	General Fitness	40625	-	-	-	100	-	100	1
	Total		**12**	**2**	**10**	**470**	**380**	**850**	**20**

Total Credits = 15

	Course: B.Tech **Semester: 7/8th**					
Course Code	**Course Name**	**M-Code**	**Marks Distribution**		**Total Marks**	**Credit**
			Internal	**External**		
ACME 16801	Industrial Training-II	40626	300	200	500	10
ACME 16802	Six Sigma/Software Training	40627	150	100	250	5
	Total		**450**	**300**	**750**	**15**

DEPARTMENT ELECTIVES

Group I

ACME/DE-1.1 - I.C. ENGINES

ACME/DE-1.2 - CRYOGENIC TECHNOLOGY

ACME/DE-1.3 - NON CONVENTIONAL ENERGY RESOURCES

ACME/DE-1.4 - ENERGY CONSERVATION AND MANAGEMENT

ACME/DE-1.5 - FLUID MECHANICS-II

ACME/DE-1.6 - SOLAR ENERGY

ACME/DE-1.7 - HEAT EXCHANGER DESIGN

ACME/DE-1.8 - POWER PLANT ENGINEERING

ACME/DE-1.9 - GAS DYANAMICS

Group II

ACME/DE-2.0 - PRODUCT DESIGN AND DEVELOPMENT

ACME/DE-2.1 - NON TRADITIONAL MACHINING

ACME/DE-2.2 - INDUSTRIAL ENGINEERING

ACME/DE-2.3 - OPERATIONS MANAGEMENT

ACME/DE-2.4 - NON DESTRUCTIVE TESTING

ACME/DE-2.5 - TOTAL QUALITY MANAGEMENT

ACME/DE-2.6 - MAINTENANCE AND RELIABILTY ENGINEERING

ACME/DE-2.7 - MATERIAL MANAGEMENT

ACME/DE-2.8 - MANAGEMENT INFORMATION SYSTEM

ACME/DE-2.9 - ENTREPRENEURSHIP

Group III

ACME/DE-3.1 - MACHINE TOOL DESIGN

ACME/DE-3.2 - OPTIMIZATION TECHINIQUES

ACME/DE-3.3 - TOOL DESIGN

ACME/DE-3.4 - FINITE ELEMENT METHOD

ACME/DE-3.5 - EXPERIMENTAL STRESS ANALYSIS

ACME/DE-3.6 - INDUSTRIAL TRIBOLOGY

ACME/DE-3.7 - THEORY OF PLASTICS

ACME/DE-3.8 - MECHATRONICS

NOTE:

1. A department elective subject may normally be offered only if at least 10 students of the class opted for it
2. The student shall select both the electives courses from the same group out of three groups (Group I, Group II, Group III)

5th Semester

ACME 16501 - AUTOMOBILE ENGINEERING

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Course objectives:

Understand about the basic structure, chassis and suspension, application of automobile engineering in industry and field and awareness of the terminology and inventory related to automobiles. Understand the working and description of power unit, fuel supply system, lubrication and cooling system of automobiles. To understand and select the suitable transmission system used in Modern Automobile Engineering. To identify and rectify the problems in various systems of automobiles.

Detailed Contents:

Section - I

Introduction:

Basic structure and terminology, general layout and type of automotive vehicles (i.e. e-vehicles, farm and constructional vehicles), Frameless and unitary construction; position of power unit.

Section - II

Power Unit:

Power requirements - motion resistance and power loss, tractive effort and vehicle performance curves; selection of power unit and engine performance characteristics; pollution due to vehicle emission and exhaust emission control system, silencers, types of pistons and rings

Section - III

Fuel Supply System:

Air cleaner and fuel pumps; Air fuel requirements and carburation; constructional details of Carter carburetors and fuel injection systems; MPFi (Petrol), Diesel fuel system - cleaning, injection pump, injector and nozzles, Common Rail fuel supply system. Alternate fuel system for CNG, LPG and LNG.

Section - IV

Lubrication and Cooling Systems:

Necessity of lubrication; Desirable properties of lubricants; various types of lubricants and oil additives; different systems of lubrication - oil filters, oil pumps and oil pressure indicator; crank case ventilation and dilution. Purpose of cooling, air and water cooling systems; radiator, thermostat, pump and fan.

Section - V

Chassis and Suspension:

Loads on the frame, considerations of strength and stiffness, engine mounting, independent suspension systems (Mac Pherson, Trailing Links, Wishbone), shock absorbers and stabilizers, Air suspension system, wheels and tyres, tyre wear types, constructional details of plies.

Section - VI

Transmission system:

Basic requirements and standard transmission systems; constructional features of automobile clutch, gear box, differential (limited slip differential), front and rear axles; overdrives, propeller shaft, universal joint and torque tube drive; Rear wheel vs front wheel drive, principle of automatic transmission (CVT –Continuous Variable Transmission)

Section - VII

Steering System:

Requirement and steering geometry; castor action, camber and king pin angle, toe-in of front wheels, steering linkages and steering gears; wheel alignment; power steering, Ball re-circulating mechanism

Section – VIII

Braking System:

General braking requirements; Mechanical, hydraulic, vacuum power and servo brakes; Weight transfer during braking and stopping distances

Section – IX

Electric System:

Classification, Introduction to Conventional and microprocessor based ignition systems; Charging, capacity ratings and battery testing; starter motor and drive arrangements: voltage and current regulation, vehicle dashboard components, cruise control system and sensors: RPM sensor, coolant and fuel sensor, speed sensor, GPS, fire sensor. ECU (Electrical Control Unit)

References:

- W.H Crouse, Automotive mechanics, McGraw Hill
- J. Heitner, Automotive Mechanics, East West Press
- Kirpal Singh, Automobile Engineering Vol. I and II, Standard Publishers
- J. Webster, Auto Mechanics, Glencoe Publishing Co.
- P.S Gill, Automobile Engineering, S.K Kataria

ACME 16502 - DESIGN OF MACHINE ELEMENTS -1

Internal Marks: 40 **L T P**
External Marks: 60 **3 0 0**
Total Marks: 100

Course Objectives:

To understand the meaning of machine design process and types of design processes. To understand the various design considerations like stress concentration factor, factor of safety and to be able to segregate components and design them independently. Design various basic machine components under different loading conditions.

Detailed Contents:

Section- I
Basics of Machine Design

Meaning of design with special reference to machine design, definition and understanding of various types of design, design process, design and creativity, general design considerations, concept of tearing, bearing, shearing, crushing, bending and fracture

Section - II
Design Considerations

Concept of concurrent engineering in design, Manufacturing considerations in machine design, stress concentration, factor of safety under different loading conditions, design for static loading, design for variable loading for both limited and unlimited life, concept of fatigue and endurance strength.

Section - III
Design of fasteners
Permanent Joints:

- Design of rivets for boiler joints, lozenge joints, eccentrically loaded joints.
- Design of welded joints for various loading conditions in torsion, shear or direct loads, eccentrically loaded joints.

Temporary Joints:

Design of spigot and socket cotter joint, Gib and cotter joint and knuckle joint.

Section - IV
Design of shaft and axles

Design of solid and hollow shafts for transmission of torque, bending moments and axial forces, Design of shaft for rigidity, Design of axle.

Section - V
Design of keys and couplings

Design of keys, design of splines, design of sleeve and solid muff coupling, clamp or compression coupling, rigid and flexible flange coupling, design of universal joint.

References:

- Joseph E. Shigley, Charles Russell Mischke, Richard Gordon Budynas, Mechanical
- Engineering Design, McGraw-Hill
- Robert C. Juvinall Fundamentals of machine component design, Wiley
- V.K Jadon, Analysis and design of machine elements, I.K. International
- V.B Bhandari, Design of Machine elements, Tata Mc. Hill
- S.S Jolly, Design of machine elements-I, Dhanpat Rai and Co.

Note:

Guide lines regarding paper setting:

Part A- 10 questions of 2 marks each. All compulsory.

Part B- There will be 6 questions of 10 marks each. Candidate will be required to attempt any four questions.

ACME 16503 - FLUID MECHANICS

Internal Marks: 40	**L T P**
External Marks: 60	**3 1 0**
Total Marks: 100	

Course Objectives:

Be familiar with the adhesion theories and effect of adhesion on friction and wear. To understand the concept of surface topography and know how to model a rough engineering surface.

Detailed Contents:

Section – I

Fundamentals of Fluid Mechanics:

Introduction; Applications; Concept of fluid; Difference between solids, liquids and gases; Concept of continuum; Ideal and real fluids; Fluid properties: density, specific volume, specific weight, specific gravity, viscosity (dynamic and kinematic), vapour pressure, compressibility, bulk modulus, Mach number, surface tension and capillarity; Newtonian and non-Newtonian fluids.

Section – II

Fluid Statics:

Concept of static fluid pressure; Pascal's law and its engineering applications; Hydrostatic paradox; Action of fluid pressure on a plane submerged surface (horizontal, vertical and inclined): resultant force and centre of pressure; Force on a curved surface due to hydrostatic pressure; Buoyancy and flotation; Stability of floating and submerged bodies; Metacentric height and its determination; Periodic time of oscillation; Pressure distribution in a liquid subjected to :
(i) Constant acceleration along horizontal, vertical and inclined direction (linear motion),
(ii) Constant rotation.

Section – III

Fluid Kinematics:

Classification of fluid flows; Lagrangian and Euler flow descriptions; Velocity and acceleration of fluid particle; Local and convective acceleration; Normal and tangential acceleration; Path line, streak line, streamline and timelines; Flow rate and discharge mean velocity; One dimensional continuity equation; Continuity equation in Cartesian (x,y,z), polar (r,θ) and cylindrical (r,θ,z) coordinates; Derivation of continuity equation using the Lagrangian method in Cartesian coordinates; Rotational flows: rotation, vorticity and circulation; Stream function and velocity potential function, and relationship between them; Flow net.

Section – IV

Fluid Dynamics:

Derivation of Euler's equation of motion in Cartesian coordinates, and along a streamline; Derivation of Bernoulli's equation (using principle of conservation of energy and equation of motion) and its applications to steady state ideal and real fluid flows; Representation of energy changes in fluid system (hydraulic and energy gradient lines); Impulse momentum equation;

Kinetic energy and momentum correction factors; Flow along a curved streamline; Free and forced vortex motions.

Section – V
Dimensional Analysis and Similitude:
Need of dimensional analysis; Fundamental and derived units; Dimensions and dimensional homogeneity; Rayleigh's and Buckingham's π - method for dimensional analysis; Dimensionless numbers (Reynolds, Froudes, Euler, Mach, and Weber) and their significance; Need of similitude; Geometric, kinematic and dynamic similarity; Model and prototype studies; Similarity model laws.

Section – VI
Internal Flows:
Laminar and Turbulent Flows: Reynolds number, critical velocity, critical Reynolds number, hydraulic diameter, flow regimes; Hagen – Poiseuille equation; Darcy equation; Head losses in pipes and pipe fittings; Flow through pipes in series and parallel; Concept of equivalent pipe; Roughness in pipes, Moody's chart.

Section- VII
Pressure and Flow Measurement:
Manometers; Pitot tubes; Various hydraulic coefficients; Orifice meters; Venturi meters; Borda mouthpieces; Notches (rectangular, V and Trapezoidal) and weirs; Rotameters.

References:

- D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, S.K. Kataria and Sons Publishers.
- S.K. Som, G. Biswas and S. Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill.
- J.F. Douglas and J.M. Gasiorek, J.A. Swaffield and L.B. Jack, Fluid Mechanics, Pearson.
- B.R. Munson, D.F. Young, T.H. Okiishi and W.W. Huebsch, Fundamentals of Fluid Mechanics, John Wiley and Sons.

ACME 16504 - MECHANCIAL MEASUREMENTS AND METROLOGY

Internal Marks: 40	**L T P**
External Marks: 60	**3 0 0**
Total Marks: 100	

Course Objectives:

Understand the classification of measurements and measurement standards used in industrial applications. Understand the concept of static and dynamic characteristic of a measuring instrument. Understand about various errors in measuring systems and evaluate the errors by statistical methods. Know about functions and types of sensors and transducers and their utility in instrumentation. Use various instruments for measurements like pressure, flow, temperature etc. in manufacturing or process industry.

Detailed Contents:

Section – I
General Concepts:
Need and classification of measurements and instruments; basic and auxiliary functional elements of a measurement system; Mechanical versus electrical / electronic instruments; primary, secondary and working standards.

