Subject: ME10149, Engineering Graphics

Lecture -1

Introduction to engineering drawing, its applications, drawing instruments and their uses, sheet layout (size margin & title block), sketching (material, sketch straight line circle and are)

Lecture -2

Types of lines (continuous thick line, Dotted or hidden line, Long break line, cutting line) and their uses, Lettering (Single Stroke vertical letters, Gothic letters) Dimensioning (Dimensioning terms, placing of dimensions, unit of dimension and general rules of dimensioning), Dimensioning System (Aligned and unidirectional).

Lecture -3

Methods of projection (Orthographic, Isometric oblique Perspective), Orthographic Projection (First angle, Third angle), Symbols for method of projection (First angle, Third angle)

Lecture -4

Scales and their importance, Representative Fraction, Types of Scale

Lecture -5

Plain and Diagonal Scales

Lecture -6

Conic Sections, (Definition, Ellipse, Parabola, Hyperbola, etc.) Basic terms (Directrix, focus, axis, etc., and eccentricity of conic section) Methods of construction of ellipse, Parabola, Hyperbola with method of drawing Tangent and normal.

Lecture -7

Special curves-Involute, Cycloid, Epicycloid, Hypocycloid, Archimedean Spiral etc. Methods of construction of Involute, Cycloid etc. with the method of drawing tangent and normal.

Lecture -8

Methods of construction of Hypocycloid, Epicycloids, and Spiral. Etc. With the method of drawing tangent and normal.

Lecture -9

Projection of points

Lecture -10

Projection of lines-
Parallel to both planes
Inclined to one plane and parallel to other

Lecture -11

Projection of lines-
Inclined to both the planes
If projections of a line are given then to find True length, Horizontal Trace, and Vertical Trace, a Few examples and to solve selected questions on projection of Straight lines.

Lecture -12

Projection of Planes, Types of Plan (Perpendicular and oblique) Projection of plane Parallel to one and perpendicular to other reference plane.

Lecture -13

Projection of planes inclined to both the plane.
Auxiliary planes and finding the shape of plane by auxiliary plane method.

Lecture -14

Projection of Solids - Types of solids, Polyhedral and Solids of revolution, Projection of Solids in Simple position (axis Perpendicular to one plane, axis Perpendicular to both the plane)

Lecture -15

Projection of Solids-Axis Parallel to one plain and inclined to the other (pyramid, prism, cylinder, cone)

Lecture -16

Projection on auxiliary plan, (Auxiliary Vertical plane and Auxiliary inclined plane AIP) Projection of Points on AVP & AIP, general conclusion for obtaining true shapes on the auxiliary planes. Section of Solids - True shape of section and sections of various solids.

Lecture -17

Development of Surfaces, (Cubes, Prisms, and cylinders)

Lecture -18

Development of Surfaces (Pyramids and Cones)

Lecture -19

Isometric Projection- Concept of isometric axes, Lines and planes, Isometric scale, Difference between isometric projection and isometric view. Isometric projection of Simple plane.

Lecture -20

Isometric Projection of Solids (Prisms, Pyramids, cylinders, Cones, Spheres.) Some typical problems on isometric Projection and views of Interpenetration.

Lecture -21

Orthographic Projections- Coordinate Planes of Projection (Horizontal, vertical & Auxiliary), Views of objects, and their analysis (Front, Top, Side, and bottom views).

Lecture -22

Methods of obtaining orthographic projection in first angle and third angle projection.

Lecture -23

Introduction to Drafting Software: Use and applications of Computer-aided drafting (CAD) tools.

Lecture -24

To draw and construct various curves and objects with CAD software.

Subject: ME26011, Fluid Mechanics

Lecture -1

Introduction: Definition of fluid, types of fluid, Continuum concept physical properties of fluid: density, specific weight, and Specific volume, Specific gravity.

Lecture -2

Viscosity: Newton's law of viscosity and its coefficients, units of viscosity, variation of viscosity with temperature & pressure, Newtonian, non – Newtonian and other type of fluids with examples

Lecture -3

Thermodynamic properties of fluid, equation of state, dimensions of gas constant R, Isothermal & adiabatic process, universal gas constant, Bulk modulus, Compressibility and Surface tension & capillarity.

Lecture -4

Fluid Static's: Pascal's law and its derivation & applications in fluid mechanics, pressure variation in a fluid at rest, change of atmospheric pressure with altitude.

Lecture -5

Hydrostatics law & its derivation, measurement of pressure; Piezometer tube & its limitation.

Lecture -6

Manometers (Simple, U – tube, differential manometers)

Lecture -7

Forces on immersed plane (horizontal, vertical & inclined) and curved surfaces, center of pressure, forces on sluice and other type gates.

Lecture -8

Buoyancy; definition, centre of buoyancy, Meta center and metacentric height.

Lecture -9

Equilibrium of floating and submerged bodies.

Lecture -10

Numerical on fluid properties and fluid static's.
Numerical and tutorial, Assignment

Lecture -11

Kinematics of flow; Lagrangian and Eulerian method of describing the fluid motion and their relation Fluid acceleration (Local & Convective), Streamline, Path line, & Streak line.

Lecture -12

Types of flow; Steady – Unsteady, Uniform – Nonuniform, Laminar – Turbulence,
Rotational – Irrotational, Compressible – Incompressible, One, Two & Three Dimensional.
Types of Motion; Translation, Deformation (Linear and angular) and rotation, Vortex flow (free and Forced).

Lecture -13

Fluid Dynamics: Control volume & control system approach used in fluid mechanics, Euler's equation, Reynolds Transport theorem.

Lecture -14

Momentum equation: different types of forces acting on fluid, Eulers equation of motion in three dimension and along a streamline, Bernoulli's equation derived from Euler's equation along stream line
Momentum equation, its application & Different forms of Bernoulli's equation and its statement.

Lecture -15

Energy equation, first law of thermodynamics, and its relation with Bernoulli's equation, Moment of momentum equation & its application.

Lecture -16

Potential flow; Stream function, velocity potential, concept, their relation with flow velocity, Laplace equation and flow net.

Lecture –17

Source, sink and Doublet, circulation and irrotational vortex, flow past a half body.

Lecture –18

Flow around cylinder, Numerical and tutorial, Assignment.

Lecture -19

Reynolds number, Reynolds experiment, laminar and turbulent flow, transition flow Critical Reynolds numbers.

Lecture -20

Flow through pipes: Viscous flow through parallel plates (different boundary conditions, Couette flow)

Numerical and tutorial, Assignment

Lecture -21

Viscous flow through pipes (Haggens – Poiseuille flow), numerical on viscous flow.

Lecture -22

Navier Stokes equation and its derivation, pressure gradient.

Lecture -23

Head loss in turbulent flow (Darcy's equation), friction factor,(Moody's chart)

Lecture -24

Minor losses, derivations of sudden enlargement, contraction equation (K factor)

Numerical on flow through pipes

Lecture -25

Hydraulic and energy gradient lines examples, pipes in series and parallel, pipe network.

Lecture -26

Numerical on flow through pipes

Numerical and tutorial, Assignment

Lecture -27

Introduction, Development of B.L., Character of laminar B.L. character of turbulent B.L., Laminar, sub layer, Boundary layer thickness,(Displacement, momentum and energy).

Lecture -28

B.L. equation –Prandtl, Blasius, Boundary layer on flat plate-Drag as plate due to B.L., Turbulent B.L. on flat plate.

Lecture -29

Momentum Integral method of exact-solution of B.L. equation – Von-Karmal pohlhauseu solution.

Lecture -30

Boundary layer separation.

Lecture -31

Numerical and tutorial, Assignment.

Lecture -32

Compressible flow: Introduction – Thermodynamic relation refresh, Basic equation of compressible flow continuity, Bernoulli's, Momentum equations & equation of state.

Lecture -33

Velocity of sound or pressure wave in a fluid, expression for velocity of sound for isothermal & adiabatic process. Mach no. Types of flow according to Mach no., Propagation of pressure waves (or disturbance) in a compressible fluid.

Lecture -34

Isentropic flow, stagnation properties, Area-Velocity relationship for compressible flow. Mass flow

from a reservoir through an orifice or convergent nozzle.

Lecture -35

Variation of mass flow rate of compressible fluid with pressure ratio. Flow through convergent-divergent nozzle – De-Level nozzle. Possible flow conditions in the nozzle . Rankine Hugoniot relations.

Lecture -36

Fanno and Reyleigh flow, plotting of Fanno and Rayleigh lines. Normal and oblique shock.

Lecture -37

Numerical and tutorials. Assignment.

Lecture -38

Forces exerted by a flowing fluid on a stationary body. Drag and lift its expression, Types of Drag, Coefficient lift and Drag.

Lecture -39

Streamlined body and bluff body, drag on sphere, Drag on a cylinder, development of lift an a circular cylinder.

Lecture -40

Drag & lift on rotating cylinder, D'Alemberts Paradox, Magnus effect, Development of lift on an airfoil.

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Subject: ME26005, Engineering Thermodynamics

Lecture -1

Basic Thermodynamics Laws, Review of First Law, Energy and mass balance equation

Lecture -2

Application to steady flow process, Application to non-steady flow process

Lecture -3

Second Law of thermodynamics, Kelvin-Plank and Clausius statements and their equivalence, Heat Engine and Heat Pump

Lecture -4

Reversible and Irreversible processes, Causes of Irreversibility, Reversible cycles, Carnot cycle

Lecture -5

Pressure- Volume diagram of Carnot cycle, Temperature –Entropy diagram of Carnot cycle, Work done calculation of Carnot cycle

Lecture -6

Theorems about the efficiencies of cycles

Lecture -7

Numerical on above problem

Lecture -8

Concept of entropy & enthalpy, Entropy and available energy, Clausius theorem, Clausius inequality,

Lecture -9

Calculation of entropy, Changes for various processes, principle of increase of entropy

Lecture -10

Entropy and irreversibility, Availability and available energy, Calculation of available energy,

Lecture -11

Quality of energy, Maximum work in reversible process.

Lecture -12

Properties of Pure Substances: Pressure-Volume diagram, Pressure-Temperature Diagram, Temperature-Entropy diagram, Enthalpy-Entropy diagrams for vapour.