Section – II
Static, Dynamic Characteristics of Instruments and Errors in Measurement:
Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and linearity, threshold and resolution; speed of response, lag, fidelity and dynamic error, dead time and dead zone. Sources of errors, systematic and random errors.

Section – III
Metrology:
Line, end and wavelength standards; linear measurements - vernier scale and micrometer, vernier height gauge and depth guage; comparators - their types, relative merits and limitations; Angular measurements - sine bar, clinometer, angle guage; concept and measurement of straightness and flatness by interferometry; surface roughness - specifications and measurement by Talysurf, Measurement of major diameter, minor diameter, effective diameter, pitch, angle and form of threads for internal and external threads; measurement of tooth thickness, pitch and checking of profile for spur gears.

Section – IV
Pressure and Flow Measurement:
Bourdon tube, diaphragm and bellows, vacuum measurement-Mcleodguage, thermal conductivity guage and ionization guage; Dead weight guage tester. Electromagnetic flux meters, ultra-sonic flow meters and flow visualisation techniques.

Section – V

Temperature Measurement:

Thermal expansion methods - bimetallic thermometers, liquid-in-glass thermometer and filled-in-system thermometers; thermo-electric sensors - common thermo couples, special materials and configurations; metal resistance thermometers and thermistors; optical and total radiation pyrometers; calibration standards.

Section – VI

Speed, Force, Torque and Shaft Power Measurement:

Mechanical tachometers, vibration reed tachometer and stroboscope; proving ring, hydraulic and pneumatic load cells, torque on rotating shafts; Absorption, transmission and driving dynamo meters.

References:

- E.O Doebelin, Measurement System: Application and Design, McGraw Hill
- J.P Holman, Experimental Methods for Engineers, McGraw Hill
- D.S Kumar, Mechanical Measurement and Control, Metropolitan Book Co.
- R.K Jain, Engineering Metrology, Khanna Publishers
- B.C Kuo, Automatic Control systems, Prentice Hall

ACME-16505 COMPUTER AIDED DESIGN AND MANUFACTURING

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Course Objectives

Illustrate the role of computer systems in design and manufacturing. Understand geometric models, geometric modeling and geometric transformation techniques in CAD. Describe the key concept of NC/CNC/DNC and part programming to establish FMS. Understand the elements of automated manufacturing environment.

Detailed Contents:

Section – I

Introduction to CAD/CAM:

Introduction to CAD/CAM and its role in Product design and development cycle. CAD/CAM system and its evaluation criteria. CAD/CAM input and output devices, display devices. Functions of a graphics package; Graphics standards. Application areas of CAD.

Section – II

Geometric Modeling:

Need and types of Geometric Modeling: Wireframe; surface and solid modeling; Geometric Modeling Techniques: Boundary Representation (B-rep); Constructive Solid Geometry (CSG); Parametric Modeling Technique; concepts of hidden-line removal and shading; Mechanical Assembly Kinematics analysis and simulation.

Section – III

Representation of curves and surfaces: Non-parametric and parametric representation of curves; Parametric representation of Hermite Cubic; Bezier curves; Uniform and Non-uniform B-spline curves; Surface and its analysis. Representation of Analytical and synthetic surfaces(Bilinear Surface; Coons Surface Patch; Bi-cubic Surface Patch; Bezier Surface; B-spline surface).

Section – IV

Geometric Transformations: Overview of Mathematics preliminaries; matrix representation of 2 and 3 dimensional transformation for translation; scaling; rotation about principal axes; mirror imaging about a plane; principal axes and origin; Concatenation of transformation matrices. Applications of geometric transformations.

Section – V

Finite Element Method overview:

Overview of FEM, Advantages and applications, recent advance in FEM, FEA software Basic principles and general procedure of FEM.

Section – VI
NC/CNC/DNC Machine Tools:
NC machine tools- basic components coordinate systems; features of NC machine tools. Computerized Numerical Control (CNC): Tooling for NC machines - tool presetting equipment; flexible tooling; tool length compensation; tool path graphics; NC motion control system; Direct Numerical Control. Adaptive control in machining system. Rapid prototyping.

Section – VII
CNC Part Programming:
Basic terminology of Parts programming; Block format; Coordinate system; fixed/floating zero; types and classification of machine codes; Manual part programming; Computer aided and computer assisted part programming.

Section – VIII
Group Technology:
Basic fundamentals of Group Technology; Part families; part classification and coding system: Group technology machine cells: Advantages of Group Technology.

Section – IX
Computer Aided Process Planning:
Introduction and benefits of CAPP. Types of CAPP systems; machinability data selection systems in CAPP.

Section – X
Computer Integrated Manufacturing Systems:
Basic Concepts of CIM: CIM Definition, The meaning of Manufacturing, Types of Manufacturing systems; Need, Elements, Evolution of CIM; Benefits of CIM; Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations; FMS benefits.

References:

- Groover Mikell P., Emory W. Zimmer's, "CAD/CAM: Computer-Aided Design and Manufacturing", PHI, 2nd Edition, 1984.
- Bedworth D. D., Henderson M. R& P.M. Wolfe, "Computer Integrated Design and Manufacturing", Tata McGraw Hill, 2nd Edition, 1991.
- Ibraham Z., "CAD/CAM - Theory and Practice", Tata McGraw Hill, 2nd Edition, 2009.
- Rao P. N, "CAD/CAM Principles and Applications", Tata McGraw Hill, 2nd Edition, 2004.
- Elanchezhian C., Selwyn Sundar T., Shanmuga Sunder G., "Computer Aided Manufacturing", Laxmi Publication, 2nd Edition, 2007.

ACME 16506 - AUTOMOBILE ENGINEERING LAB

Internal Marks: 30	**L T P**
External Marks: 20	**0 0 2**
Total Marks: 50	

List of Experiments:

1. Valve refacing and valve seat grinding and checking for leakage of valves.
2. Trouble shooting in cooling system of an automotive vehicle.
3. Trouble shooting in the ignition system, setting of contact breaker points and spark plug gap.
4. Demonstration of steering system and measurement of steering geometry angles and their impact on vehicle performance.
5. Trouble shooting in braking system with specific reference to master cylinder, brake shoes, overhauling of system and the adjusting of the system and its testing.
6. Fault diagnosis in transmission system including clutches, gear box assembly and differential.
7. Replacing of ring and studying the method of replacing piston.

ACME 16507 - MECHANICAL MEASUREMENTS AND METROLOGY LAB

Internal Marks: 30	**L T P**
External Marks: 20	**0 0 2**
Total Marks: 50	

List of Experiments:

1. Measurement of an angle with the help of sine bar.
2. Measurement of surface roughness of a machined Plate, Rod and Pipe.
3. Measurement of gear elements using profile projector.
4. Measurement of effective diameter of external threads using Three wire method.
5. Measurement of thread element by Tool makers' microscope.
6. Calibration of a pressure guage with the help of a dead weight guage tester.
7. Use of stroboscope for measurement of speed of shaft.
8. Measurement of dimensions using vernier caliper.
9. Measurement of diameter of circular object using Micrometer.

ACME 16508 - FLUID MECHANICS LAB

Internal Marks: 30 | **L T P**
External Marks: 20 | **0 0 2**
Total Marks: 50

List of Experiments:

1. To determine the metacentric height of a floating vessel under loaded and unloaded conditions.
2. To study the flow through a variable area duct and verify Bernoulli's energy equation.
3. To determine the coefficient of discharge for an obstruction flow meter (venturi meter/ orifice meter)
4. To determine the discharge coefficient for a V- notch or rectangular notch.
5. To study the transition from laminar to turbulent flow and to ascertain the lower critical Reynolds number.
6. To determine the hydraulic coefficients for flow through an orifice.
7. To determine the friction coefficients for pipes of different diameters.
8. To determine the head loss in a pipe line due to sudden expansion/ sudden contraction/ bend.
9. To determine the velocity distribution for pipeline flow with a pitot static probe.
10. Experimental evaluation of free and forced vortex flow.

ACME 16509 - COMPUTER AIDED DESIGN AND MANUFACTURING LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

List of Experiments:

1. Introduction to modeling (using any CAD software):

1. 2D drawing using sketcher – 2 Drawings
2. 3D modeling using 3D features (Modeling of Crane Hook, Bench Vice, Screw Jack components)
3. Assembling and drafting (any 2 above mentioned assemblies) with proper mating conditions and interference checking.
4. Surface modeling – (Computer mouse, Plastic bottles with spraying Nozzle)

2. Computer Aided Manufacturing:

1. Manual part programming on CNC Lathe and CNC Milling – (4 programs, 2 for each)
2. Computer Aided Part programming for CNC Lathe and CNC Milling to generate tool path, NC code, and Optimization of tool path (to reduce machining time) using any CAM software

ACME 16510 – DESIGN OF MACHINE ELEMENTS – I PRACTICE

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

List of Experiments:

1. Select a daily use product and study its design by applying the design process.
2. Take a mechanical component and know their materials and suggest some alternative materials for the each one of them.
3. Design a wall bracket, which is being used in real life by actual measurement of load
- Riveted and bolted joints
- Welded joints and justify your findings.

4. Design, draw and assemble a knuckle joint used in some practical application, by actual working and loading conditions.
5. Design a shaft used in some practical application, by actual working and loading conditions.
6. Design, draw and assemble a flange coupling and justify its design by actual measurements.

6th Semester

ACME 16601 - DESIGN OF MACHINE ELEMENTS -II

Internal Marks: 40	**L T P**
External Marks: 60	**4 1 0**
Total Marks: 100	

Course objectives:

Understand about the various modes to transmit power (like: Belt drives, rope drives, chain drives, gears etc. Understand about the various bearings and bearing housings and will be able to suggest suitable bearings for different applications. Know about the lubrication in the transmission system and will be able to solve various problems regarding it. Design various machine members like: springs, flywheel, clutches and brakes etc. as per different requirements in the industry. Analyse the design and suggest/apply suitable modifications in the design.

Detailed content:

Section – I
Bearings
Slider: Principle of hydrodynamic lubrication, modes of lubrication, Reynolds equation, bearing performance parameters, slider bearing design Roller: Types, selection guidelines, static and dynamic load carrying capacity, Stribeck's equation, equivalent bearing load, load life relationship, selection of bearing, comparison of roller and slider bearing

Section – II
Design of Flywheel:
Introduction, Energy stored in a flywheel, stresses in a rim, design considerations

Section – III
Springs:
Types; end styles of helical compression spring; stress and deflection equation; surge in spring; nipping of leaf spring; Design of close-coil helical spring and multi leaf spring

Section – IV
Clutches:
Design of contact clutches i.e. plate, multi-disc, cone and centrifugal clutches.

Section – V
Brakes:
Design of band, disc, block with shoe and internal expanding brakes.

Section VI

Design of levers and links:

Design of levers(foot lever, hand lever, cranked lever, bell crank lever, safety valve lever and shoe brake lever), design of link.

References :

- Joseph E. Shigley, Charles Russell Mischke, Richard Gordon Budynas, Mechanical Engineering Design, McGraw Hill.
- Robert C. Juvinall Fundamentals of machine component design, JohnWiley Eastern
- V.K Jadon, Analysis and design of machine elements, I.K. International
- .B Bhandari, Design of Machine elements, Tata Mc-Graw. Hill
- S.S Jolly, Design of machine elements-II, Dhanpat Rai and Co.

Note:1 Design data book compiled by V. K Jadon, I.K International Publishers
Design data book compiled by V. B Bhandari, McGraw Hill

Note: 2 Guide lines regarding paper setting:

Part A- 10 questions of 2 marks each. All compulsory.

Part B- There will be 6 questions of 10 marks each. Candidate will be required to attempt any four questions.

ACME 16602 - HEAT TRANSFER

Internal Marks: 40	**L T P**
External Marks: 60	**3 1 0**
Total Marks: 100	

Course objectives:

Recognize the predominant mode of heat transfer and apply the knowledge of basic laws of heat transfer to solve and analyze various engineering problems (mainly one dimensional under steady state conditions. Develop mathematical relations to solve heat transfer problems. Select and design the use of fins under different circumstances as well as optimum conditions. Formulate convective (simple and with phase change) heat transfer problems and solve them using dimensional analysis and analytical/empirical relations. Use electrical analogy to solve one dimensional conduction and radiation problems.

Detailed contents:

Section – I
Introduction:

Concept of heat transfer, Difference between the subject of "Heat Transfer" and its parent subject "Thermodynamics". Different modes of heat transfer - conditions, convection, and radiation.