Lecture -13

Application of the Steam, Generation of the steam, Review of Boilers,

Lecture -14

Introduction to the High-Pressure Boiler, Need of high-Pressure boiler, Application of high-Pressure boilers

Lecture -15

Use of steam tables and Mollier chart, Measurement of quality of steam, Introduction to various Calorimeters,

Lecture -16

Throttling & Separating Calorimeter, Dryness fraction, Calculation of dryness fraction,

Lecture -17

Thermodynamic properties of steam, Specific Heat and Entropy of Gas and Vapour Mixture with emphasis on air-water vapour mixture.

Lecture -18

Review of ideal gas equation, Real gas equations, Wander Wall's equations, Betty Bridgeman, Berthelot equations, Dieterici and Martin Hou equations,

Lecture -19

Concept of Reduced pressure and Temperature, Variable Coefficients & there application,

Lecture -20

Laws of Corresponding Stages, Application of laws

Lecture -21

Combined First and Second Law, T-Ds Law of Partial Pressures, Enthalpy, Specific Heat and Entropy

Lecture -22

Entropy of Gas and Vapour Mixture with emphasis on air-water vapour, Mixture, Psychometric Chart and its uses. Numerical on psychometric chart and application of psychometric chart

Lecture -23

Introduction to air standard cycle's & air standard efficiencies, Otto cycle, Diesel cycle, Dual cycle

Lecture -24

Otto, diesel, dual cycle efficiencies Comparison of Otto cycle, diesel cycle & dual cycle

Lecture -25

Introduction to Brayton cycle and the application of it, Derivation of Brayton cycle efficiencies, Mean Effective Pressure

Lecture -26

Introduction to positive displacement machines, Working principle of them, Introduction of reciprocating compressors

Lecture -27

Hypothetical pressure-volume diagram for reciprocating compressor without Clearance & with clearance, Actual P-V diagram of reciprocating compressors

Lecture -28

Derivation of work done for reciprocating compressors with and without Clearance.

Lecture -29

The condition for minimum work, Isothermal efficiency of reciprocating compressors

Lecture -30

Reciprocating compressors include clearance, volumetric efficiency of reciprocating compressors

Lecture -31

Multistage compression, P-V diagram for two-stage compression, Effect on the volumetric efficiency of increasing the delivery pressure.

Lecture -32

Intercooling between compressor stages, Effect of intercooling on the compression work. T-s diagram representation of intercooling and after cooling, The ideal intermediate pressure.

Lecture -33

Energy balance for a two – stage machine with intercooler, Numerical on reciprocating, compressors efficiency & work done, Numerical on Multistage compression efficiency & work done

Lecture -34

Combustion equations & Combustion phenomenon, Practical analysis of combustion products, Stoichiometric air-fuel ratio. Reactive Systems, Degree and Equilibrium of reaction, Heat of reaction,

Lecture -35

Changes due to temperature and pressure, Enthalpy of formation, First and Second law of thermodynamics, Internal energy of combustion

Lecture -36

Solid, liquid and gaseous, and their combustion, Analysis of fuel gases of Orsat Apparatus, Infra red gas analyzer.

Lecture -37

Determination of Air-Fuel Ratio from Analysis of Products of Combustion, Proximate analysis, Flue gas analysis.

Lecture -38

High Pressure Boilers, natural and forced Circulation, Constructional details of modern boilers and their applications.

Lecture -39

Coal feed systems, Simple consideration of furnace design, Draught and boiler performance,

Lecture -40

Boiler operation, and boiler room management, Oil fired boiler and their constructional details. Various loses of boiler, Heat balance of Boiler, Boiler efficiency, Boiler management

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Subject: ME26008, Material Science

Lecture -1

Introduction, what is Material Science, Importance of Material Science, Classification of Engineering Materials (Metals, Alloys, Ceramics, Glasses, Organic Polymers Etc.), Area of using Materials (Structures, Machine, Devices), Structure of Materials (Macrostructure, Microstructure, Substructure, Crystal Structure, Electronic and Nuclear Structure)

Lecture -2

Mechanical Properties Of Engineering Materials, Engineering Stress-Strain Curve (Tensile Strength, True Elastic Limit, Proportional Limit, Elastic Limit, Yield Strength, Proof Stress, Ultimate Stress, Modulus of Elasticity, Strain Aging), Properties of Materials (Elasticity, Plasticity, Resilience, Toughness, Ductility, Malleability, Brittleness etc.), True Stress-Strain Curve, Hardness (Scratch Hardness, Indentation Hardness, Rebound Hardness)

Lecture -3

Fatigue and Creep, Features of Fatigue Failure, Completely Reversed Cycle and Repeated Cycle, SN Curve and Statistical Nature of Fatigue, Soderberg Equation, Goodman and Gerber Parabola, Bauchinger Effect, Hysterisis Loop and Losses, Structural Features of Fatigue

Lecture -4

Slip Line and Slip Planes, Creep (Anelasticity, Elastic After Effect, Hysterisis Loop, Isothermal and Adiabatic Loading, Thermal Expansion and Contraction)

Lecture -5

The Creep Curve, Hot Working, Lower and Upper Temperature Limit, Change in Properties due to Hot Working, Cold Working, Change in Properties due to Cold Working

Lecture -6

Crystallography, Solid Materials (Single Crystal, Poly Crystal), Description of Crystal Structure (Lattice, Space Lattice, Unit Cell etc.), Two- and Three-Dimensional Lattice, Seven Crystal Classes, Bravice Lattice, Simple, BCC, FCC, HCP Crystals

Lecture -7

Number of Atoms in per Unit Cell of Simple, BCC, FCC, HCP Structure, Atomic Radius of Simple, BCC, FCC, HCP Structure, Atomic Packing Factor of Simple, BCC, FCC, HCP Structure

Lecture -8

Inter Planner Spacing, Symmetry in Crystal (Translation, Rotational, Reflection, Inversion and Combined type Symmetries), N- Fold Symmetry, Numerical Problems on Atomic Radius, APF, and Inter Planner Spacing

Lecture -9

Neumann's Principle, Crystal Direction, Miller Indices, Question on Miller Indices

Lecture -10

X – Ray Diffraction By Crystal, Details by X-Ray Diffraction Methods, Atomic Scattering, Braggs Law, Experimental Methods of X-Ray Diffraction (Debye Scherrer, Laue and Rotating Crystal Methods)

Lecture -11

Crystal Bonding, Different Bond in Crystals (Ionic, Covalent, Metallic, Hydrogen, Wonder Walls etc.), Lattice Vibration in Monoatomic and Die-Atomic Crystals

Lecture -12

Imperfection In Crystal, Type of Defects (Point, Line, Plane, Surface), Point Defects (Lattice Vacancy, Schottky Defect, Interstitial Atoms or Freckle Defect, Impurity), Influence of Point Defects on the Properties of Crystal, Surface Imperfection (Grain Boundaries, Stacking Fault, Twin Boundaries etc.)

Lecture -13

Line Defects, Edge Dislocation, Screw Dislocation, Burgers Vector, Dislocation and Mechanical Properties of Crystal

Lecture -14

Diffusion In Solids, Diffusion, Fick's Law (First and Second), Type of Diffusion (Self, Inter, Volume, Grain, Surface), Diffusion Mechanism (Vacancy, Interstitial, Direct Interchange), Activation Energy, Application of Diffusion

Lecture -15

Solidification Of Metal, Solidification (Volume, Shrinkage), Solidification of Pure Metal, Solidification of Alloys, Technique of Crystal Growing

Lecture -16

Growth of Crystal, Solidification Pattern and Dendrite Formation, Solidification Rate, Segregation or Coring, Chvorinov's Rule

Lecture -17

Magnetic Materials, Magnetic Susceptibility, Para Magnetism, Diamagnetism and Ferromagnetism, Soft Magnetic Materials, Ferrites

Lecture -18

Elementary Idea of Nuclear Magnetic Resonance, Magneto Mechanical Effect, Dielectric Properties, Polarization, Ferro Electricity

Lecture -19

Elementary Concept of Superconductivity, Meisner Effect, BCS Theory, Josephon Rule, Josephon Tunneling, Type 1 and Type 2 Superconductor

Lecture -20

Testing Of Materials, Destructive Testing, Testing (Tension, Compression, Shear, Torsion, Fatigue, Impact, Hardness etc), Advantages of NDT over Destructive Testing

Lecture -21

Non Destructive Testing, Ultrasonic Test, Magnetic Particle Test, Radiography, Dye Penetration Test

Lecture -22

Equilibrium Diagrams

Allotropy of metals, properties of alloys, effects of alloying, solid solutions, various types of solid solutions.

Lecture -23

Various types of equilibrium diagrams, single component system, two component systems, example and description of diagrams

Lecture -24

Gibb's phase rule, application of rule in different equilibrium diagrams, laver rule, determination of phase amount by this rule.

Lecture -25

Microstructure development for different phase diagrams according to solubility, showing different phases on temp composition scale.

Lecture -26

Iron –carbon equilibrium diagram – its construction, cooling curves, important features of diagrams, different phases on diagram, and their properties

Lecture -27

Phase Transformation

Mechanism of phase transformation, development of new phases, various factors influence the process

Lecture -28

Time temp transformation diagram, Its construction, various phases obtained, their properties.

Lecture -29

Heat Treatment Of Metals

Definition, objects, theory of heat treatment of steel, heat treatment processes on iron carbon diagram its explanation.

Lecture -30

Annealing: various types of annealing as full annealing, isothermal. Process, spherodising, diffusion annealing, description of these methods, Their applications and differences.

Lecture -31

Normalizing and hardening: definition objects, various types, their description and comparison.

Lecture -32

Hardening methods, quenching in two media, self-tempering, steeped quenching, isothermal quenching, sub-zero treatment.

Lecture -33

Harden ability: definition, factors affecting hardenability, measuring methods, description.

Lecture -34

Tempering methods: objects, various methods, their description, and applications.

Lecture -35

Strengthening Mechanism

Strengthening mechanisms: principle, various methods, description for grain refinement, strain hardening, solid solution strengthening, precipitation, dispersion hardening mechanism with examples.

Lecture -36

Powder Metallurgy

Powder metallurgy: introduction, definition, advantages, disadvantages, and applications, design considerations.