Section - II
Conduction:

Fouier's law of heat conduction, coefficient of thermal conductivity, effect of temperature and pressure on thermal conductivity of solids, liquids and gases and its measurement. Three-dimensional general conduction equation in rectangular, cylindrical and spherical coordinates involving internal heat generation and unsteady state conditions. Derivation of equations for simple one dimensional steady state heat conduction from three dimensional equations for heat conduction though walls, cylinders and spherical shells (simple and composite), electrical analogy of the heat transfer phenomenon in the cases discussed above. Influence of variable thermal conductivity on conduction through simple cases of walls / cylinders and spheres. Equivalent areas, shape factor, conduction through edges and corners of walls and critical thickness of insulation layers on electric wires and pipes carrying hot fluids. Internal generation cases along with some practical cases of heat conduction like heat transfer through piston crown, through under-ground electrical cables/Hot fluid pipes etc and case of nuclear fuel rod with and without cladding. Introduction to unsteady heat transfer, Newtonian heating and cooling of solids; definition and explanation of the term thermal diffusivity. Numerical.

Section – III
Theory of Fins

Concept of fin, classification of fins and their applications. Straight fins of uniform cross-section; e.g. of circular, rectangular or any other cross-section). Straight fins with varying cross-sectional area and having triangular or trapezoidal profile area. Circumferential fins of rectangular cross- section provided on the circumference of a cylinder. Fin performance: fin effectiveness and fin efficiency, total fin effectiveness, total fin efficiency. Optimum design of straight fin of rectangular and triangular profile area. Application of fins in temperature measurement of flow through pipes and determination of error in its measurement. Numerical.

Section – IV

Convection:

Free and forced convection. Derivation of three-dimensional mass, momentum and energy conservation equations (with introduction to Tensor notations). Boundary layer formation, laminar and turbulent boundary layers (simple explanation only and no derivation). Analytical formulae for heat transfer in laminar and turbulent flow over vertical and horizontal tubes and plates Numericals. Newton's law of cooling. Overall coefficient of heat transfer. Different design criterion for heat exchangers. Log mean temperature difference for evaporator and condenser tubes, and parallel and counter flow heat exchangers, Calculation of number and length of tubes in a heat exchanger effectiveness and number of transfer units(NTU); Numerical.

Section – V

Convection with Phase Change (Boiling and Condensation):

Pool boiling, forced convection boiling, heat transfer during pool boiling of a liquid. Nucleation and different theories of nucleation, different theories accounting for the increased values of h.t.c. during nucleate phase of boiling of liquids; different phases of flow boiling (theory only), Condensation, types of condensation, film wise condensation on a vertical and inclined surface, Numerical.

Section - VI

Radiation:

Process of heat flow due to radiation, definition of emissivity, absorptivity, reflectivity and transmissivity. Concept of black and grey bodies, Plank's law of nonchromatic radiation. Kirchhoff’s law and Stefan Boltzmann’s law. Interchange factor. Lambert's Cosine law and the geometric factor. Intensity of Radiation (Definition only), radiation density, irradiation, radiosity and radiation shields. Derivation formula for radiation exchange between two bodies using the definition of radiosity and irradiation and its application to cases of radiation exchange between three or four bodies (e.g. boiler or other furnaces), simplification of the formula for its application to simple bodies like two parallel surfaces, concentric cylinders and a body enveloped by another body etc. Error in Temperature measurement by a thermocouple probe due to radiation losses.

References:

- Frank P. Incropera and David P. De Witt, Fundamentals of Heat and Mass transfer, John Wiley
- P.S. Ghoshdastidar, Heat Transfer, Oxford Press
- D.S. Kumar, Fundamentals of Heat and Mass Transfer, SK Kataria & Sons ($6^{th}/7^{th}$ Edition)
- A.J. Chapman, Heat Transfer, McGraw Hill Book Company, New York.
- J.P. Holman, Heat Transfer, Tata McGraw-Hill Publishing Company Ltd.(Special Indian Edition).

- Yunus A.Cengel, Heat and Mass Transfer, Tata McGraw Hills Education Private Ltd (Special Indian Edition).
- Eckert & Drake, Heat and Mass Transfer, McGraw Hill Book Company, New York.

ACME 16603 - FLUID MACHINERY

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Course objectives:

Recognize basic components of turbo machines and understand related fundamental laws/ principles and apply these for calculation of various parameters like work done, force efficiency etc. Know about constructional details, working and design aspects of runner/wheel and evaluate the performance of various turbines like Pelton, Kaplan and Francis. Know about constructional details, working and evaluate the performance of centrifugal pump under different vane shape conditions. Know about constructional details, working and evaluate the performance of reciprocating pump and evaluate the effect of various deviations from the ideal conditions on the work done. Know about constructional details and working of hydraulic devices like fluid coupling, accumulator and intensifier.

Detailed Contents:

Section – I
General Concepts:

Impulse momentum principle; jet impingement on stationary and moving flat plates, and on stationary or moving vanes with jet striking at the centre and tangentially at one end of the vane; calculations for force exerted, work done and efficiency of jet. Basic components of a turbo machine and its classification on the basis of purpose, fluid dynamic action, operating principle, geometrical features, path followed by the fluid and the type of fluid etc. Euler's equation for energy transfer in a turbo machine and specifying the energy transfer in terms of fluid and rotor kinetic energy changes.

Section – II
Pelton Turbine:

Component parts and operation; velocity triangles for different runners, work output; Effective head, available power and efficiency; design aspects such as mean diameter of wheel, jet ratio, number of jets, number of buckets with working proportions

Section - III
Francis and Kaplan Turbines:

Component parts and operation velocity triangles and work output; working proportions and design parameters for the runner; Degree of reaction; Draft tubes - its function and types. Function and brief description of commonly used surge tanks.

Section - IV
Centrifugal Pumps:

Layout and installation; Main elements and their functions; Various types and classification; Pressure changes in a pump - suction, delivery and manometric heads; vane shape and its effect on head-capacity relationships; Departure from Euler's theory and losses; pump output and efficiency; Minimum starting speed and impeller diameters at the inner and outer periphery; Priming and priming devices, Multistage pumps - series and parallel arrangement; submersible pumps. Construction and operation; Axial and mixed flow pumps; Trouble shooting - field problems, causes and remedies.

Section – V

Similarity Relations and Performance Characteristics:

Unit quantities, specific speed, scale effect; cavitation and Thoma's cavitation number; Concept of Net Positive Suction Head (NPSH) and its application in determining turbine / pump setting

Section – VI

Reciprocating Pumps:

Components parts and working; pressure variations due to piston acceleration; acceleration effects in suction and delivery pipes; work done against friction; maximum permissible vacuum during suction stroke; Air vessels

Section - VII

Hydraulic Devices and Systems:

Const., operation and utility of simple and differential accumulator, intensifier, fluid coupling and torque converter, Air lift and jet pumps; gear, vane and piston pumps, Hydraulic Rams

References:

- R.L. Daughaty, Hydraulic Turbines, McGraw Hill
- Jagdish Lal, Hydraulic Machines by Metropolitan Book Co
- D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, SK Kataria and Sons,
- K. Subramaniam, Hydraulic Machines, Tata McGraw Hill
- R.K. Purohit., Hydraulic Machines, Scientific Publishers

ACME 16604 - INDUSTRIAL AUTOMATION AND ROBOTICS

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Course objectives:

Understand the concept, need and application of hard automation, soft automation and their advantages. Describe the constructional features, working and use of valves and their application in automation. Conceptualize and design the pneumatic and hydraulic circuits for industrial automation applications. Describe the working of fluidic sensors for their industrial applications. Describe the details and working of various transfer devices and feeders in manufacturing industry. Know about the programming of robotic arm and its industrial applications.

Detailed content:

Section – I
Introduction

Concept and scope of automation: Socio economic impacts of automation, Types of Automation, Low Cost Automation.

Section - II
Fluid Power

Fluid power control elements Standard graphical symbols Fluid power generators Hydraulic and pneumatic Cylinders - construction, design and mounting; Hydraulic and pneumatic Valves for pressure, flow and direction control.

Section - III
Fluidics

Boolean algebra, Truth Tables, Logic Gates, Coanda effect.

Section – IV
Electrical and Electronic Controls

Basics of Programmable logic controllers (PLC) Architecture & Components of PLC
Ladder Logic Diagrams.

Section - V
Transfer Devices and feeders

Classification, Constructional details and Applications of Transfer devices Vibratory bowl feeders, Reciprocating tube, Centrifugal hopper feeders.

Section - VI
Robotics
Introduction, Classification based on geometry, control and path movement, Robot Specifications, Robot Performance Parameters, Robot Programming, Machine Vision, Teach pendants, Industrial Applications of Robots.

References:

- Anthony Esposito, Fluid Power with applications, Pearson
- S. R Majumdar, Pneumatic Control, McGraw Hill
- S. R Deb, Robotic Technology and Flexible Automation, Tata Mc Hill
- Saeed B. Niku Introduction to Robotics, Wiley India
- Ashitava Ghosal, Robotics, Oxford

ACME 16606 - HEAT TRANSFER LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

List of Experiments:

1. Determination of thermal conductivity of:
(a) A solid insulating material by slab method
(b) Powder materials by concentric spheres method / or by some transient heat transfer technique.
(c) A metal by comparison with another metal by employing two bars when kept in series and / or in parallel under different boundary conditions
(d) Liquids by employing thin layer
2. Determination of coefficient of heat transfer for free/forced convection from the surface of a cylinder / plate when kept:
a) Along the direction of flow
b) Perpendicular to the direction of flow
c) Inclined at an angle to the direction of flow
3. To plot the pool boiling curves for water and to determine its critical point
4. Determination of heat transfer coefficient for
i) Film condensation ii) drop-wise condensation
5. Determination heat transfer coefficient by radiation and hence find the Stefan Boltzmann's constant using two plates/two cylinders of same size by making one of the plates/cylinders as a black body.
6. Determination of shape factor of a complex body by an analog technique.
7. To plot the temperature profile and to determine fin effectiveness and fin efficiency for
i) A rod fin when its tip surface is superimposed by different boundary condition like.
a) Insulated tip
b) Cooled tip
c) Temperature controlled tip
ii) Straight triangular fins of various sizes and optimization of fin proportions
iii) Circumferential fins of rectangular/triangular section

ACME 16607 - FLUID MACHINERY LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

List of Experiments:

1. Determination of various efficiencies of Hydraulic Ram.
2. To draw characteristics of Francis turbine/Kaplan Turbine.
3. To study the constructional features of reciprocating pump and to perform test on it for determination of pump performance.
4. To draw the characteristics of Pelton Turbine.
5. To draw the various characteristics of Centrifugal pump.
6. Determine the effect of vane shape and vane angle on the performance of centrifugal fan/Blower.
7. A visit to any Hydroelectric Power Station.

ACME 16608 - INDUSTRIAL AUTOMATION AND ROBOTICS LAB

Internal Marks: 30	**L T P**
External Marks: 20	**0 0 2**
Total Marks: 50	

List of Experiments:

1. Design and assembly of hydraulic / pneumatic circuit.
2. Demonstration and working of power steering mechanism
3. Study of reciprocating movement of double acting cylinder using pneumatic direction control valves
4. Use of direction control valve and pressure control valves clamping devices for jig and fixture
5. Study of robotic arm and its configuration
6. Study the robotic end effectors
7. Study of different types of hydraulic and pneumatic valves

7^{th} / 8^{th} Semester

ACME-16701 – INDUSTRIAL ENGINEERING AND MANAGEMENT

Internal Marks: 40	**L T P**
External Marks: 60	**3 0 0**
Total Marks: 100	

Course Objective:

The main objective of this course is to understand the various Management theories for motivating the employees, Types of plant layout, Functions of Management, Role of Industrial Engineer.

Detailed Content:

Section-I

Introduction:

Definition and scope of industrial engineering, Functions of industrial engineering department and its organization, Qualities of an industrial engineer.

Section-II

Concepts of Management:

Functions of Management, Principles of Management, Douglas Mc-Gregor's Theory X and Theory Y, Maslow's Hierarchy of Human Needs – Systems Approach to Management.

Section-III

Management Planning, Decision Making and Control:

Steps, hierarchy, principles and dimensions of planning function, Approaches to decision making, Decision support systems, Basic control process, control parameters, principles of control.

Section-IV

Plant Location & Layout:

Plant location: definition, factors affecting the plant location, comparison of rural and urban sites-methods for selection. Plant layout**:** Needs for a good layout, Different types viz. Product, process and combination layouts, Introduction to layouts based on the GT, JIT and cellular manufacturing systems, Development of plant layout.

Section-V

Productivity:

Definition, reasons for low productivity, methods to improve productivity, relation between work-study and productivity.

Section VI

Work Analysis:

Definition, need and scope of Work Analysis. Method-study: Definition, objectives, step-by-step procedure, questioning technique~~s~~, charts and diagrams for recording data. Principles of motion economy; Development and installation of new method. Work–measurement: Definition, various techniques of work-measurement such as work-sampling, stopwatch time study & its procedure.

Section-VII

Value Engineering:
Definition, Types of values, concept, phases and application of value engineering.

Books:

1. Philip E Hick, Industrial Engineering & Management, Tata McGraw Hill
2. Lawrence D. Miles, Techniques of Value Analysis and Engineering, McGraw Hill.
3. R.N. Nauhria, Rajnish Parkash, Management of Systems, Wheeler Publishers
4. S. Buffa, Modern Production Management, Wiley Eastern
5. H.S. Shan, Work Study and Ergonomics, Dhanpat Rai and Co. (P) Ltd.

ACME-16702 – REFRIGERATION AND AIRCONDITIONING

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Course Objectives:

To Understand and identify method/type of refrigeration and air conditioning systems, and express their performance, Analysis of air refrigeration cycles especially for aircraft air conditioning, and vapor compression refrigeration cycle, Identifying the different refrigerants from their nomenclature and select them from environmental aspects and field of application.

Detailed Contents:

Section-I

Basic Concepts:

Definition of Refrigeration and Air conditioning; Difference between Refrigeration and cooling; Difference between Refrigeration and Air conditioning; Brief history of Refrigeration and Air conditioning; Natural and Mechanical Refrigeration; Applications of Refrigeration and Air conditioning; Definitions of refrigerant, cooling/ Refrigeration effect, cooling capacity, heating effect, heating capacity; Units of refrigeration; Coefficient of performance and Energy Efficient Ratio; COP of a refrigerator; and COP/EPR of a heat pump; Single Phase Reversed Carnot cycle and its limitations; Two Phase Reversed Carnot cycle and its limitations; Methods of Refrigeration; Numerical.

Section-II

Gas Cycle Refrigeration and Aircraft Refrigeration & Air conditioning:

Bell Coleman/Reversed Brayton / Reversed Joule Cycle and its analysis; Numerical; optimum COP and pressure ratio (No mathematical Analysis); Applications of Gas Cycle Refrigeration; Necessity of aircraft refrigeration and air conditioning; Classification of aircraft refrigeration and air conditioning systems; Simple/basic aircraft refrigeration and air conditioning system (with and without evaporative cooler); Need of evaporator cooler; Boot Strap aircraft refrigeration and air conditioning system (with and without evaporative cooler); Regenerative aircraft refrigeration and air conditioning system; Reduced Ambient aircraft refrigeration and air conditioning system, Numerical.

Section-III

Vapor Compression Refrigeration Cycle:

Vapor compression refrigeration system and its basic components; Representation of Simple/ Theoretical vapor compression refrigeration cycle on P-v, T-s and P-h diagrams; Dry versus wet compression; expansion versus throttling of liquid refrigerant; Analysis of Simple/Theoretical vapor compression refrigeration cycle; Introduction of P-h diagram/chart and Refrigeration Tables; Determination of properties of sub cooled, saturated and superheated refrigerant by using saturated properties & specific heat tables/saturated & superheated properties tables and P-h diagram; Compressor work and volumetric efficiency; Effect on performance and cooling capacity due to change in evaporator pressure, condenser pressure, sub cooling of liquid refrigerant, super heating of suction vapors, use of liquid - vapor regenerative heat exchanger; Effect on performance and cooling capacity due to heat exchange of vapors with compressor cylinder walls, pressure drop in suction (wire drawing) and discharge valves, pressure drop in evaporator and condenser; Actual vapor compression refrigeration cycle on T-s and P-h diagrams (No mathematical analysis); Numericals. Flash gas, its advantages and disadvantages, and its removal: flash chamber, liquid sub-cooler; Brief introduction (no mathematical analysis) to compound (multistage) compression, its advantages, schematic representation of these systems with use of flash chamber, water intercooler, flash intercooler, liquid sub-cooler (independent and combination of these).

Section-IV

Vapor Absorption Refrigeration Cycle (No Mathematical Analysis):

Principle of vapor absorption refrigeration; basic components of the vapor absorption refrigeration system; Desirable properties of absorption system refrigerant and absorbent; Aqua - ammonia vapor absorption refrigeration system; Lithium Bromide - water absorption system (Single and double effect);Electrolux refrigeration system; comparison between vapor absorption and compression systems.

Section-V

Refrigerants:

Classification and nomenclature of refrigerants; Desirable thermodynamic, chemical and physical properties of refrigerants; comparative study of commonly used refrigerants and their fields of application; Azeotropes; Zeotropes; Effect of moisture and oil miscibility; Refrigerants dying agents and antifreeze solution; leak detection and charging of refrigerants; environmental aspects of conventional refrigerants; Ecofriendly refrigerants.

Section-VI

Alternative Refrigeration Systems and Low Temperature Refrigeration: (No Mathematical Analysis)

Steam Jet Refrigeration, Mixed Refrigeration Systems, Vortex Tube Refrigeration, Cascade Refrigeration System, Linde and Claude cycles, cryogenics and its engineering applications.

Section-VII

Air Conditioning Concepts and Applications:

Psychrometry; Dry Air; Moist Air; Basic laws obeyed by Dry Air and Moist Air; Psychometric properties of air: Dry bulb, wet bulb and dew point temperatures, Relative and specific humidity, degree of saturation adiabatic saturation temperature, enthalpy of air and water vapors; Psychometric chart and its use; Adiabatic mixing of moist air streams without condensation and with condensation, Numerical.

Section-VIII

Psychometric Processes:

Basic psychometric processes; Sensible heat process; Latent heat process; Total heat process; Sensible heat factor; Evaporative cooling; cooling with dehumidification; Heating with dehumidification; chemical dehumidification; By-pass factor; Contact factor; Psychometric processes in air conditioning equipment: Cooling coils, Heating coils, cooling and dehumidification coils, Evaporative coolers, Adiabatic dehumidifiers, Steam injection, Air washer; Numerical.

Section-IX

Calculations for Air conditioning Load and for Rate and state of Supply Air:

Sources of heat load; sensible and latent heat load; Cooling and heating load estimation; Apparatus dew point temperature; Rate and state of supply air for air conditioning of different types of premises; Numerical

Section-X

Refrigeration and Air Conditioning Equipment:
Brief description of compressors, condensers, evaporators and expansion devices; Cooling towers; Ducts; dampers; grills; air filters; fans; room air conditioners; split units; Package and central air conditioning plants.

Books:

1. C.P. Arora, Refrigeration and Conditioning, Tata McGraw Hill
2. Manohar Prasad, Refrigeration and Conditioning, Wiley Eastern Limited
3. Jordan and Priester, Refrigeration and Conditioning, Prentice Hall of India
4. W.F. Stoecker, Refrigeration and Conditioning, McGraw Hill

ACME-16703 - MECHANICAL VIBRATIONS

Internal Marks: 40	**L T P**
External Marks: 60	**3 1 0**
Total Marks: 100	

Course Objectives:

This course helps to understand the need and measurement of vibration in mechanical systems, Suggesting suitable method of vibration reduction and absorption.

Detailed contents:

Section-I

Introduction:

Basic concepts, Types of vibration, Periodic & Harmonic vibrations, Methods of vibration analysis

Section-II

Vibration of Single Degree of Freedom System:

Undamped free vibrations, damped free vibrations and damped force vibration system, Modelling of stiffness and damping (both viscous and coulomb), vibration isolation, vibration measuring instruments.

Section-III

Two degrees of Freedom systems:

Principal modes of vibrations, natural frequencies, amplitude ratio, undamped free, damped free, forced harmonic vibration, semi-definite systems, combined rectilinear & angular modes; Lagrange's equation.

Application to un-damped and damped absorbers: untuned dry friction and viscous vibration damper.

Section-IV

Multi-degree of freedom systems:

Undamped free vibrations, influence coefficients, Generalised coordinates, orthogonality principal, matrix iteration method, Rayleigh and Dunkerley, Holzer's , Stodola method, Eigen values and eigen vectors

Section-V

Continuous systems:

Lateral vibrations of a string, longitudinal vibrations of bars, transverse vibrations of beams, Euler's equation of motion for beam vibration, natural frequencies for various end conditions, torsional vibration of circular shafts

Books:

1. G.K. Grover, Mechanical Vibrations Hem Chand and Bros
2. K.K. Purjara, Mechanical Vibrations, Dhanpat Rai and Sons, Delhi

ACME-16704 – OPERATION RESEARCH

Internal Marks: 40	**L T P**
External Marks: 60	**3 0 0**
Total Marks: 100	

Detailed Contents:

Section-I
Introduction:
Origin of OR and its role in solving industrial problems: General approach for solving OR problems. Classification of mathematical models: various decision making environments.

Section-II
Deterministic Models:
Formulation of deterministic linear mathematical models: Graphical and simplex techniques for solution of linear programming problems, Big M method and two phase method, Introduction to duality theory and sensitivity analysis: transportation, assignment and sequencing models.

Section-III
Game theory:
Solution of simple two person zero-sum games: Examples of simple competitive situation.

Section-IV
Sequencing Problems:
Types of sequencing problems, Shortest processing time rule, Processing of jobs through different machines.

Section-V
Replacement Models:
Replacement of items that deteriorate, Replacement of items whose maintenance and repair costs increase with time, replacement of items that fail suddenly; replacement of items whose maintenance costs increase with time and value of money also changes, individual replacement policy, group replacement policy.

Section-VII
Network models:
Shortest route and traveling sales - man problems, PERT & CPM introduction, analysis of time bound project situations, construction of networks, identification of critical path, slack and float, crashing of network for cost reduction, resource leveling and smoothening.

Books:

1. D.S. Hira, Operation Research, S. Chand & Co.

2. Hamdy A. Taha, Operation Research – An Introduction, Pearson Publishers

ACME-16705 - REFRIGERATION AND AIRCONDITIONING LAB

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. Study of various elements of a vapor compression refrigeration system through cut sections models / actual apparatus.
2. Study and performance testing of domestic refrigerator.
3. Study the performance testing of Electrolux refrigerator.
4. Study and performance testing of an Ice plant.
5. Calculation/ Estimation of cooling load for a large building.
6. Visit to a central Air conditioning plant for study of processes for winter and summer air conditioning
7. Visit to a cold storage for study of its working.
8. Study and performance testing of window type room air conditioner.
9. Study and performance testing of water cooler.

ACME-16706 – MECHANICAL VIBRATION LAB

Internal Marks: 30	**L T P**
External Marks: 20	**0 0 2**
Total Marks: 50	

1. Determine the viscosity of given fluid by single wire torsional pendulum.
2. Determine the natural frequencies of a coupled pendulum.
3. Find out the fundamental natural frequency of a cantilever beam.
4. Determine the modulus of elasticity from free vibration test.
5. Study of forced vibration of a two degree of freedom system under harmonic excitation.
6. Study of a dynamic absorber.
7. Determine the coefficient of dry friction from measurement of natural frequency of vibration of a bar resting on two disks rotating in opposite direction.

Group - I

ACME/DE-1.1 - I. C. Engines

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Detailed contents:

Section – I
Introduction to IC Engines
Definition of engine; Heat Engine, Historical Development of IC Engines, Classification & Nomenclature, Application of IC Engines, Air Standard Cycle, Carnot Cycle, Sterling Cycle, Ericson Cycle, Otto Cycle, Diesel cycle, Dual Cycle, Thermodynamics Analysis of these cycles.

Section - II
Actual Working of I.C. Engine
Working of 4 stroke petrol & diesel engines and their valve timing diagram, working of 2-stroke petrol & diesel engines & their valve timing diagrams, comparison of two stroke & four stroke engines, Actual working of 2 & 4 stroke gas engines and their valve diagram.

Section - III
Fuel Air Cycles and their analysis
Introduction to fuel air cycles and their significance, composition of cylinder gases, variable specific heats, Dissociation, effect of no. of moles, comparison of air standards & fuel air cycles, effect of operating variable like compression ratio, fuel air ratio, actual cycles and their analysis; Difference between Actual and Fuel-Air Cycle, Actual and Fuel-Air Cycles for S.I. and C.I. Engines.