Lecture -37

Powder metallurgy process description, various methods of powder production,

Atomization, its various types, reduction method, mechanical methods, electrolysis, chemical methods

Lecture -38

Blending and mixing of powders, compacting methods and sintering method its mechanism and advantages

Lecture -39

Composite Materials

Introduction of composite materials, their classification as particle reinforced, fiber reinforced, structural, working principle, properties, and applications.

Subject : ME26551, Machine Design- 1

Lecture -1

Introduction to engineering design, phases of design, factors considered during design, ergonomics consideration,

Lecture -2

Failure of components, modes of failure, Factor of safety, factors affecting fos,

Lecture -3

Mechanical properties and material selection,

Lecture -4

Manufacturing consideration, assembly considerations, limits and fits

Lecture -5

Standardization, preferred sizes, types of load, statistical nature of loading,

Lecture -6

Simple stresses and compound stresses in machine parts,

Lecture -7

Design for static loading, preliminary stress calculations, theories of failure

Lecture -8

Principal stress theory, maximum shear stress theory, principal strain theory

Lecture -9

Maximum strain energy theory, maximum distortion energy theory, etc. Application of theories of failure to design problems

Lecture -10

Shaft, design of shaft under combined loading,

Lecture -11

Coupling, types, rigid and flexible coupling, stress analysis.

Lecture -12

Design of rigid and flexible coupling for power transmission, stress distribution and angle of twist.

Lecture -13

Design considering for shafts various theories of failure

Lecture -14

Keys, types and their design

Lecture -15

Types of lever, strength consideration and their design.

Lecture -16

Design of bell crank lever

Lecture -17

Pressure vessels and cover plates, types, comparison of thin and thick cylinders

Lecture -18

Analysis of thick pressure vessels, stress variation

Lecture -19

Lame's theory, Clavarino's and Birnie's equation

Lecture -20

Strengthening of cylinders, Compound cylinders,

Lecture -21

Design considerations for pressure vessels

Lecture -22

Pipe and pipe joints, types, high pressure applications

Lecture -23

Design of different types of pipe joints for high pressure

Lecture -24

Design of cotter joint and knuckle joint.

Lecture -25

Threaded fasteners, classification, standard specifications, effect of initial tension, types of nut - bolt - washers

Lecture -26

Static and dynamic load consideration of for threaded fasteners design,

Lecture -27

Eccentric loading in threaded joint

Lecture -28

Design of threaded fasteners, turnbuckle

Lecture -29

Contact stress and deformation: Contact surfaces - their geometries and deformations, contact stress distributions.

Lecture -30

Analysis of stress, Effect of geometry of stress, application

Lecture -31

Antifriction bearing, types, life and load criteria of bearings,

Lecture -32

Different applications and selection procedure of bearings.

Lecture -33

Riveted Joints, types, terminology, caulking and fullering, analysis of riveted joint

Lecture -34

Analysis of riveted joint, efficiency of a riveted joint,

Lecture -35

Design of boiler joints and structural joints,

Lecture -36

Direct and eccentric loading.

Lecture -37

Welded Joints, Welding process, merits and demerits of welded joint, analysis of heat affected zone,

Lecture -38

Types of welded joints, Strength of a welded joint,

Lecture -39

Welded joint subject to bending moment, torsional moment,

Lecture -40

Direct and eccentric loading

Subject: ME26881, Machine Drawing and Computer Graphics

Lecture -1
Simple stresses in machine parts. Tensile stress. Shear Stress.

Lecture -2
Design of parts subjected to simple tension, compression, and shear load.

Lecture -3
Types of keys. Stressed in keys.

Lecture -4
Design of keys.

Lecture -5
Stresses in pins and cotters. Design of pins and cotters.

Lecture -6
Loading in different types of levers. Bearing pressure.

Lecture -7
Design of levers. Design of pin and arm sections.

Lecture -8
Stresses in cylindrical thin shells. Longitudinal and circumferential stresses in shells.

Lecture -9
Types of riveted joints. Riveted joints used in boilers. Loading in boiler shell and joints.

Lecture -10
Modes of failure of rived joints. Efficiency of joint.

Lecture -11
Design of longitudinal joint for boiler shell.

Lecture -12
Design of circumferential joint for boiler shell.

Lecture -13
Structural joints using rivets.

Lecture -14
Eccentrically loaded riveted joints.

Lecture -15
Welded joints. Types of welded joints. Symbols used in welding.

Lecture -16
Loading and stresses in different types of welded joints.

Lecture -17
Design of different types of welded joints.

Lecture -18
Design of eccentrically loaded welded joints.

Lecture -19
Different types of screwed fastenings. Applications of screwed fastenings.

Lecture -20
Loading in screwed fastenings. Stresses induced. Allowable stresses.

Lecture -21
Initial tightening in bolted joints. Effects and application.

Lecture -22
Design of bolted joints for structural applications.

Lecture -23
Design of bolted joints for leak-proof cylinder heads for high-pressure applications.

Lecture -24
Design of eccentrically loaded bolted joints for applications like wall brackets, hangers etc.

Lecture -25
Design of turnbuckle.

Lecture -26

Stresses in shafts under torsion. Shaft materials. Allowable stresses.

Lecture -27

Shafts under combined bending, torsion and axial loads. Stresses under combined loading.

Lecture -28

Design of solid and hollow shafts subjected to combined loading. Shock and fatigue factors. Effect of keyways.

Lecture -29

Design of overhung crankshaft. Design of main and crank pin bushed bearings.

Lecture -30

Design of crank web for bending and twisting load.

Lecture -31

Different types of shaft couplings. Applications. Advantages and limitations.

Lecture -32

Design of muff coupling. Loading and modes of failure. Induced stresses.

Lecture -33

Design of flanged coupling. Material selection for different parts. Design of hub. Design of bolts.

Lecture -34

Design of pin type flexible flanged coupling. Design of cotter joint. Principal modes of failure of the components.

Lecture -35

Design of socket end, spigot end and cotter. Checks on the design. Iterations on design in case of failures.

Lecture -36

Design of knuckle joint. Principal modes of failure of the components. Design of eye end, forked end and pin.

Lecture -37

Checks for failures. Iterations on design.

Lecture -38

Introduction to fits and tolerances Hole system. Shaft system. Tolerances on engineering components. Symbols.

Lecture -39

Surface finish conditions. Designation of surface finish. Symbols. Surface finish requirements on engineering components.

Lecture -40

Limits on dimensions. Engineering applications.

Subject: ME26562, Kinematics of Machine

Lecture -1

Introduction to the subject, Kinematics & Dynamics of M/cs Its role in the process of design/analysis. Spatial and Planar motion, Rectilinear & curvilinear motion of particle

Lecture -2

Motion of rigid body, concept, motion of translation & rotation, Degrees of freedom: Definition, application to D.O.F. of simple mechanisms.

Lecture -3

Vectors, addition & subtraction, Representation of vectors in complex polar notations, Position vector, Displacement vector, rigid body displacement Relative displacement-concept

Lecture -4

Planar Mechanisms, Definition and examples of Links, Element, Pair, Kinematics (skeleton) diagrams. Kinematics chain, structure and Mechanisms

Lecture -5

Classifications Links classification of pairs based on type of relative motion, type of contact based on d.o.f. and based on type of closure.

Lecture -6

Mechanism & Machine definition & comparison, Inversion: definition, properties and importance. Quadric cycle chain & its inversions: Grashoff's law.

Lecture -7

Inversions of slider crank Mechanisms and applications.

Lecture -8

Constrained motion. Mobility/D.o.f. of chains and mechanisms, Effect of higher pairs, Grubler's criterion

Lecture -9

Interpretations of mobility equation, Effects of spring connection & multiple joints, Equivalent Linkages, Number synthesis Introduction

Lecture -10

Number synthesis Effect of odd and even number of links on d.o.f. Minimum number of binary links in a mechanism, maximum number of simple turning pairs in a mechanism.

Lecture -11

Enumeration of Kinematics chains with 6,7,8 number of links.

Lecture -12

Mechanisms with lower pairs. The pantograph. Straight line motion mechanisms-exact & approximate.

Lecture -13

Steering-gear mechanisms of 4-wheelers: condition of correct steering. Davis steering Gear.

Lecture -14

Ackerman steering gear. Required value of x1, neglecting obliquity of cross-link. Hooke's Joint: Construction & derivation of expression for relative angular displacement

Lecture -15

Expressions for angular velocity & acceleration of driven shaft in Hooke's joint. Polar diagram for angular velocities. Double Hooke's joint and condition for uniform angular speed ratio.

Lecture -16

Concept of linear and angular velocities as vectors. Velocity of a point on a rotating rigid body wing complex polar notation. Relative velocity between two points on the same Link.

Lecture -17

Velocity image and velocity polygon. Velocity equation and velocity polygons for simple mechanisms crank slider and four bar mechanisms.

Lecture -18

Instantaneous center of rotation: Definition properties, their number for a given mechanism & locations.

Lecture -19

Aronhold Kennedy's Theorem. Determination of velocities at different points in simple mechanisms using Instantaneous center method.

Lecture -20

Acceleration analysis in Mechanisms. Relative acceleration: concept and acceleration image.

Lecture -21

General acceleration equation for a link. Coriolis component of acceleration. Acceleration Polygon & method of construction.

Lecture -22

Klein's construction for determining velocities & acceleration in Mechanisms. Proof of Klein's construction.

Lecture -23

Representation of links by vectors and loop closure equation for mechanisms, & Displacement equation.

Lecture -24

Types of problem for analytical methods. Determination of velocities and acceleration for slider crank mechanism.

Lecture -25

Analytical determination of velocities & accelerations in 4-bar Mechanisms.

Lecture -26

Analytical method for velocity and acceleration for problems involving coriolis component of acceleration.

Lecture -27

Cam, Definition, purpose and classification. Different types of classification for radial cams : Terminology for redial cams: Cam profile, Base circle, Trace point, Pressure angle, the pitch curve, prime circle, pitch point, pitch circle, lift or stroke of follower, cam angle.

Lecture -28

Types of follower motion eg., uniform motion, Modified uniform motion, and simple Harmonic motion. Their motion characteristics.

Lecture -29

Parabolic and cycloidal follower motions and their motion characteristics. Significance of Pressure angle of Cams.

Lecture -30

Parameters affecting pressure angle; Effect of off set on follower motion. Main considerations influencing choice of Cam.