Section - IV
IC Engine Fuels
Introduction, types of fuels, solid, liquid and gaseous fuels, chemical structure of petroleum, petroleum refining process, important qualities of S.I. & C.I. Engine fuels and their rating. Combustion of fuels; Calorific valves of fuels, theoretical determination of CV of fuel, combustion equation for hydrocarbon fuels, determination of minimum air required for combustion, conversions of volumetric analysis of mass analysis, Determination of air supplied from volumetric analysis of Dry flue gases, Determination of excess air supplied , Determination of % of carbon in fuel burning to CO & CO2 , Determination of minimum quantity of air supplied to gaseous

Section - V
Fuel Supply System
Fuel Supply System and fuel pumps, properties of air fuel mixture, a sample carburetor an its working, approximate analysis of simple carburetor, Actual air fuel ratio of single jet carburetor, Exact analysis of single jet carburetor, ideal requirements from a carburetor, limitations of single jet carburetor, different devices used to meet the requirements of an ideal carburetor. Different modern carburetors, introduction to petrol injection, fuel injection systems for C.I.

Section - VI
Engines
Classification of injection systems, injection pump, injection pump governor, mechanical governor, fuel injection systems, injection pump Governor, Mechanical Governor, Fuel Injector, Nozzle, Injection of S.I. Engines, Fuel Filters.

Section - VII
Combustion in S.I. Engines
Introduction, Stages of Combination in S.I. Engine, Flame font propagation, factor influencing the flame speed, ignition lag and factors affecting the lag, Abnormal combustion and knocking, control and measurement of knock, rating of S.I. Engine fuels and anti-knock agents, combustion chambers of S.I. Engines

Section - VIII
Supercharging
Introduction, purpose of supercharging, type of superchargers, analysis of superchargers, performance of superchargers, Arrangement of Supercharger and its installation, Turbo charged engines, supercharging of S.I. & C.I. Engines. Limitations of supercharging.

Section - IX
Measurement and Testing
Measurement of friction horse power, brake horse power, indicated horse power, measurement of speed, air consumption, fuel consumption, heat carried by cooling water, heat carried by the exhaust gases, heat balance sheet, governing of I.C. Engines, performance characteristics of I.C. Engines: Performance parameters, performance of S.I. Engines, performance of C.I. Engine, Engine performance maps

References:

- V. Ganesan, Internal Combustion Engines, Prentice Hall.
- V. M. Damundwar, A Course in Internal Combustion Engines, Dhanpat Rai.
- John B. Heywood, Internal combustion engine fundamentals McGraw-Hill.
- Colin R. Ferguson, Allan Thomson, Kirkpatrick Internal combustion engines: applied thermo sciences, John Wiley & Sons.
- Richard Stone, Introduction to Internal Combustion Engines Society of Automotive Engineers.

ACME/DE-1.2 - CRYOGENIC TECHNOLOGY

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Detailed contents:

Section - I

1. History of cryogenic engineering; application of cryogenics
2. Properties of Oxygen, Nitrogen and Argon, and Hydrogen, Helium and rare gases
3. Thermal, mechanical and electrical properties of engineering materials at low temperature: Introduction to the phenomenon of superconductivity and its applications

Section - II

1. Thermodynamics of ideal liquefaction cycles; Joule-Thomson effect 3 Linde cycle; prncooled linde cycle; exercise
2. Claude, Heylandt, and kapitza cycles; exercises
3. Liquification of hydrogen and helium

Section - III

Heat exchangers and definition of effectiveness

1 Coiled tube (hampson type) and brazed Aluminum heat exchangers

2 Cryogenic expansion engines and turbines

Section - IV

1. Principal of binary Distillation
2. Linde signal & double column system

Section - V

1. Types of cryogenic insulation: foam, fibre, powder vacuum
2. Liquid cryogen storage vessels and cryogen transfer line; PART –VI
3. Measurement of temperature: gas and vapor pressure Thermometers, thermocouple, RTD and semiconductor sensors;

Section - VI

1. Safety in cryogenic systems fir, asphyxiation, cold burns and pressure problems

References:

- Randall F. Barron, Cryogenic Systems, McGraw-Hill.
- Marshall Sitting and Stephen Kidd D, Cryogenic Research and Applications, Van Norstad.
- Russell Burton, Scott Cryogenic engineering, Van Nostrand

ACME/DE-1.3 - NON CONVENTIONAL ENERGY RESOURCES

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

<u>Detailed contents:</u>

Section - I
Introduction
Renewable and non-renewable energy sources, their availability and growth in India; energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements.

Section - II
Solar Energy
Solar radiation - beam and diffuse radiation; earth sun angles, attenuation and measurement of solar radiation; Optical properties of materials and selective surfaces; Principles, general description and design procedures of flat Platte and concentrating collectors; Performance analysis of cylindrical and parabolic collectors; Solar energy storage systems - their types, characteristics and capacity; solar ponds. Applications of solar energy in water, space and process heating, solar refrigeration and air conditioning; water desalination and water pumping; solar thermal power generation; solar cells and batteries; economic analysis of solar systems.

Section - III
Wind Energy
Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of accodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.

Section - IV
Direct energy conversion systems
i) Magnetic Hydrodynamic (MHD) Generator: gas conductivity and MHD equations; operating principle, types and working of different MHD systems – their relative merits; MHD materials and production of magnetic fields.
ii) Thermo-electric generators: Thermo-electric effects and materials; thermo-electric devices and types of thermo-electric generators; thermo-electric refrigeration.
iii) Thermionic generators: thermionic emission and materials; working principle of thermionic convertors.
iv) Fuel Cells: thermodynamic aspects; types, components and working of fuel cells.
v) Performance, applications and economic aspects of above mentioned direct energy conversions systems.

Section - V

Miscellaneous Non-Conventional energy Systems

i) Bio-mass: Concept of bio-mass conversion, photo-synthesis and bio-gasification;
Bio gas generators and plants - their types constructional features and functioning; digesters and their design; Fuel properties of bio gas and community bio gas plants
ii) Geothermal: Sources of geothermal energy - types, constructional features and associated prime movers.
iii) Tidal and wave energy: Basic principles and components of tidal and wave energy plants; single basin and double basin tidal power plants; conversion devices Advantages/disadvantages and applications of above mentioned energy systems.

References:

- H.P. Garg and Jai Prakash, Solar Energy: Fundamentals and Applications, Tata McGraw Hill.
- S.P. Sukhatme, Solar Energy: Principles of Thermal Collection and Storage, Tata McGrawHill.
- John A. Duffic and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley.
- S. L. Sheldon, Chang, Energy Conversion, Prentice Hall.
- O. M. Bockris and S. Srinivasan, Fuel Cells, McGraw Hill.

ACME/DE-1.4 - ENERGY CONSERVATION AND MANAGEMENT

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Detailed contents:

Section - I

Need for energy conservation, its potentials, fiscal incentives, primary energy sources such as coal, gas, oil, nuclear fuel, Optimum use of prime movers for power generation such as steam turbines, gas turbines, diesel and gas engines, energy intensive industries i.e. iron and steel, aluminum, pulp and paper, textile and oil refineries and their energy usage pattern.

Section - II

Plant Good housekeeping measures in air conditioning boilers, combustion system, steam, furnaces and general awareness, Energy audit, methodology and analysis, Energy conservation case studies in air conditioning, boiler and burners

Section - III

Waste heat recovery systems i.e. recuperates economizers waste heat boilers, heat pipe heat exchangers regenerators etc. Energy storage systems thermal storage, insulation, refractory, specialized processes such as Dielectric & micro wave heating, electronic beam welding, Fluidized bed technology, laser as a welding tool, Alternative sources of energy.

References:

- D.A. Reay, Industrial Energy Conservation Handbook, Oxford Press.
- P. L. Diwakar Rao, Energy Conservation Handbook, Utility Publication Ltd.
- Richard Greene, Process Energy conservation (Chemical Engineering), McGraw-Hill.

ACME/DE-1.5 - FLUID MECHANICS-II

Internal Marks: 40 **L T P**
External Marks: 60 **4 0 0**
Total Marks: 100

Detailed contents:

Section – I
Potential Flow
Stream function and velocity potential functions for standard flow patterns uniforms flow, source/sink, doublet and free vortex ; combination of uniform flow with certain flows to obtain flow patterns of various shapes such as flow past a half body, a cylinder, a Rankine oval body, and a cylinder with circulation : Kutta joukowski, Theorem-lift on a cylinder.

Section - II
Viscous Flow
Navier Stokes equation of motion; Relationship between shear stress and pressure gradient; two dimensional laminar flow between two fixed parallel planes ; Plain Couette flow and its application to hydro-dynamic theory of lubrication.

Section - III
Turbulence
Fluctuation velocity components; intensity and scale of turbulence; Reynolds equations and turbulence modeling.

Section - IV
Boundary Layer
Salient features of flow pattern in a boundary layer; Velocity and shear stress distribution along the boundary; Von-Karman momentum integral equation, Quantitative correlation for boundary layer thickness, local skin friction coefficient and drag coefficient in laminar, turbulent and laminar turbulent combined boundary layer flows on a flat plate without pressure gradient; flow over a courved surface boundary layer separation and its control.

Section - V
Flow around Immersed Bodies
Concept of friction, pressure, wave and induced drag- lift and drag coefficients; variation of drag coefficient with Reynolds number for two dimensional bodies (flat plate, circular cylinder) ; Vortex shedding from cylindrical bodies; effect of streamlining ; drag coefficient versus Reynolds number for flow past axisymmetric bodies (sphere) ; Terminal velocity ; Lift of an airfoil ; Airfoil of finite length-effect on drag and lift ; Downwash and induced drag.

Section – VI

Compressible Flow

Wave propagation and sonic velocity; Mach number, Limits of incompressibility and compressible flow regimes; pressure field due to a moving source of disturbance, Mach cone and Mach angle. Basic equations for one-dimensional compressible flow; static and stagnation values; Isentropic flow relations; compressibility correction factor. Isentropic flow through a duct of varying cross-section, mass flow rate and choking in a converging passage. Normal shock and change in flow properties across a normal shock wave.

References:

- B.S. Massey, ELBS and Van Nostrand, Mechanics of Fluids, Reinhold Co.
- Richard H.F. Pao, Fluid Mechanics, John Wiley.
- D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, SK Kataria.
- J.F. Douglas, J.M. Gasionckw, and J.A. Swaffield JP, Fluid Mechanics, Pitman.
- V.L. Streeter and E.B. Wylie, Fluid Mechanics, McGraw Hill.

ACME/DE-1.6 - SOLAR ENERGY

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

<u>Detailed contents:</u>

Section – I
Solar Flux and Weather Data
Introduction, Solar Constant, Spectrum of sun, Diurnal Variation of Direct Sunlight, Height variation of direct sunlight. Standard Atmosphere, Zenith Distance Flux Variation, Geographical distribution of sun-shine and effects of weather on Solar Flux. Introduction to solar Flux observation, Instruments such as pyrometer, Phyrheliometer and Sunshine Recorder, Correlation between direct and total Insulation, Solar flux variation dynamic, Correlation of sunshine with Wind Velocity, Environmental Thermal Infrared Flux and ETIR Model.

Section – II
Solar Availability
Introduction, Zenith Distance Vs time, Time of sunrise and sun-set fully Tracking collector, Variation of flux curves with latitude and geometry, Introduction tom Fixed Flat plate (horizontal, latitude Tilted, fixed latitude + 15°, Vertical South-facing, seasonally Tilted) N-S and horz, east west tracking and N-S polar east west tracking, East west horz and N-S tracking, Comparison of theoretical curves with observation, comparison of daily output; Peak flux Vs Average flux.

Section - III
Heat Transfer in Solar Collectors
Introduction, Heat Losses in a Distributed Collector system. The Liquid Transfer Module System, Solar Heat Availability, Fluid Mechanics, Fluid Properties, Temperature Rise, Solar Flux, Pressure Drop Relations, Reynolds Number, Ratio of Power Expended to Power Generated, Magnitude of Power Output/Input Ratio, Parametric Relationships for Fluid Transfer, Variation of Output/Input Ratio with Solar Flux. Air-Transfer Systems, Air Heat Transfer in Terms of Volume Rate of Flow, Typical Evaluation Situation. Alternative Forms of the Heat- Rise Equation, Effect of Changing Heat-Transfer Fluid, Heat Transfer in Evacuated Collectors, Thermodynamic Utilization of Collected Energy, Evacuated Collectot Tradeoffs. Linear Absorber with Air Radiation Suppression Using Honeycombs Convection Suppression Using Honey-combs, Heat Pipes, Heat Transfer alongh Thin Sheets, Differential Thermal Expansion, Problems.