Lecture -31

Cam layout: Method of construction with roller and Flat faced followers with and without off-set.

Lecture -32

Cam layout for oscillating follower. Cams with specified contours: Circular are cam with tangent follower.

Lecture -33

Cams with specified contours: Tangent cam with roller follower.

Lecture -34

Gears: Introduction. Rolling contact and concept of positive drive. Classification of gears.

Lecture -35

Nomenclature for straight spur gears. Fundamental law of gearing, conjugate tooth profiles physical concept.

Lecture -36

Cycloidal & Involute tooth profiles - a comparison. Relation between base circle radius, pitch circle radius and center distance. Effect of changing center distance slightly on velocity ratio & pressure angle.

Lecture -37

Length of path of contact and are of contact ratio. Interference e & undercutting minimum number of teeth required avoiding interference. Methods of reducing/eliminating interference.

Lecture -38

Helical gears & Bevel gears. Simple, compound and reverted gear trains. Velocity ratio obtainable in each gear train.

Lecture -39

Epicyclic gear trains: Algebraic method of solution. Epicyclic trains: Tabulation method. Torques and tooth loads in epicyclic gear trains

Lecture -40

Gyroscopic motion, gyroscopic effects, processional motion and angular acceleration. Gyroscopic & couple & Gyro-reaction couple. Stability analysis of 2-Wheeler & 4-wheeler vehicles. Gyroscopic effects on Naval ships: due to rolling, pitching and steering Gyroscopic ship stabilization

Subject: ME36501, Refrigeration and Air Conditioning

Lecture -1

Introduction & Definition: Refrigeration, Unit of refrigeration, Refrigeration effect, COP
Review of reversed Carnot cycle, Comparison between Heat engine, Heat pump and refrigerator, Numerical on carnot cycle.

Lecture -2

Air refrigeration system: Introduction of open & closed cycle system, Mechanism, flow diagram, Representation on p-v & T-s diagram, Comparison between open & closed cycle system, Derivation for COP

Lecture -3

Different methods of Air refrigeration system: Simple A R system, simple Evaporative A R system. Boot –strap A R System, Boot –Strap Evaporative A R System, Reduced Ambient A R System, Regenerative A R System
Simple Air refrigeration system: Flow & T-s diagram, Mechanism, Calculation for M_{air}, W_t, R.E & COP, Simple Evaporative Air Refrigeration System: Flow & T-s diagram, Mechanism, Calculation for M_{air}, W_t, R.E & COP

Lecture -4

Boot –strap A R System: Flow & T-s diagram, Mechanism, Calculation
Boot –Strap Evaporative A R System, Flow & T-s diagram, Mechanism, Calculation

Lecture -5

Reduced Ambient A R System, Flow & T-s diagram, Mechanism, Calculation
Regenerative A R System, Flow & T-s diagram, Mechanism, Calculation

Lecture -6

Assignment and Numerical on Air refrigeration System in aircraft, Mechanism, Layout, Working

Lecture -7

Vapour Compression Refrigeration system: Introduction, Main Components, Flow diagram, P-h & T-s diagram, Simple Mechanism, Basic principles of thermodynamics based on which VCR systems are designed

Lecture -8

Types of theoretical VCR cycles, Dry saturated vapour after compression, Superheated Vapour after compression, Superheated Vapour before compression, Under or sub –cooling before EV

Lecture -9

Numerical based on above

Lecture -10

Standard Rating cycle & effect of operating condition: Evaporator pressure, Condenser pressure, Suction Vapour Superheating, Liquid sub cooling
Improvement in simple VCR cycles by different methods: by using flash chamber, by using accumulator, Sub- cooling of liquid refrigerant by vapour refrigerant, Sub- cooling of liquid refrigerant by liquid refrigerant.

Lecture -11

Multi Stage Compression: Introduction, Advantage over single stage compression, Different methods of Compound V.C system
With water inter cooler & liquid Sub –cooler, With liquid inter cooler, With water inter cooler, liquid sub cooler & liquid inter Cooler with flash gas removal, With water inter cooler, liquid sub cooler & flash inter cooler

Lecture -12

Compound cycle with water inter cooler & liquid sub cooler: Introduction, Flow & T-s diagram, Mechanism, Calculation for M_{air}, W_t, R.E & COP
Compound cycle with liquid inter cooler, Introduction, Flow & T-s diagram, Mechanism, Calculation for M_{air}, W_t, R.E & COP

Lecture -13

Compound cycle with water inter cooler, liquid sub cooler & with flash gas removal Introduction, Flow & T-s diagram, Mechanism, Calculation for $M_{air,}$ $W_{t,}$ R.E & COP

Compound cycle with water inter cooler, liquid sub cooler & liquid inter Cooler with flash gas removal: Introduction, Flow & T-s diagram, Mechanism, Calculation for $M_{air,}$ $W_{t,}$ R.E & COP

Lecture -14

Typical Numerical

Lecture -15

Multiple Evaporation: Introduction, Advantage over single evaporation, Different methods of multiple evaporation:

M.Es. at the same temperature with single compressor & E.V.

M.Es. at the different temperature with single compressor; individual E.Vs. &back pressure valves.

M.Es. at the different temperature with individual compressor & individual E.Vs.

M.Es. at different temperature with single compressor; multiple E.Vs. & back Pressure valves.

M.Es. at the different temperature with individual compressor & multiple E.Vs.

Lecture -16

M.Es. at the same temperature with single compressor & E.V.

Introduction, Flow & p-h diagram, Mechanism, Calculation for M_{F1} $M_{F2,}$ $W_{C,}$ R.E & COP,

M.Es. at the different temperature with single compressor ; individual E.Vs. & back pressure valves.

Introduction, Flow & p-h diagram, Mechanism, Calculation

Lecture -17

M.Es. at the different temperature with individual compressor & individual E.Vs

Introduction, Flow & p-h diagram, Mechanism, Calculation and Numerical Assignment

Lecture -18

Refrigerants: Classification & Definitions, Primary Refrigerants, secondary Refrigerants

Lecture -19

Desirable properties: Thermodynamic properties, Physical properties, Safe working properties, Requirements for Refrigerants

Lecture -20

Introduction to ozone friendly refrigerant, Comparison with refrigerants, Properties, COP etc

Lecture -21

Vapour Absorption System: Introduction, Flow diagram & Mechanism, Essential Components, Function of H.E., analyzer, rectifier & absorber, Comparison between V.C.R System & V.A.R Systems

Lecture -22

Electrolux System: Introduction, Flow diagram & Mechanism

Lecture -23

Joule – Thomson Effect, Introduction, Principle, Joule – Thomson coefficient: Definition, Mathematical Value, Derivation, and Conclusion.

Low Temperature Refrigeration, Introduction, and Limitation of V.C.R for producing Low temperature

Lecture -24

Unconventional Refrigeration System: Introduction, Necessity

Steam jet refrigeration system, Introduction, Working principle, Applications

Thermo- electric Refrigeration System: Introduction, Working principle, Applications

Lecture -25

Properties of air water mixture, Definition - Relative humidity , Specific humidity, Dew point temperature, Degree of saturation, Wet bulb temperature

Relation between R.H, ω, $P_{V,}$ $P_{a.}$, Pvs

Lecture -26

Numerical on calculation of: - Relative humidity, Specific humidity, and Dew point temperature, Degree of saturation, Enthalpy of air

Lecture -27

Psychrometry chart: Construction of psychrometry chart, various process representations on psychrometry chart

Sc. Number, Numerical on calculation of enthalpy of air with or without chart

Lecture -28

Thermodynamics of human body, Human comfort, Comfort chart & comfort zone, Effective temperature, Factors affecting comforts

Lecture -29

Tables: heat released by human body during different activities. Sensible, Latent heat.

Lecture -30

Classification of A/C system & its layout.

Lecture -31

Evaporative cooler –thermodynamic, Testing of evaporative coolers, Performance of coolers, Representation of all the A/C system on psychrometry chart

Lecture -32

Calculation of capacity of air cooler

Lecture -33

Definition: RSHF, ESHR, GSHR, BPF, ADP & their applications

Summer A/C system} process layout Psy. Chart, Winter A/C system} process layout Psy. Chart, Calculation of cooling coil load

Lecture -34

Numerical

Lecture -35

Fundamentals of calculation of building load structure.

Lecture -36

Load due to –ventilation, infiltration, and Simple numerical

Lecture -37

Practical problems of load calculations

Lecture -38

Advance pychrometry problems, Practical problems of flow chart, Physical process lay out & Psychometry chart

Lecture -39

Air distribution system, Economic factor influencing duct layout, aspect ratio, Duct fitting: elbow, bend etc and losses through it.

Lecture -40

Air distribution in the space, Terminologies: blow, drop, induction etc., Importance & direction of airflow, Type of outlets.

Subject: ME36503, Machine Design-II

Lecture -1

Functional requirement of springs. Types of springs. Linear and non-linear springs. Open coil and close coil springs. Material properties for springs. Materials for springs

Lecture -2

Helical compression springs. Applications and design issues. Loading and induced stresses. Graphical representation of stresses. Stress equation. Spring Index, Wahl's correction factor

Lecture -3

Deflection in helical compression spring. Deflection equation. Effect of number of coils. End conditions. Effective number of coils

Lecture -4

Design of helical compression springs. Selection of Spring Index. Dimensional constraints. Calculation of number of coils. Check for buckling. Check for natural frequency.

Lecture -5

Helical tension springs. Design considerations and applications. Types of ends

Lecture -6

Design example: Automotive Valve spring. Design example: Clutch Spring. Design example: Spring Loaded safety valve.

Sessional: Two problems on spring design (Practical turns: 02)

Field: Study of helical springs for different automotive valves, clutches, spring loaded safety valve etc.

Lecture -7

Types of leaf springs. Applications. Automotive leaf spring construction and arrangement. Materials for leaf springs. Functional requirements.

Lecture -8

Analysis of stresses in leaf springs. Design for uniform strength. Deflection in leaf springs.

Lecture -9

Prestressing in leaf springs. Full length and graduated leaves. Design for equalized stresses.

Lecture -10

Design of U-bolts, central band. Design of Pins.

Sessional: Two problems on leaf spring design. (Practical turns: 02)

Field: Study of leaf springs for different automobiles, railways.