Section - IV
Flat-Plate Collectors
Introduction, Basic Collector Configurations, Diurnal Temperature, Profile, Thermal Inertia U-Factor, Collector Heat Balances. Sample Calculation, Surface Temperature. Efficiency versus-Temperature Curves, General Properties of an efficiency Vs Change and Temperature, The Bare Collector; Single –Window Collector, Double Window Collector Improvement of Performance, Geometrical Suppression of Convection, Window Temperature. Effect of Selective Absorber Surface, Selective Windows Facing Selective Surface Combination of Absorber and selective windows, Comparison of Thermal Behaviour for Selective Windows, Window Absorption Non reflection Coated Window, Variation of Efficiency with Solar Flux, Evacuated, Cooling, Selective Radioactive Cooling, Cylindrical Collector Structure Flat-Plate .Collector performance, Solar Ponds, Problems

Section – V
Energy Storage
Introduction, Basic System Diagram, Peaking Effect of Back up Demands, Energy Storage, Hydro storage Chemical Batteries Flywheels Chemical Storage, Compressed Air, Biological Storage, Thermal Storage, Sensible-Heat Storage, Latent-Heat Storage, Salt Eutectics, Zoned Thermal Storage Fluid Tank, Rock Thermal Storage Tank, Thermal Storage Tank Farm, Heat Management with and without Phase Change, Thermal inertia, Calculation of Detailed Performance, Problems. Application of Solar Energy (History and Survey Application) Community Heating & Cooling system, Solar Water pumping, Solar gas absorption refrigeration, MEC Cooling system, Two stage evaporative cooling etc.

Section - VI
Direct Conversion to Electricity
Introduction, Direct conversion by Means of Solar Ce4lls, Silicon Cells, Manufacture of Silicon Cells, Efg Ribbon Silicon Cells Polycry Stalline silicon cells, Cadmium sulfide Solar Cells, Manufacture of Cadmium Sulfide Cells Gallium Arsenide Solar Cells, Thermal Behaviors of Solar Cells Cooled Solar Cells for Concentrating System. Thermo-electric Solar Cells, Thermionic Solar Cells, Phase-Change Thermal Direct Conversion, Problems.

References:

- Aden B.Meinel and Marjoric P.Meinel, An Introduction to Applied Solar Energy, Addison Wesley.
- Jan F.Kreider and Fran Kreith, Hand Book of Solar Energy, McGraw-Hill.

ACME/DE-1.7 - HEAT EXCHANGER DESIGN

Internal Marks: 40 **L T P**
External Marks: 60 **4 0 0**
Total Marks: 100

Detailed contents:

Section - I
Introduction
Classification, types and applications of heat Exchangers, Heat Exchanger Design methodology, Selection of Heat Exchangers.

Section - II
Single Phase Heat Exchangers
LMTD and NTU methods, Rating and sizing methods, design criteria, geometry, process parameters, pressure drops and applications.

Section - III
Two Phase Heat Exchangers
Types of Boiling, Boiling mechanisms, two phase flow boiling pressure drop Condensation Mechanism, types of condensers and design procedures, Evaporators, Reboilers, Multiple effect evaporators, Design procedures, Liquid chillers, kettle, thermosyphen and forced circulation Reboilers, Augmented surface heat Exchangers, Heat transfer coefficients, pressure drops, compact heat exchangers and air coolers, plate heat exchangers and plate fine heat exchangers.

Section - IV
Heat Pipe Heat Exchangers
Types and design procedure and applications Installation, Operation and Maintenance: Fouling factors, type of fouling and cleaning methods.

Section - V
Mechanical Considerations
Codes and Standards, Mechanical design requirements and materials.

References:

- Saunders EAD, Heat Exchangers Selection Design and Construction, Longman Scientific and Technical, John Wiley.
- D.Q. Kern, Process Heat Transfer International Edition, Mc. Graw Hill.
- J.P. Holman, Heat Transfer, Mc. Graw Hill.
- J.P Gupta, Fundamentals of Heat Exchangers and Pressure Vessels Technology, Hemisphere Publishing Corporation.

ACME/DE-1.8 - POWER PLANT ENGINEERING

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

<u>Detailed contents:</u>

Section - I
Introduction

Energy sources for generation of electric power, Principles types of power plants-their special features and applications, Present status and future trends.

Section - II
Hydro-Electric Power Plants

Classifications, Components and their general layout, Hydroelectric survey, rainfall run-off, hydrograph, flow duration curve, mass curve, storage capacity, Site selection.

Section - III
Steam Power Plant

General Introduction, Developing trends, Essential features, Site Selection, Coal-its storage, preparation, handling, feeding and burning, Ash handling, dust collection, High pressure boilers.

Section - IV
Diesel and Gas Turbine Power Plants

Field of use, components, Plant layout, Comparison with stream power plants, Operation of combined steam and gas power plants.

Section - V
Nuclear Power Plant

Nuclear fuels, nuclear energy, Main components of nuclear power plant, Nuclear reactors-types and applications, Radiation shielding, radioactive waste disposal, Safety aspects.

Section - VI
Power Plant Economics

Load curves, terms and conditions, Effect of load on power plant design, methods to meet variable load, prediction of load, cost of electric energy, Selection of types of generation and generating equipment, Performance and operating characteristics of power plants, Load division among generators and prime movers, Tariff methods of electric energy. Non-Conventional Power Generation: Geothermal power plants, Tidal power plants, Wind power plants, Solar power plants, Electricity from city refuge.

Section - VII
Direct Energy Conversion Systems
Thermoelectric conversion system, Thermionic conversion system, Photo voltaic power system, Fuel Cells, Magneto-hydrodynamic system.

References:

- P.K.Nag, Plant Engineering, Tata McGraw Hill.
- G.R. Nagpal, Power Plant Engineering, Khanna Publishers.
- S.C. Arora and S. Domkundwar, Power Plant Engineering, Dhanpat Rai.

ACME/DE-1.9 - GAS DYANAMICS

Internal Marks: 40 | **L T P**
External Marks: 60 | **4 0 0**
Total Marks: 100

Detailed contents:

Section - I

Basic concepts of Gas Dynamics and Gas Properties

Definition: Units and dimensions. The concepts of continuous, properties of the continuum. Methods of describing fluid motion, Lagrangian method. Eulerian Method. The integral form of the equations of Conservations of Mass. Momentum and energy as applied to Control Volumes, applications to the study flow of inviscid compressible fluids.

Section - II

Fundamentals Equations Study of One Dimensional Flow

Continuity equation, the momentum equation, the dynamic equation and Euller's equation. Bernoulli's equation, thrust function, steady flow energy equation.

Section - III

Isentropic Flow

Introduction, Acoustic velocity, Mach number, Mach line and Mach angle. Classification of flows, Karman's rules supersonic flow, flow parameters, Critical conditions stagnation values.

Section - IV

Flow in Ducts with Heating or Cooling

Stagnation temp. change, governing equations, Rayleigh lines, choking effects in simple to change. Maximum heat transfer.

Section - V

Flow in constant- Area Ducts with friction

Friction loss, the friction parameter, Fannolines, effect of the increase of inlet Mach number and duct length. Chocking due to friction. Isothermal flow through long ducts.

Section - VI

Normal Shock Waves

Formation of shock waves, weak waves, compression waves. Governing relations of the Normal shock, Pressure. Temperature, Density, Mach number across shock.

Section - VII

Oblique shocks

Oblique shock equations, shock geometry, shock polars.

Section - VIII

Flow through Nozzles

The Converging diverging nozzle, area ratio for complete expansion, effect of varying back pressure on nozzle flow. Under-expansion and over-expansion in nozzle flow. Losses in nozzle.

Section - IX

Flow through Diffusers

Classification of diffusers, internal compression subsonic diffuser, velocity gradient, effect of friction and area change, the conical internal-compression subsonic diffuser, external compression subsonic diffuser, supersonic diffuser, normal shock supersonic diffuser, the converging diverging supersonic diffuser.

Section - X

Introduction to Multidimensional Flow

The equation of continuity, the momentum equations, Bernoulli,s equation, the energy equation, Navier-Stock' Equations, Potential Flow.

References:

- Asher H. Shaprio, Thermodynamics of Compressible Fluid flow, John Wiley.
- Culbert B. Laney, Computational Gas Dynamics, Cambridge University Press.

Group-II

ACME/DE-2.0 - PRODUCT DESIGN AND DEVLOPMENT

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

<u>Detailed contents:</u>

Section – I
Visual Design
Basic elements and concept of visual design-line color, Balance proportion, Size shape mass, unity and variety, Special relationships and composition in two and three dimensions.

Section - II
Form and Color
Elementary forms their characteristics and significance in design. Form transition, Form in relation to ergonomics, material and manufacturing process, color as an element of design, color clarification dynamics, interrelation of colors, colors and traditions; Psychological use of color form and material.

Section - III
Product Graphics
Meaning and objectives of product graphics. Basic principles of graphic design, Visual communication aspects of product graphics, Graphics of displays and control panels,

Section - IV
Product Detailing
Standard fastening and joining details in different materials; Temporary and permanent joints: Detailing for plastic products, Detailing for fabricated products in sheet metal.

Section - V
Products Development
Definition and objective, Role of designer in product development. Manufacturing and economic aspects of product development, Product promotions, product developments.

References:

- W.H. Mayal, Industrial Design for Engineers, London Liifee Books Ltd.
- Huchingson R. Dale, New Horizons for Human Factors in Design, McGraw Hill.
- N.L. Svensson, Engineering Design.
- R. Matousek, Engineering Design.
- K. J. Mccormick (Ed), Human Factor Engineering, McGraw Hill.

ACME/DE-2.1 - NON TRADITIONAL MACHINING

Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
4	0	0

Detailed contents:

Section – I
Introduction
Latest trends in Manufacturing, Introduction to Flexible manufacturing system, Introduction to computer integrated manufacturing, Limitations of conventional machining processes, Development of Non-conventional machining processes, their classification, advantages and major applications

Section - II
Advanced Mechanical Processes
Ultrasonic machining, Water Jet Machining and Abrasive Flow Machining-elements of process, Applications and limitations

Section - III
Electrochemical & Chemical Removal Processes
Principle of operation, elements and applications of Electrochemical Machining, Electrochemical grinding, Electrochemical deburring, Electrochemical honing, Chemical Machining, Photochemical machining

Section - IV
Thermal Metal Removal Processes
Electric Discharge Machining- Mechanism of metal removal, electrode feed control, die electric fluids flushing, selection of electrode material, applications. Plasma Arc Machining- Mechanism of metal removal, PAM parameters, Equipment's for unit, safety precautions and applications. Laser Beam machining- Material removal, limitations and advantages. Hot machining- method of heat, Applications and limitations. Electon-Beam Machining-, Generation and control of electron beam, process capabilities and limitations

Section – V
Hybrid Machining Processes
Concept, classification, application, Advantages

References:

- P.C. Panday and H.S. Shan, Modern Machining Processes, Tata Mc Graw Hill
- G. Boothroyd and W.A. Knight, Fundamentals of Machining and Machine Tools, Marcel Dekker Inc.

- G.F. Benedict, Non-traditional Manufacturing Processes, Marcel Dekker Inc.
- V.K Jain, Advanced Machining Processes, Allied Publishers.
- Hassan Abdel, Gawad El-hofy Fundamentals of Machining Processes: Conventional and Nonconventional Processes, Taylor & Francis.

ACME/DE-2.2 - INDUSTRIAL ENGINEERING

Internal Marks: 40 **L T P**
External Marks: 60 **4 0 0**
Total Marks: 100

Detailed contents:

Section – I
Introduction
Definition and scope of industrial engineering Role of an industrial engineering Role of an industrial engineer in industry, Functions of industrial engineering department and its organization, Qualities of an industrial engineer.

Section - II
Plant Layout and Material Handling
Different types of layouts viz. Product, process and combination layouts, Introduction to layouts based on the GT, JIT and cellular manufacturing systems, Development of plant layout. Types of material handling equipment, relationship of material handling with plant layouts.

Section - III
Work-study
Areas of application of work study in industry; Method study and work measurements and their inter-relationship. Reaction of management and labour to work study; Role of work study in improving plant productivity and safety.

Section - IV
Method Study
Objectives and procedure for methods analysis: Select, Record, Examine, Develop, Define, Install and Maintain. Recording techniques, Micro motion and macro-motion study: Principles of motion economy, Normal work areas and work place design.

Section - V
Work Measurement
Objectives, Work measurement techniques - time study, work sampling, pre-determined motion time standards (PMTS) Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, standard time.

Section - VI
Value Engineering
Types of values, concept of value engineering, phases of value engineering studies, application of value engineering.

Section - VII

Work Design
Concepts of job enlargement, job enrichment and job rotation. Effective job design considering technological and behavior factors.

Section - VIII

Ergonomics

Introduction to ergonomic considerations in designing man-machine systems with special reference to design of displays and controls.

References:

- Gayler Shotbolt, Introduction to Work study, Tata McGraw Hill.
- H.S. Shan, Work Study and Ergonomics, Dhanpat Rai and Co. (p) Ltd.
- R. Bernes, Motion and time study by, John-Wiley.
- D.J. Oborne, Ergonomics at work, John Wiley.
- D. Miles, Techniques of Value Analysis and Engineering, McGraw Hill.

ACME/DE-2.3 - OPERATIONS MANAGEMENT

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

<u>Detailed contents:</u>

Section - I
Need and Scope of Operation Management
Types of production system and their characteristics, productivity definition, types and measurements

Section - II
Product Design And Development
Steps involved in product design and development, considerations of technical, ergonomic, aesthetic, economic and time factors. Use of concurrent engineering in product design and development. Discussion of case studies. Feasibility and locational analysis.

Section - III
Planning And Forecasting
Role of market survey and market research in pre-planning, long medium and short range forecasting, objective and techniques of forecasting, smoothening and revision of forecast

Section - IV
Production Planning

Production planning objective and functions, Bill of material, Capacity and man power requirement planning, operation analysis and process planning, long range planning, aggregate planning; Objective, Strategies, graphical and mathematical techniques of aggregate planning, master production scheduling, MRP and MRPII Systems

Section - V
Production Control
Capacity control and priority control, production control functions; Routing, scheduling, dispatching, expediting and follow up. Techniques of production control in job shop production, batch production and mass production systems.

Section - VI
Material Management
Objectives, scope and functions of material management, planning, procurement, storing, ending and inventory control. Purpose of inventory, inventory cost, inventory control systems, Selective inventory control systems, Determination of EOQ, Lead time and reorder point. Methods of physical stock control.

Section - VII
Quality Control
Meaning of quality and quality control, quality of design, quality of conformance and quality of performance, functions of quality control. Introduction to statistical quality control-control charts and sampling plans.

Section - VIII
Management Information Systems
Introduction to MIS, Steps in designing MIS, Role of Computers in MIS.

Section - IX
Maintenance Systems
Type of maintenance, objective of maintenance, Planned maintenance strategies, preventive maintenance, condition monitoring and total productive maintenance

References:

- S.N. Charry, Production and Operation Management, Tata-McGraw Hill.
- J.G. Monks, Production/Operation Management, Tata-McGraw Hill.
- R.N. Nauhria and Rajnish Prakash, Management of systems, Wheeler Publishing.
- Elwood S. Buffa, Modern Production Management, John Wiley.
- E. L. Grant and R.S. Leaven Worth, Statistical Quality Control, McGraw Hill.

ACME/DE-2.4 - NON-DESTRUCTIVE TESTING

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Detailed contents:

Section - I
Introduction
Classification of techniques of material testing, Need and Significance of Non Destructive Testing methods, type of Non Destructive testing methods.

Section - II
Radiographic Examination
Radiant energy and radiography, practical applications, X-ray and Gamma –ray equipment, effect of variables on radiographs, requirement of a good radiograph, interpretation of radiograph, safety precautions, Xeroradiography.

Section - III
Magnaflux methods
Basic principles, scope and applications, magnetic analysis of steel bars and tubing magnetization methods, equipment, inspection medium, preparation of surfaces Fluorescent Penetration inspection, Demagnetization.

Section - IV
Electrical and ultrasonic Methods
Basic principles, flaw detection in rails and tubes (Sperry Detector), Ultrasonic testing surface roughness, moisture in wood, Detection of defects in ferrous and non ferrous metals, plastics, ceramics, measurement of thickness, hardness, stiffness, sonic material analyzer, proof tests, concrete test hammer.

Section - V
Photo elasticity
Concept and applications of Plane and circular polarization, Photo stress, models.

References:

- H.E. Davies, G.E Troxell and GFW Hauck, The testing of Engg materials, Mc Graw Hill.
- W.H Armstrong, Mechanical Inspection, Mc Graw Hill.

ACME/DE-2.5 - TOTAL QUALITY MANAGEMENT

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

<u>Detailed contents:</u>

Section – I
Quality and Total Quality Management
Excellence in manufacturing/service, factors of excellence, relevance of TQM.

Section – II
Concept and definition of quality
Total quality control (TQC) and Total Quality Management (TQM), salient features of TQC and TQM. Total Quality Management Models, benefits of TQM.

Section – III
Just-in-time (JIT)
Definition: Elements, benefits, equipment layout for JIT system, Kanban system MRP (Material Requirement planning) vs JIT system, Waste elimination, workers involvement through JIT: JIT cause and effect chain, JIT implementation.

Section – IV
Customer
Satisfaction, data collection and complaint, redressal mechanism.

Section - V
Planning Process
Policy development and implementation; plan formulation and implementation.

Section - VI
Process Management
Factors affecting process management, Quality function development (QFD), and quality assurance system.

Section - VII
Total Employees Involvement (TEI)
Empowering employees: team building; quality circles; reward and Recognition; education and training, Suggestion schemes.

Section – VIII
Problems solving
Defining problem, Problem identification and solving process, QC tools.

Section - IX
Benchmarking

Definition, concept, process and types of benchmarking.

Section - X
Quality Systems
Concept of quality system standards: relevance and origin of ISO 9000; Benefits; Elements of ISO 9001, ISO 9002, ISO 9003.

Section - XI
Advanced techniques of TQM
Design of experiments: failure mode effect analysis: Taguchi methods.

References:

- Sunder Raju, Total Quality Management , Tata McGraw Hill.
- M.Zairi, TQM for engineers, Aditya Books.
- J.L. Hradeskym, Total Quality Management Handbook, McGraw Hill.
- Dalela and Saurabh, ISO 9000 quality System, Standard Publishers.

ACME/DE-2.6 - MAINTENANCE AND RELIABILITY ENGINEERING

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

<u>Detailed contents:</u>

Section - I
Introduction
Objective and characteristics of maintenance function, Organization of the maintenance system, Operating practices in maintenance, Maintenance record keeping.

Section - II
Cost Aspect of Maintenance
Costs of machine breakdown, estimation of life cycle costs, Application of work measurement in maintenance, Manpower planning and training, Incentive payments for maintenance.

Section - III
Planning of Maintenance Activities
Evaluation of alternative maintenance policies breakdown, preventive and predictive maintenance, fault diagnosis and condition monitoring techniques, simulation of alternative Practices, Development of preventive maintenance schedule, Housekeeping practices, total productive maintenance.

Section - IV
Maintenance Engineering
Maintenance requirements of mechanical, electrical, process and service equipment, Safety aspect in maintenance, Aspect of lubrication; chemical control of corrosion, Computerized maintenance information systems.

Section - V
Reliability
Concept and definition, configuration of failure data, various terms used in failure data analysis in mathematical forms, component and system failures, uses of reliability concepts in design and maintenance of different system.

Section - VI
Reliability and Availability of Engineering systems
Quantitative estimation of reliability of parts, Reliability of parallel and series elements, Accuracy and confidence of reliability estimation, Statistical estimation of reliability indices, Machine failure pattern, Breakdown time distribution.

Section - VII
Reliability improvement
Reliability in design, reliability in engineering, systems, systems with spares, reliability simulation, redundant and stand by systems, confidence levels, component improvement element, unit and standby redundancy optimization and reliability-cost trade off.

Section - VIII

Fault Tree Analysis

Introduction and importance, fault tree construction, reliability calculations from fault tree, tie set and cut set methods, event tree and numerical problems.

References:

- Lindley R. Higgins, Maintenance Engineering Handbook, McGraw Hill.
- R.H. Clifton, Principles of Planned Maintenance, Edward Arnold.
- A Kelly, Maintenance Planning control, McGraw Hill.
- L.S Srinath, Reliability Engineering, East West Press.
- S.K. Sinha, Reliability Engineering, John Wiley.

ACME/DE-2.7 - MATERIAL MANAGEMENT

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Detailed contents:

Section – I
Introduction
Meaning, definition, functions of materials management, Concept of integrated material management, Relationship of material management with other Organizational functions.

Section - II
Material Planning & Budgeting
Need for material planning, Factors affecting material planning, Techniques of material planning, Material classification, codification and standardization, Material budgeting - meaning and need, techniques of material budgeting.

Section - III
Inventory Control
Need and meaning of inventory, types of inventory, functions of inventory control, Inventory costs, Inventory control tool - ABC, VED, XYZ and FSN: Economic order Quantity and replenishment of stocks. Physical control of inventory: Fixed order, Two bin and Kardex systems - Material requirement planning (MRP-I) Spare parts control for maintenance purposes. Evaluation of inventory control performance. Concept of Just-in-Time(JIT). Use of computers for inventory control

Section - IV
Purchasing
Purchasing principles, procedures and systems, Functions of purchasing, Make-or-buy decision, Vendor development and vendor rating. Factors affecting purchase decisions, Legal aspects of purchasing, Documentation and procedure for import.

Section - V
Storage
Functions and importance of store keeping, types of stores, store accounting and store verification, Legal aspects of store keeping, Management of surplus, scrap and obsolete items. Importance of material handling in store keeping, handling equipment.

References:

- M.M. Verma, Materials Management, S. Chand and Co.
- Gopal Krishnan and Sundaresan, Material Management - An Integrated Approach, Prentice Hall
- Dobbler and Burt, Purchasing and materials management, Tata McGraw Hill
- M. Starr and D. Miller, Inventory control, Prentice Hall.

ACME/DE-2.8 - MANAGEMENT INFORMATION SYSTEM

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Detailed contents:

Section - I

Information and Decision Making

Concept of information; data versus information, characteristics of information, classification of information, cost and value of information, Use of information in the decision making process, information requirements for decision making, types of decisions, decision making process, decision making models role of information system, decision support systems, expert systems.

Section - II

Management Information Systems (MIS)

Concept, Characteristics and importance of management information systems, types of information systems role of computers in management information systems, hierarchy of data processing systems, operating elements of MIS, information needs of MIS, storage and retrieval of data processing, functions of information systems, management reports. Analysis and design cycle for MIS. Various approaches to system analysis and design. Strategic and project Planning for MIS, analysis and design, matching mission, objectives and plans of MIS with business plans, project planning for MIS, Conceptual system design, Detailed system design, Implementation, Evaluation and Maintenance of MIS.

Section - III

Computer Networks and Data Communication Computer network

Local Area networks; characteristics topologies network structures, switching networks, OSI standards for multi-vendor network. I.A.N standards, application of networks, Data Communication concepts, types and modes of transmission, hardware requirements, communication controllers, Data Communication software, data communication protocol.

Section - IV

Data Base Management Systems

Introduction, data base designing, relational data base management system. Introduction to computerized data base management system.

References:

- Robert G. Mudrick, Joel E. Ross and James R. Clagget, Information System for Modern Management, Prentice Hall.
- G. Davis and M. Olson, Management Information systems, McGraw Hill
- Henry C. Lucas, Information systems for management, McGraw Hill.

ACME/DE-2.9 - ENTERPRENEURSHP

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Detailed contents:

Section - I

Concept of Entrepreneurship

Entrepreneurship and small scale industry, need for promotion of entrepreneurship, entrepreneurship development programmes (EDP), personality characteristics of entrepreneur.

Section - II

Identification of Investment Opportunities

Governmental regulatory framework, industrial policy, industrial development and regulation act, regulation of foreign collaboration and investment, foreign exchange regulation act, incentives for export oriented units, incentives for units in industrially backward areas, incentives for small scale industry, government assistance to SSI, how to start and SSI, list of items reserved for SSI, Scouting for project ideas, preliminary screening, project identification for an existing company.

Section - III

Market and Demand Analysis

Information required for market and demand analysis, market survey, demand forecasting, uncertainties demand forecasting.

Section - IV

Cost of Project and Means of Financing

Cost of project, means of financing, planning the capital structure of a new company, term loan financial institutions, cost of production.

Section - V

Financial Management

Concept and definition of financial management types of capital, of finance, reserve and surplus, concepts and liabilities, profit and loss statement balance sheet, depreciation, methods of calculating depreciation break even analysis.

References:

- E.D.I. Ahmedabad, Publication regarding Entrepreneurship.
- Prasanna Chandra, Project Preparation, Appraisal Budgeting and Implementation, McGrawHill.
- C.S.Gupta and N.P.Srinivasan, Entrepreneurial Development, S. Chand and co.
- S. S. Khanka, Entrepreneurship Development Practice and Planning, S. Chand and co.