Lecture -11

Introduction to combined failure. Need for theories of failure. Mohr's circles for different combined loading cases. Applications of theories of failure. Ductile and brittle materials.

Lecture -12

Maximum normal stress theory. Applications of the theory through examples. Maximum shear stress theory. Plots for the failure zones.

Lecture -13

Maximum normal strain theory. Maximum strain energy theory. Maximum Distortion energy theory. Octahedral shear stress. Applications of the theories through examples. Plots for the failure zones.

Lecture -14

Application of different theories Simple bending. Simple torsion. Combined bending, torsion and axial load. Example: Design of circular shaft using different theories of failure.

Sessional: Two problems on design of machine components (Practical turns: 02)

Lecture -15

Stress distribution in thin cylinders. Limitations of thin cylinder analysis approach. Need for analysis of thick cylinders.

Lecture -16

Analysis of thick cylinder. Lami's equations. Equations for radial, circumferential and axial stresses in thick cylinder. Graphical representation of stresses.

Lecture -17

Calculation of thickness of cylinder wall. Limitations of thick cylinder. Need for pre-stressing. Methods of pre-stressing. Compounding of cylinders. Stress distribution after compounding. Graphical representation of stresses.

Lecture -18

Functional requirements of compounded cylinders. Stress distribution under fluid pressure. Design equations. Constraints on design. Design Approach.

Sessional: One problem on design of thick cylinder (Practical turns: 01) One problem on design of compound cylinder (Practical turns: 02)

Lecture -19

Need for experimental stress analysis. Methods and techniques for measurement of strain. Visualization of stress distribution.

Lecture -20

Strain Gauging for measurement of strain. Piezo-resistivity. Application of strain gages for complex loading conditions. Determination of stresses from strain gage data. Strain rosettes.

Lecture -21

Application of strain gages to member loaded under tension. Quarter bridge, half bridge and full bridge application. Measurement of bending stresses. Measurement of torsional stresses.

Lecture -22

Introduction to full-field stress analysis techniques. Photo elasticity. Stress-Optic law.

Lecture -23

Plane polariscope. Circular polariscope. Fringe patterns.

Sessional: One problem on strain gages – complex loading (Practical turns: 01)

Demonstration: Study of fringes on Plane and Circular Polariscope (Practical turns: 01).

Lecture -24

Rotating discs and rings. Centrifugal stresses in rotating machine components.

Lecture -25

Rotating rings. Rotating discs –solid and hollow discs. Stresses in rotating disc fitted on a shaft.

Lecture -26

Disk of uniform thickness and uniform strength. Disk of variable thickness.

Lecture -27

Effect of drilled hole and extra mass on stressed in rotating disc.

Lecture -28

Design of flywheel and pulleys. Disk of variable thickness

Lecture -29

Stresses in flywheel. Stresses due to acceleration, bending and centrifugal action. Stresses in rim and arms.

Lecture -30

Flywheel with solid web. Stress distribution. Design of flywheel with solid web.

Lecture -31

Design of curved machine members. Examples of curved machine members. Straight beam versus curved beam.

Lecture -32

Winkler Bach theory. Neutral axis in curved beams. Derivations.

Lecture -33

Common cross sections for curved beam applications. Hooks, wall brackets and machine frames. Stress distribution in different cross sections.

Lecture -34

Different types of crane hooks. Stresses in crane hooks. Design parameters and design issues.

Lecture -35

Design of crane hook with different cross sections.

Lecture -36

Types of ropes. Nomenclature of ropes. Construction of wire ropes. Selection of wire ropes.

Lecture -37

Chain links. Open and closed rings. Applications of links. Stresses in open and closed rings

Lecture -38

Design of chain links Different types of pipe joints. Applications and classification of pipe joints.

Lecture -39

Design of flanged pipe joints- Elliptical flange

Lecture -40

Design of flanged pipe joints- Square flange.

Subject: ME36006, Measurement and Automatic Control

Lecture -1

Introduction to general measurement system, Noise and interference, calibration

Lecture -2

Static Performance Characteristics of measuring instrument and measurement system,

Lecture -3

Sequential and random tests.

Lecture -4

Measurement errors; error sources: calibration, Data acquisition, data reduction

Lecture -5

Design stage uncertainty analysis

Lecture -6

Combining elemental errors; Bias & Precision errors; Error propagation

Lecture -7

Higher order uncertainty analysis

Lecture -8

Temperature standards, Temperature scales, Thermometry based on thermal expansion, Liquid in glass thermometers

Lecture -9

Bimetallic Thermometers; Electrical resistance thermometry, Resistance Temperature Detectors

Lecture -10

Thermistors, Thermoelectric temperature measurement:

Lecture -11

Temperature measurement with thermocouples, thermocouple standards

Lecture -12

Relative pressure scales, pressure reference instruments, barometer, U-Tube manometer

Lecture -13

Well Type manometer, Inclined well type manometer

Lecture -14

Deadweight tester, pressure gauges and transducers, Pitot tube, turbine meter

Lecture -15

Total and static pressure measurement in moving fluids

Lecture -16

Flow measurements: Pressure differential meters.

Lecture -17

Orifice meter, Venturi meter, Rota-meter

Lecture -18

Strain Measurements: Stress and strain, resistance strain gauges, gauge factor

Lecture -19

Strain gauge electrical circuits, multiple gauge bridge, bridge constant

Lecture -20

Apparent strain and temperature compensation, bending compensation

Lecture -21

Displacement measurement: Potentiometers, Linear variable differential transformers ***Lecture -22***

Rotary variable differential transformer

Lecture -23 .

Velocity measurement: moving coil transducer

Lecture -24

Angular velocity measurement: electromagnetic techniques, stroboscopic measurement

Lecture -25

Torque measurement: measurement of torque on rotating shafts

Lecture -26

Power estimation from rotational speed and torque

Lecture -27

Introduction to control systems: Examples of control systems. Open loop and closed loop control.

Lecture -28

Mathematical modeling of dynamic systems: Transfer function, impulse response function

Lecture -29

Block diagram of closed loop system, block diagram reduction

Lecture -30

Modeling of mechanical systems, modeling of electrical systems

Lecture -31

Signal flow graphs, modeling of fluid systems, liquid level systems

Lecture -32

Modeling hydraulic systems, and modeling of thermal systems.

Lecture -33

Poles and zeros of a transfer function, the relationship between response behavior and location of poles and zeros, poles and zeros of first and second order system

Lecture -34

Transient and steady-state response analyses: First order systems

Lecture -35

Unit step and unit impulse response of first order systems, second order systems

Lecture -36

Unit step and unit impulse response of second order systems

Lecture -37

Transient response specifications

Lecture -38

Routh Hurwitz stability criteria

Lecture -39

Introduction to Bode plot and root locus method

Lecture -40

Determination of performance parameters using lab software, design changes for a desired change in its response

Subject: ME36006, Heat and Mass Transfer

Lecture -1

Introduction to HMT, Definition, Modes of heat transfer & their Definition
Introduction to Convection, Convection heat transfer coefficient, Convection Mechanism, Review of different dimensional formula

Lecture -2

Introduction to different dimensionless Numbers, Reynold No., Prandtl No., Nusselt No. Stanton No., Biot No., Boundary Layer Concept with diagram
Simple Numerical based on L-1&2

Lecture -3

Momentum Equation, Assumptions made, Derivation
Energy Equation, Assumptions made, Derivation (Home Work)
Simple Numerical and Assignment –1

Lecture -4

Flow Over a Flat Plate for Laminar Flow, Exact Solution For Hydrodynamic Boundary Layer Thickness, Exact Solution For Thermal Boundary Layer Thickness

Lecture -5

Simple Numerical based on L-4

Lecture -6

Flow Over a Flat Plate for Laminar Flow, Relation between Re, Pr & Nu
i.e. $Nu_x = 0.332\ (Rex)^{0.5}\ (Pr)^{0.33}$
Reynold's Analogy, (inter relationship between fluid friction & Newton's law of viscosity), i.e. $St_x.Pr^{2/3} = 0.5\ C_{fx}$, and Numerical

Lecture -7

Introduction to Couette or Parallel flow, Assumptions made, Form of Continuity equation, Velocity distribution, Temp. Distribution, Position at which max. temp. will occur, Value of max. Temp., Surface heat fluxes and Numerical and Assignment-2

Lecture -8

Flow Over a Flat Plate for Turbulent Flow, Heat Transfer based on Fluid Friction Analogy
For Re No. Between 5X 10^5 to 10^7 and For $10^7 < Re < 10^9$
Boundary layer follows a laminar growth pattern up to xc i.e. Rex = 5X 105 and
a turbulent growth there after
Numerical

Lecture -9

Flow Over a Flat Plate for Turbulent Flow, Hydrodynamic Boundary Layer Thickness:
For Re No. Between 5X 10^5 to 10^7 and For $10^7 < Re < 10^9$ and Numerical

Lecture -10

Laminar Flow through Circular Tubes, Development of hydrodynamic boundary layer, Definitions: Hydrodynamic entrance region, Fully developed region, Hydrodynamic entrance length, Mean Velocity
Calculation of hydrodynamic entrance length i.e. $(x_{hl}/D) = 0.05\ Re_D$
Where $Re_D \leq 2300 = u_m D/\nu$

Lecture -11

Laminar Flow through Circular Tubes, Assumptions made, Velocity distribution, Temperature distribution, Mean fluid velocity i.e. u_m, Ratio of velocity at any point to u_m

Lecture -12

Bulk mean temp, Definition, its calculation, Heat flux, and Heat transfer coefficient
Numerical

Lecture -13

Empirical relations for Convection heat transfer through circular tubes & Flow over flat plates
Numerical based on natural convection

Lecture -14

Practice of Numerical and Assignment-4

Lecture -15

Heat Transfer with change of phase, Introduction, Condensation, Introduction, Types Comparison between Drop wise & Film condensation, Factors affecting Condensing heat transfer, Boiling heat transfer, Introduction, Boiling curves & various boiling regions

Lecture -16

Heat Exchangers, Definitions, Classifications, Overall heat transfer coefficient, Mean Temp. Difference, Mean temp., Difference for different arrangements: For Parallel flow H.E., For Counter flow H.E., For Cross flow H.E.

Lecture -17

Numerical based on L-16

Lecture -18

Heat Transfer from Parallel & Counter flow H.E., Fouling Factor phenomenon
Numerical

Lecture -19

Temperature Distribution & Heat Transfer In Condenser and In Evaporator
Effectiveness Method (N.T.U. Method), Definition of Effectiveness i.e. ε, when we adopt this method instead of LMTD approach, Mechanism

Lecture -20

ε for Parallel Flow H.E., ε, εmax, ε in case of gas turbine, ε for boiler & condenser

Lecture -21

ε for Counter Flow H.E., ε, εmax, ε in case of gas turbine, ε for boiler & condenser and Numerical

Lecture -22

More Numerical based on Analysis of H.E

Lecture -23

Heat Pipe, Introduction, Working, Advantages, Applications, Limitations, Performance

Lecture -24

Definition of thermal conductivity, Range of the values of K for different materials, Air, liquid, and solids (conductors and insulators), General Heat Conduction Equation, Derivation from first principle and importance of each term

Lecture -25

General Heat Conduction Equation in- cylindrical coordinate system, Spherical coordinate System, Importance and application

Lecture -26

General Heat conduction in one dimensional system, Initial and boundary condition, Simple numerical relate to B.C.

Lecture -27

Heat conduction through Plane walls 1-D, through cylindrical wall, through spherical wall, Composite structures

Lecture -28

Numerical on 1-D heat conduction related to L-29

Lecture -29

Shape factor in conduction, Effect of K on the temperature variation in thick slab, Formula derivation of thickness of insulation, Critical thickness of insulation in cylinder, Critical thickness of insulation in sphere

Lecture -30

Application of critical thickness of insulation its importance and significance
Numerical on critical thickness of insulation

Lecture -31

Steady flow of heat along a rod: its governing differential equation, Derivation

Lecture -32

Heat dissipation from an infinitely long rod, from an insulated end. Numerical on heat transfer and temperature variation along the length

Lecture -33

Definition of fin efficiency an effectiveness, Factors affecting the performance of fin Numerical based on heat transfer and performance

Lecture -34

Heat flow through parabolic, Triangular fin, circumferential fin Its formula and its comparison with the other profile

Lecture -35

Application of fin in thermometric well, Heat transfer from a bar connected to two-heat source at different temp.

Lecture -36

Transient conduction in solids with infinite K (lumped system)
Simple numerical

Lecture -37

Time response and thermal tome constant of thermocouple, Transient conduction in solids with finite conduction and convection in solids

Lecture -38

Heat transfer in periodic variation, Examples of periodic variation

Lecture -39

General equation of mass diffusion, Steady state diffusion through plane membrane

Lecture -40

Equimolal diffusion, Diffusion of water vapors through air , Convective mass transfer
Non-dimensional correlation Schmidt number and Lewis number

Subject: ME36506, Fluid Machinery

Lecture -1

Introduction of fluid machines
Units & Dimensions, Dimensional homogeneity

Lecture -2

Buckingham Theorem & its application, Rayleigh's method, Comparison with Buckingham theorem

Lecture -3

Similitude, Non-dimensional parameters
Reynolds number, Froud Number, Euler's Number, Mach number, Weber Number

Lecture -4

Distorted model, undistorted model

Lecture -5

Numerical on dimensional analysis
Assignment: Numerical related to dimensional analysis

Lecture -6

Classification of fluid machines, Impulse, Reaction, Impact of jet: Plate is stationary, Plate is moving.

Lecture -7

Velocity triangles, Euler's equation l

Lecture -8

Efficiencies of hydraulic machines
Hydraulic efficiency, Mechanical efficiency, Overall efficiency, volumetric efficiency

Lecture -9

Constructional details of different turbines
Pelton Turbine

Lecture -10

Numerical on Pelton turbine

Lecture -11

Constructional details of different turbines
Francis Turbine

Lecture -12

Numerical on Francis Turbine

Lecture -13

Construction details of different turbines
Kaplan Turbine, Propeller Turbine and Numerical based on it

Lecture -14

Unit quantities, Specific speed of hydraulic turbines

Lecture -15

Characteristics of turbines,
Main characteristic

Lecture -16

Operating characteristic,
Iso – efficiency curves, Losses in turbine

Lecture -17

Numerical on Pelton, Francis & Kaplan Turbines

Lecture -18

Governing of turbines

Lecture -19

Types of Pumps-Constructional details of roto-dynamic pumps

Lecture -20

Velocity triangles of centrifugal pump, Euler's equation of work for centrifugal pump, Work & power

Lecture -21

Different efficiencies, characteristic of pump Eulers Head and actual head, Manometric head of installation.

Lecture -22

Similarities in pumps, Affinity laws, specific speed, Classification according to specific speed etc., Minimum starting speed

Lecture -23

NPSH, Multistaging - series & parallel connection. Advantages of multi staging

Lecture -24

Reciprocating pumps- Main part, working, discharge, work done & power, slip, Indicator diagram.

Lecture -25

Indicator diagram and its application

Lecture -26

Effect of acceleration in suction and delivery pipes on indicator diagram, Effect of friction in suction and delivery pipes on indicator diagram, Air vessels.

Lecture -27

Energy saved with pressure vessels in single-acting and double-acting reciprocating pumps.

Lecture -28

Numerical & Assignment No-1

Lecture -29

Numerical & Assignment No-2

Lecture -30

Water hammer- Definition, Propagation of pressure waves, fundament equation derivation for rigid water column theory & Elastic water column theory, Gradual & sudden closer.

Lecture -31

Arithmetical integration, Surge tank their purpose, their operations & different types.

Lecture -32

Cavitation – Definition, Different types of cavitation, Theories of cavitation and cavitation effects.

Lecture -33

Effect of cavitation in turbines, different types of cavitation in turbines, Thoma cavitation factors

Lecture -34

Effect of Cavitation in Pumps, Thoma cavitaion factor, NPSH
(Available and required)

Lecture -35

Apparatus for cavitation test and prevention of cavitation in pumps & turbines

Lecture -36

Numerical & assignment No.-3

Lecture -37

Numerical & assignment No.-3

Lecture -38

Numerical & assignment No.-3

Lecture -36

Subject: ME36007, Steam and Gas Power Systems

Lecture -1

Introduction to vapour power cycle, Carnot cycle, derivation for efficiency, Numerical

Lecture -2

Limitations of Carnot cycle, Rankine cycle, modified Rankine cycle, thermodynamic analysis, derivation for efficiency, effect of operating conditions on efficiency, Numerical.

Lecture -3

Principles of increasing the thermal efficiency, Requirements of ideal working fluids, Binary vapour power cycle, Numerical

Lecture -4

Reheat cycle, Stage efficiency, reheat factor, internal efficiency, overall thermal efficiency, mechanical efficiency, relative efficiency, mass flow rate, numerical.

Lecture -5

Ideal Regenerative cycle, most ideal Regenerative feed heating cycle, Actual feed heating cycles, direct contact heaters, surface heaters, numerical. Combined cycles of steam and gas.

Lecture -6

Various types of nozzles, equation of continuity sonic velocity and mach number, steady flow energy equation in nozzles.

Lecture -7

The momentum equation for the flow through steam nozzle, entropy changes with friction, nozzle efficiency, mass of discharge through nozzle, numerical.

Lecture -8

Throat pressure for maximum flow (existence of critical pressure in nozzle), physical explanation of critical pressure, Maximum discharge of saturated steam, maximum discharge of steam initially superheated, Numerical

Lecture -9

General relation between area-velocity and pressure in nozzle flow, effect of friction on critical pressure ration, critical pressure ratio in a frictionally resisted expansion from a given initial velocity, Numerical

Lecture -10

Supersaturated flow in nozzles, effect of variation of backpressure, parameters affecting the performance of nozzle, Theory of steam injectors, numerical.

Lecture -11

Principle of operation of steam turbine, comparison of steam engines and turbines, Classification of steam turbines

Lecture -12

Working of Simple Impulse turbines, drawback of Simple Impulse turbines, compounding of impulse turbines. Working of pressure compounded impulse turbine, Working of velocity compounded impulse turbine

Lecture -13

Working of pressure-velocity compounded impulse turbine, working of impulse reaction steam turbine, difference between impulse and reaction turbine, velocity diagram for impulse turbine.

Lecture -14

Combined velocity diagram for impulse turbine, forces on blades and work done by blades, diagram efficiency, end thrust on rotor, gross stage efficiency, energy converted to heat by blade friction, numerical.

Lecture -15

Numerical on Velocity diagram for simple impulse turbine, influence of ratio of blade speed to steam speed on blade efficiency in a single stage impulse turbine, maximum blade efficiency

Lecture -16

Velocity diagram for two rows and three-row velocity compounded impulse turbine, most economical ratio of blade speed to steam speed for a two-row velocity compounded impulse turbine.

Lecture -17

Numerical on Velocity diagram for velocity compounded impulse turbine, blade height, advantages and disadvantages of velocity compounded impulse turbine.

Lecture -18

Flow of steam through impulse reaction blades, degree of reaction, Impulse turbine with similar blade section and half-degree reaction (Parson's turbine), Most economical ratio of blade speed to steam speed for Parson's turbine. Maximum blade efficiency

Lecture -19

Numerical on velocity diagram for impulse-reaction turbine, Height of reaction turbine, blading

Lecture -20

Energy losses in steam turbine (both internal and external losses), Governing of turbines (throttle, nozzle control, by-pass and combination)

Lecture -21

Classification, Types of condensers, construction and working, Efficiency

Lecture -22

Method of extraction of Air. Calculations of pump capacity, Cooling water calculations. Numerical

Lecture -23

Gas Turbines, Introduction & Classification. Main components of a simple G.T., Working of a simple G.T., Simple Open Cycle G.T., Flow diagram, Representation on p-v & T-s diagram

Lecture -24

Comparison between Open cycle & Closed cycle G.T., Assumptions made for ideal simple G.T. Derivation for η_{th} of the cycle

Lecture -25

G.T. cycle with ideal heat exchanger, Flow Diagram, Representation on T-s diagram, η_{th} of the cycle, Advantages, Conclusion. Numerical.

Lecture -26

Two Stage Compression With Perfect Inter Cooling, Flow Diagram, Representation on T-s diagram, η_{th} of the cycle, Advantages, Conclusion. Numerical.