Group-III

ACME/DE-3.1 - MACHINE TOOL DESIGN

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Detailed contents:

Section- I
Introduction
General requirements to machine tools, Machine tool design recommendations, Classification of motions to shape surface, Machine tool drives for rectilinear motion, Periodic motion, reversing motion etc.

Section - II
Kinematics of Machine Tools
Kinematics or gearing diagram of Lathe, drilling Machine, Milling Machine etc. Main. drive and feed drive, principles specification of Machine tool.

Section -III
Design of Kinematics Scheme
Methods to determine transmission ratios for drives,. Development of Kinematics scheme, minimum of transmission groups, Determination of number of teeth on gears.

Section - IV
Speed and Feed Boxes
General requirement Design of gear trains, speed boxes types, speed changing devices, Feed boxes characteristics of feed mechanism, types of Rapid traverse mechanisms, variable devices.

Section - V
Spindle Design and Spindle Bearings
Main requirement, Materials and details of spindle design, Spindle bearings, bearings, types of bearings and their selections, Bearing Materials BED,

Section - VI
Columns, Tables and Ways
Materials, typical constructions and design.

Section - VII
Machine Tools Control Systems
Requirement of control system selection and construction of control systems Mechanical control system, predilection control, remote control safety devices.

Section - VIII
Machine Tool Dynamics
Dynamic performance, dynamic and elastic system of Machine, tools. Dynamics of cutting forces, tool chatter.

References:

- Sen and Bhattacharya, Machine Tools Design, CBS Publishers.
- N.K. Mehta, Machine Tool Design, Tata McGraw Hill.
- N. Acherkan, Machine Tool Design, Four Volumes, Mir Publishers.
- S.K. Basu and D.K. Pal, Design of machine tools, Oxford and IBH.

ACME/DE-3.2 - OPTIMIZATION TECHNIQUES

Internal Marks: 40 **L T P**
External Marks: 60 **4 0 0**
Total Marks: 100

Detailed contents:

Section - I

1.Introduction

Origin of OR and its role in solving industrial problems : Generalapproach for solving OR problems. Classification of mathematical models: variousdecision making environments.

Section - II

Linear Programming

Formulation of linear mathematical models: Graphical and simplex techniques for solution of linear programming problems, Big M method and two phase method, Introduction to duality theory and sensitivity analysis.

Section - III

Transportation and Assignment Models

Various initial basic feasible solutions methods, Optimization of transportation and assignment using different methods considering the concept of time and cost function.

Section - IV

Dynamic Programming

Introduction to deterministic and probabilistic dynamic programming.

Section - V

Queuing Theory:

Types of queuing situation: Queuing models with Poisson's inputand exponential service, their application to simple situations.

Section - VI

Replacement Models

Replacement of items that deteriorate, Replacement ofitems whose maintenance and repair costs increase with time, replacement of items that fail suddenly; replacement of items whose maintenance costs increase with time and value of money also changes, individual replacement policy, group replacement policy.

Section - VII

Network models

Shortest route and traveling sales - man problems, PERT &CPM introduction, analysis of time bound project situations, construction of networks, identification of critical path, slack and float, crashing of network for cost reduction.

Section - VIII

Non-linear Programming Models

Introduction to non-linear programming models. Problems related to the topic.

References:

- H.M Wagner, Principles of Operations Research, Prentice Hall.
- P.K. Gupta and D.S. Hira, Operations Research, S. Chand & Co.
- F.S. Hiller and G.I. Libermann, Introduction to Operation Research, Holden Ray.
- A Management Guide to PERT/CPM Wiest & Levy Prentice Hall

ACME/DE-3.3 - TOOL DESIGN

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Detailed contents:

Section - I
Process Planning
Product Engineering, Process Engineering, Definition of Process Planning, Contents of Process Plan, Process Operations, Steps of Process Planning, Process Planning Sheet, Planning and Tooling for Low Cost Planning.

Section - II
Jigs and Fixture
Principles of jig and fixture design, Principle of degrees of freedoms, methods of locations and clamping, Various devices for location and clamping, indexing devices, Hydraulic and pneumatic actuation of clamping devices, jig bushes, use of standard parts of jig design, type of drilling jigs, milling fixtures, lathe fixture, grinding fixtures and their classification.

Section - III
Die Design
Components of die design, design of die blocks, punches and strippers, methods of holding punches, sketches of stock stops, Design procedure for progressive dies, compound dies and combination dies for press tool operation forging die design for drop and machine forging parts.

Section - IV
Tool Layout for Turrets
Characteristics of Turret lathes, Differences between capstan and turret lathes, methods of holding jobs on the Turret lathe, Universal chucking equipment, universal bar equipment, operation sheet and tool layout.

Section - V
Tool Layout for Automatics
Classification of Automatics, Turret type automatic, tool layout procedure, time required for each operation, operation sheet, tool layout, cam layout.

Section - VI
Tooling Costs
Estimating cost of a product, estimating costs of tools, Economics of tooling, Break even point analysis, minimum cost analysis.

Section - VII
Gauges
Limits and fits, Plain Gauges, types of Gauges, fundamentals of Gauge Design, Gauge makers tolerance, allowance for wear, Practical application of Taylor's principles of limit gauging, care of Gauges, Limitation of Limit Gauging.

Section - VIII

Surface Finish

Elements of surface finish, Factors affecting surface finish, Effect of surface quality on Functional properties of machine parts, Evaluation of surface finish, Indian Standards on surface finish. Measurement of surface finish, Relationship of surface finish to the production methods. Finishing operations like honing, lapping, buffing super finishing etc.

References:

- Cole: Tool Design.
- C. Donaldson, Tool Design, Mc Graw Hill
- ASTM, Fundamentals of Tool Design.
- P.C.Sharma, A Textbook of Production Engineering, S.Chand Publication.

ACME/DE-3.4 - FINITE ELEMENT METHOD

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

<u>Detailed contents:</u>

Section - I
Introduction
General description of the method summary of the analysis procedure

Section - II
Discretisation of the domain
Type of elements, location of nodes, number of elements, simplification on offered by physical configuration of body, node numbering scheme.

Section – III
One and Two Dimensional Problems
Introduction, coordinates and shape functions, Potential energy approach, Galerkin Approach, Assembly of the global stiffness matrix and load vector , FEM equations and treatment of boundary conditions, quadratic shape functions, Two dimensional problems using constant strain triangles

Section - IV
Axisymmetric solids subjected to axisymmetric loadings
Axisymmetric formulation, FEM using triangular element, problem using boundary conditions.

Section - V
Static analysis
Plain and three Dimensional Trusses, Assembly of global matrix for the banded and skyline solutions, Beams and frames in various different conditions.

Section - VI
Dynamic Analysis
Dynamic equation of motion, consistent mass matrix for truss element frame element and triangular plate element, evaluation of eigen values and eigen vectors.

Section - VII
Solution of finite element equations
Direct integration methods, central difference method, Houbolt method, Wilson method, Newmark method, mode superposition method,

Books:

- Bathe, Finite Element Procedures in Engineering Analysis, Prentice Hall.
- Chandrupatla and Belegundu, Introduction to Finite Element in Engineering, Prentice Hall.
- Cook Concepts and Applications of Finite Element Analysis, John Wiley.

ACME/ DE-3.5 - EXPERIMENTAL STRESS ANALYSIS

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Detailed contents:

Section - I
Basic Elasticity
Laws of stress transformation, principal stresses and principal planes, Cauchy's stress quadric strain analysis, strain equations of transformation, Cauchy's strain quadric, stress, strain relationship.

Section - II
Two Dimensional Photo elasticity
Stress optics law, Optics of polarization plane and circular polariscope, dark and light field arrangements, fringe multiplication, fringe sharp ending, compensation techniques, commonly employed photo elastic materials.

Section - III
Dimensional Photo elasticity
Neuman's strain optic relationship, stress freezing in model materials for three dimensional photo elasticity, shear difference method for stress separation.

Section - IV
Birefringence Coatings
Sensitivity, reinforcing effects, thickness of birefringence coatings.

Section - V
Electric Resistance Strain Gauges
Gauge construction and installation, temperature compensation, gauge sensitivities, gauge factor, corrections for transverse strain effects, factors affective gauge relation, rosetters Rosetre analysis, potentiometer and whetstone's bridge circuits for strain measurements.

Section - VI
Brittle Coatings
Introduction, coating stresses and failure theories, different types of crack patterns, crack detection composition of brittle coatings, coating cure, influence of atmospheric conditions, effects of biaxial stress field.

References:

- Dally and Rilley, Experimental Stress Analysis, McGraw Hill.
- Dow and Adams, Experimental Stress Analysis and Motion Measurement, Prentice Hall.
- Durelly and Riley, Introduction to Photo Mechanics, Prentice Hall.

ACME/DE-3.6 - INDUSTRIAL TRIBOLOGY

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

Detailed contents:

Section - I
Introduction
Tribological considerations, Nature of surfaces and their contact, Physic mechanical properties of surface layer Geometrical properties of surfaces, methods of studying surfaces, Study of contract of smoothly and rough surfaces.

Section - II
Friction and Wear
Role of friction and laws of static friction, causes of friction , adhesion theory, Laws of rolling friction, Friction of metals and non-metals; Friction measurements. Definition of wear, mechanism of wear, friction affecting wear, wear measurement, Wear of metals and non-metals.

Section - III
Lubrication and Lubricants
Introduction, dry friction, Boundary lubrication, classic hydrodynamics, hydrostatic and elasto hydrodynamic lubrication, Functions of lubricants, Types of lubricants and their industrial uses, properties of liquid and grease lubricants; lubricant additives , general properties and selection.

Section - IV
Special Topics
Selection of bearing and lubricant, bearing maintenance, diagnostic maintenance of tribological components, lubrication systems, Filters and filtration.

References:

- O'Conner and Royle, Standard Hand Book of Lubrication Engg. McGraw Hill.
- Halling and Wykeham, Introduction to Tribology, Publications Ltd.
- Raymono O.Gunther, Lubrication, Bailey Bros and Swinfan Ltd.
- PT Barwll, Rearing Systems, Principles and Practice, Oxford press.
- A Cameron, Basic Lubrication Theory, Wiley (Indian Edition).

ACME/DE -3.7 - THEORY OF PLASTICS

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

<u>Detailed contents:</u>

Section - I
Introduction to Plasticity
Idealized stress-strain systems, approximate equation for stress strain curves (Ramberg-Osgood, Ludwig's and Karunes equations), Bauschinger effect-yield locus, yield surface.

Section - II
Yield Criteria and Flow Rules
Tresca theory & Von-Mises yield criterion, their geometrical representation, experimental evidence for the criteria.

Section - III
Slip Line Field Theory
Two-dimensional plasticity, slip lines, basic equations, Hencjy's first theorem, Geiringer's Velocity equation, Applications of slip line field theory to plane strain problems.

Section - IV
Load Bounding
The lower bound theorem, the upper bound theorem and their corollaries. Application of load bounding to plane strain problems.

References:

- Johanson and Miller, Plasticity for mechanical Engineers, Van Nostrand.
- Calladina, Engg Plasticity, Pergmean Press.

ACME/DE -3.8 - MECHATRONICS

Internal Marks: 40	**L T P**
External Marks: 60	**4 0 0**
Total Marks: 100	

<u>Detailed contents:</u>

Section - I
Introduction to Mechatronics
Definition and approach of Mechatronics, Measurement and Control Systems, Microprocessor based controllers and Mechatronics Approach.

Section - II
Sensors and Transducers
Performance Terminology, Displacement, velocity, Position, Proximity, force, fluid pressure, liquid level, temperature, light sensors, procedure for selection.

Section - III
Signal Conditioning
Op Amp, Protection, digital signals, Multiplexes and digital signal processing, pulse modulation

Section - IV
Pneumatic and Hydraulic Systems
Actuation systems, Directions, pressure and process control valve, Pneumatic and hydraulic systems

Section - V
Electrical Actuation System
Mechanical Switches, Solid State Switches, Solenoid, DC/AC Motors, Stepper Motors

Section - VI
Microprocessor and Its Application
Architecture of Microprocssor 8085, Instruction set, Embedding a microprocessor into a Mechatronics system.

Section - VII
Microprocessor Based Project
Assemble a suitable system using microprocessor kit for its control.

References:

- W. Bolton, Mechatronics, Pearson Education.
- Rafiquzzaman, Microprocessors.
- S. Boennett, Real time computer controls, Prentice Hall.
- Benjamin C. Kuo, Automatic Control Systems, Prentice Hall.