Lecture -27

Two Stage Expansion With Reheating to Max. Temp., Flow Diagram, Representation on T-s diagram, η_{th} of the cycle, Advantages, Conclusion. Numerical.

Lecture -28

G.T. cycle with Inter cooler, Reheater & Regenerator, Flow Diagram, Representation on T-s diagram, η_{th} of the cycle, Advantages, Conclusion. Numerical.

Lecture -29

Condition of Maximum Work out put from the cycle for all above cases. Numerical.

Lecture -30

Practice of numerical. Assignment

Lecture -31

Deviations of actual G.T. cycle from ideal G.T. cycle.
Isentropic η of compressor, Isentropic η of turbine

Lecture -32

G.T. cycle with Inter cooler, Reheater & Regenerator, Flow Diagram, Representation on T-s diagram, η_{th} of the cycle, Advantages, Conclusion. Numerical.

Lecture -33

Practice of numerical. Assignment

Lecture -34

Jet Propulsion Engines, Introduction, Principle, Classification,
Comparison between Air breathing & Rocket Engines,
Definitions of Thrust equation, Thrust Power(F_{net} .V_i),

Lecture -35

T.S.F.C.(m_f / F_{net}), Sp. Thrust (F_{net} /m_a). Numerical

Lecture -36

Construction & Working of Turbo-jet enjine.
Efficiencies used in Turbojet Engines, Ram η, Thermal η, Propulsive η. Numerical.

Lecture -37

Construction & Working of different Engines: Ram-jet , Pulse-jet, Turbo-prop.
Construction & Working of different Rocket Engines, Chemical Rocket Engine, Nuclear Rocket Engine, Electric Propulsion Rocket Engine

Lecture -38

Practice of Numerical. Assignment

Lecture -39

Construction and working of Combined Steam and Gas Power Cycle.
Flow and T-s diagram. η_{th} of the cycle, Advantages.

Lecture -40

Practice of Numerical. Assignment

Subject: ME36509, Internal Combustion Engine

Lecture -1

Engine Performance definition, Geometrical properties of Engine (Bore, Strokes, R/L), Mean Piston Speed (its values), Brake torque measurement (Brake power determination), Indicated work (Gross indicated work, net indicated work), Mechanical Efficiency, Mean Effective Pressure, (Turbo inter-cooled, two-stroke), Specific fuel Consumption, and Air fuel ratio, volumetric efficiency

Lecture -2

Correction factor for Engine Power, (Numerical on Lecture 1)

Lecture -3

Definitions of flames for SI & CI engines, Composition of Air (Motor ratios), Combustion stoichiometry determination (Generalized formula for fuel composition) fuel air Equivalence ratios

Lecture -4

Heat of Reactions at Const Volume, Heat of Reactions at Const Pressure, Enthalpy of formation & determinations of Heat of Reaction, Lower Heating value & Higher Heating Value, Adiabatic flame Temperature, Combustion efficiency

Lecture -5

(Numerical on above)

Lecture -6

Unburned Mixture Composition and determination of Overall Molecular weight simple analytic model for engine cycle, Unburned Mixture charts. Burned Mixture charts.

Lecture -7

Tables of properties and composition, Computer Routines for Properly and composition calculation, (Numerical on Lecture 6 & 7)

Lecture -8

Thermodynamic Relations for Engine Processes, Non-Dimensional Relations for States in Cycle, Comparison of Cycles, Fuel Air Cycle, Comparison with Actual cycles

Lecture -9

Pollutant Formation and Control: Order of Various pollutants from Engine, NO formation in SI Engine (Kinetics, characteristic time), NO formation in SI Engine, Effect of NO on Equivalence ratio, Burned gas fraction, Excess air & GER, Spark

Lecture -10

NOx formation in CI Engine, CO formation in SI Engine

Lecture -11

Effect of various fuel compositions on HC formation, Flame Quenching Phenomenon (Analytic compression), HC formation due to (SI), Flame Quenching, Crevices, Absorption & Desorption, Poor Combustion Quality, Deposits, HC Oxidation in Exhaust

Lecture -12

HC formation in Diesel Engine, Effect HC on over leaning, under mixing, Quenching Particulates of SI & CI

Lecture -13

Particulates Composition & Structure, Particulate distribution in Cylinder, Soot formation

Lecture -14

Exhaust gas treatment options, Catalytic Converter Oxidation Catalyst No. Catalyst, Three way catalytic converter, Thermal reactors, Particulate Traps

Lecture -15

Engine friction and Lubrication, Comparison of Major Categories of frictional Power, Boundary & Hydrodynamic friction, Measurement Methods of friction, Correlation of Temp for SI CI Engine

Lecture -16

Pumping friction, Piston Assembly friction, Crankshaft bearing friction, Valve train friction, Accessory Power Requirement

Lecture -17

Lubrication (Oil kit), Lubricant Requirement, Multi grade Oils and Numerical

Lecture -18

Engine Operating Characteristics, Indicated Power Curve & Brake Power for SI, Indicated Power Curve & Brake Power for CI, Operating Parameters affecting SI engine Performance (Spark time, Mixture composition, A/F ratio, EGR, Lead & Speed Compression ratio).

Lecture -19

SI Engine Combustion chamber design, Factors that control combustion, Factor that control Performance (Volumetric efficiency, Heat Transfer Chambers Octane Requirement

Lecture -20

Factors that affect CI Engine Performance, (Load and speed, fuel Injection parameters, Air Swirl and Bowl in Piston Design), Performance of 4 stroke SI Engine, Performance of 4 stroke CI Engine

Lecture -21

Numerical

Lecture -22

Gas Exchange Process: Inlet & Exhaust process in 4-stroke cycle, Volumetric efficiency and its depended on various parameters, Volumetric efficiency of ideal cycle, Effect of fuel composition, Effect of fracture of fuel vaporized, Heat of vaporization, Effect of Intel and Exhaust pr ratio and compression ratio

Lecture -23

Frictional losses in intake, Ram effect, Reverse flow phenomenon, Tuning of Intake, system

Lecture -24

Effect of Volumetric efficiency on speed, value lift, Area, Value Geometry determination of flow velocity, Inlet Mean Mach No, Discharge coefficient for Inlet and Exhaust valve.

Lecture -25

Cross scavenging loop scavenging, Uniflow Scavenging, Delivery ratio, trapping efficiency Scavenging efficiency, purity, charging efficiency, Actual scavenging Process, Numerical on Scavenging

Lecture -26

SI Engine: Mixture requirement at various operating conditions of Engine, Fundamental Carburetor, Flow through venturi, and flow through fuel orifice Carburettor performance

Lecture -27

Modern Carburetor design, Boost Venturi, Multiple barrel Carburetor Compensation and Main metering system Idle system, Power increments system Accelerator pump, choke, Altitude Compensation, Transient affects

Lecture -28

Flow in Intake Manifold, Airflow phenomena, Airflow Model, Fuel flow phenomena, Transport process, Fuel droplet behaviors, Fuel film behavior

Lecture -29

Intake Jet flow, Mean Velocity and Turbulence Characteristics, Swirl, Swirl Measurement, Crevice flows and blow by flow generated by cylinders piston wall Interaction

Lecture -30

Combustion in SI Engine: Thermodynamic analysis of SI Engine combustion Analysis of Cylinder pressure data

Lecture -31

Combustion process characterization Flame structure Speed, Laminar burning speed, Flame propagation Relations

Lecture -32

Cyclic Variations in Combustion, Partial burning Misfire, Causes of cycle-to-cycle variation, partial burning, misfire and Engine Stability

Lecture -33

Abnormal Combustion: Knock & Surface Ignition Knock fundamentals, Effect of Radials fuel factors, Fuel Sensitivity, RON, MON, Anti knock Index.

Lecture -34

Injection System & S. Ignition System: Layout of Multipoint Port, Injection system, Operating parameter operation

Lecture -35

Single point throttle body Injection Fuel back systems (Pollutant reduction), Fundamentals on Ignition process Conventional Ignition systems, Spark Plug design's

Lecture -36

Alternative ignition approaches, Plasma jet, flame jet, alternative sparks discharge

Lecture -37

Combustion in I.C. engine: Comparison of various types of combustion chambers of diesel engine, P-Q curve of diesel engine and its analysis

Lecture -38

Analysis of cylinder pressure data to determine heat release rate, fuel mass burning rate

Lecture -39

Injection pump, Behavior of fuel spray, mass flow rate, structure of fuel spray, spray penetration, droplet size distribution, spray evaporation

Lecture -40

Ignition delay, fuel ignition quality, diesel index, physical factor affecting delay, effect of fuel property as on delay, mixing controlled combustion

Subject: ME 46020, CAD (Computer Aided Design)

Lecture –1

Introduction to Computer Aided Design. Definition and scope.

Lecture –2

CAD Hardware. Systems, input devices, output devices.

Lecture –3

Types of systems. Systems evaluating criteria.

Lecture –4

Input Devices: Keyboards, Light pens, Digitizing Tablets, Mouse Systems, Joysticks, Trackballs and Thumbwheels.

Lecture –5

Output Devices: Graphics Displays, Hardcopy Printers, and Plotters.

Lecture –6

Hardware Integration and Networking. Hardware Trends.

Lecture –7

CAD/CAM Software. Introduction of Data Structure, Database, Working Coordinate System.

Lecture –8

Graphics Standards. Modes of Graphics Operations. Introduction of CAD/CAM Data Exchange, Evolution of Data Exchange Formats, IGES file format.

Lecture –9

Software Modules: Operating System (OS) Module, Graphics Module, Applications Module, Programming Module, Communications Module.

Lecture –10

Modeling and Viewing in CAD/CAM Software.

Lecture –11

Documentation, Development, & Efficient Use of CAD/CAM Software.

Lecture –12

Software Trends & its increasing demand.

Lecture –13

Introduction of Geometric Modeling.

Lecture –14

Wireframe Models. Wireframe Entities.

Lecture –15

Parametric Representation of Analytic Curves: Review of Vector Algebra.

Lecture –16

Review of Lines, Circles, Ellipses, Parabolas, Hyperbolas, Conics.

Lecture –17

Parametric Representation of Synthetic Curves: Review of Hermite Cubic Splines, Bezier Curves, B-Spline Curves, Rational Curves.

Lecture –18

Various order continuity in curves.

Lecture –19

Engineering Applications of curves.

Lecture –20

Curve Manipulations Features: Displaying, Evaluating Points on Curves, Blending, Segmentation, Trimming, Intersection, Transformation.

Lecture –21

Introduction of Surface Models.

Lecture –22

Different Surface Entities: Review of Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder.

Lecture –23

Review of Bezier Surface, B-Spline Surface, Coons Surface, Blending Surface, Offset Surface.

Lecture –24

Parametric Representation of Analytic Surfaces.

Lecture –25

Parametric Representation of Synthetic Surfaces.

Lecture –26

Surface Manipulations Features: Displaying, Evaluating Points and Curves on Surfaces, Segmentation, Trimming, Intersection.

Lecture –27

Engineering Applications of Surface Models.

Lecture –28

Introduction of Solid Modeling.

Lecture –29

Introduction of Solid Entities.

Lecture –30

Basic Elements & Boolion Operations of Boundary Representation (B-rep), Constructive Solid Geometry (CSG).

Lecture –31

Basic Elements & Boolion Operations of Sweep Representation, Analytical Solid Modeling.

Lecture –32

Engineering Applications of Solid Models.

Lecture –33

Overview of Reverse engineering and Rapid Prototype and complete product development cycle

Lecture –34

Transformations of Geometric Models: Translation, Scaling, Reflection, Rotation, etc.

Lecture –35

Introduction of Finite Element Modeling.

Lecture –36

Introduction of Finite Element Analysis.

Lecture –37

Engineering Applications of Finite Element Modeling.

Lecture –38

One Dimensional Finite Element Analysis: Beam Element Analysis, One Dimensional Heat Transfer.

Lecture –39

Introduction of Two Dimensional Finite Element Analysis.

Lecture –40

Detail study of Vibrational Approach, & Galerkin Methods in Finite Element Modeling.

Subject: ME46219, Advanced Machine Design

RELIABILITY

Lecture -1

Introduction to reliability. Importance of reliability in engineering. Confidence level. Application of reliability.

Lecture -2

Deterministic Approach v/s Reliability based approach. Limitations of deterministic approach.

Lecture -3

Probability distributions. Applications of different probability distributions. Normal distribution.

Lecture -4

Normal distribution charts and tables. Use of normal distribution charts. Examples. Assignment: Sessional: Problem on use of normal distribution charts.

Lecture -5

Examples: Journal and bearing tolerances. Setting tolerances. Tolerancing using Standard deviation.

Lecture -6

Normal distribution for strength and stress. Failure criteria. Standard Normal Variate. Conversion of raw data in to standard normal variation.

Lecture -7

Example: Design of tensile bar with probability-based approach.
Assignment: Sessional: One problem on design of tensile bar.

Lecture -8

Example: Design of torsion shaft with probability-based approach.
Assignment: Sessional: One problem on design of shaft.

JOURNAL BEARING

Lecture -9

Introduction. Constructional features. Types of lubrication regimes.

Lecture -10

Fluid film lubrication theory.

Lecture -11

Viscosity of oil. Different units of viscosity. Inter conversion of viscosity in different systems. Viscosity charts.

Lecture -12

Design parameters in bearing design. Selection of lubricating oil. Determining working viscosity.

Lecture -13

Working pressure in bearing. Working clearances. Bearing characteristic number. Selection of these parameters.

Lecture -14

Friction in bearings. Calculation of friction coefficient. Heat generation in bearing

Lecture -15

Heat Dissipation in bearing. Checking the design for thermal considerations.

Lecture -16

Use of Raymondi Boyd charts.

Lecture -17

Selection of surface finish. Specifying surface finish. Minimum oil film thickness.

Lecture -18

Calculation of actual operational parameters of designed bearing. Comments on suitability of design. Assignment: Sessional: Two problems on design of Journal bearing.

DESIGN OF MACHINE TOOL DRIVE

Lecture -19

Introduction to machine tool drives. Different types of drives. Suitability and comparison of different types of drives.

Lecture -20

Advantages and limitations of gear drives. Types of gear drives. Loss of speed. Minimizing the loss of speed in gear drives.

Lecture -21

Selection of gearing layout. Ray diagram of gear box. Selection of number of teeth of various gears in the gear box.

Lecture -22

Deviation diagram of gear box. Structure diagram of gear box.

DESIGN AGAINST CREEP

Lecture -23

Stages in creep failure. Mathematical models for creep related strain.

Lecture -24

Generation of creep data. Accelerated creep tests. Need for parameter methods.

Lecture -25

Larsen Miller Parameter Method. Mason Hafford Parameter Method.

Lecture -26

Example Assignment: Sessional: One problem each on Larsen Miller & Manson Hafford methods.

DESIGN OF STRUCTURAL MEMBERS BASED ON ELASTIC-PLASTIC THEORY

Lecture -27

What is Elastic-plastic theory-based design? Its applications. Ideal plastic behavior. Elastic-Plastic Design of Beams with Symmetric Cross Section

Lecture -28

Elastic-Plastic Design of Beams with Unsymmetrical Cross Section. Elastic-Plastic Design of Shafts

Lecture -29

Elastic-Plastic Design of Thick Cylinders. Development and Analysis of Residual Stresses due to Elastic-Plastic loading

DESIGN OF BEAMS UNDER UNSYMMETRICAL BENDING ACTION

Lecture -30

What is unsymmetrical bending and how it can occur? What are Principal axes of inertia? What is Principal Moment of Inertia? Determination of above for some standard cross-sections

Lecture -31

Equation for stresses at a point on beam cross section when under unsymmetrical bending action. Design on the basis of above equation. How to locate of Neutral axis. What is Shear Center? How to locate it?

INTRODUCTION TO OPTIMUM DESIGN

Lecture -32

Difference between Optimum and Conventional design. General format of formulation of an optimum design problem, Correlate various elements in it with real life examples.

Lecture -33

Graphical explanation using a simple 2-variable optimum design problem to demonstrate concept of objective-function, constraints, infeasible & feasible region, optimum solution, inconsistent problem formulation, unbounded solution, unique solution, multiple solutions.

Lecture -34

Concepts of stationary points, local and global optima, saddle point. Taylor series expansion, linear and quadratic approximations.

Lecture -35

Quadratic forms, positive definite, positive semi-definite, negative definite, negative semi-definite and indefinite matrices. Derivation of necessary and sufficient conditions at unconstrained optimum point for a 1-variable problem

Lecture -36

Derivation of necessary and sufficient conditions at unconstrained optimum point for a 2-variable problem. General framework/algorithm of an optimization method

Lecture -37

Methods of unconstrained optimizations: zero-order methods (typically used for one-dimensional line searches)

Lecture -38

Methods of unconstrained optimizations: First-order methods (Steepest descent method). Methods of unconstrained optimizations: Second-order method (Newton's method).

Lecture -39

Methods of unconstrained optimizations: Marquartd's method. Examples of formulation of some typical machine design problem as optimum design problems.

Lecture -40

Introduction to MATLAB. Basic commands. Optimization Toolbox: Discussion of various functions available in the Toolbox? Optimization Toolbox: How to code a given optimum design formulation using a function available in the Toolbox?

Subject: ME46051, Vibration and Noise control

Lecture -1

Definition, desirable and undesirable aspects of Vibration, Characteristics of Vibration eg., displacement, velocity, acceleration and phase. Addition of harmonic motions, Beats phenomenon.

Lecture -2

Work done by harmonic force on harmonic motion, periodic, non-harmonic excitation and need for Fourier series.

Lecture -3

Evaluation of coefficients of Fourier series, mathematical models introduction.

Lecture -4

Series and parallel arrangements of springs and dampers: Equivalent springs and dashpot, equivalent shaft of uniform diameter.

Lecture -5

Undamped free Vibrations: Definitions system response, free & forced vibrations, derivation of differential equation of motion, Method based on Newton's 2^{nd} law of motion, Energy methods.

Lecture -6

Rayleigh's method. Solution of differential equation of motion for free undamped vibration. Concept of natural frequency.

Lecture -7

Systems involving angular oscillations. Effect of Mass of spring on natural frequency,

Lecture -8

Damped free vibrations: Viscous damping and Eddy current damping. To establish differential equation of motion & the different types of damped system.

Lecture -9

Under-damped vibrations: damped frequency of Vibration; concept of overshoot in automobile suspension, Logarithmic decrement: definition's derivation of expression.

Lecture -10

Logarithmic decrement in terms of n number of cycles, Coulomb or Dry Friction damping Damped frequency in dry friction damping, rate of decay in coulomb damping, Energy considerations.

Lecture -11

Comparison between viscous and coulomb damping, structural damping, slip/interfacial damping.

Lecture -12

Harmonically excited vibrations; Transient & steady state vibrations, Comments on steady state solution, Magnification factor. Effect of frequency ratio on phase angles, Excitations due to rotating unbalance

Lecture -13

Excitation due to reciprocating unbalance, Vibration Isolation and force transmissibility, Vibration isolation using springs alone.

Lecture -14

Whirling of shaft: synchronous whirl, critical speed, critical speed of light vertical shaft with single rotor (without damping), Heavy side and light side on the outside,

Lecture -15

Critical speeds of a shaft with multiple discs (without damping).

Lecture -16

Vibration Measurement: Motion transmissibility, Relative motion of mass (seismic Instruments). Vibrometers. Accelerometer: Principle, phase distortion.

Lecture -17

Two degree of freedom system: Differential equations of motion for systems with 2 d.o.f . frequency or characteristic equation and the natural frequencies.

Lecture -18

Principal modes of vibration, mode shapes, Torsional vibrations, semi-definite systems

Lecture -19

Coordinate coupling; static and dynamic coupling

Lecture -20

Dynamic Vibration Absorber: Principal of operation, effect of mass ratio on spread of frequency ratio, frequency response curves for main and auxiliary system.

Lecture 21

Modal Analysis, Classification of Modal Analysis, Theoretical, Computational, Experimental Modal analysis

Lecture22

Orthogonality of Eigenvectors, Decoupling of Equations of Motion,

Lecture 23

Modal Mass, Modal Stiffness and Modal Damping, General solution in terms of normal mode (Normal Mode Summation)

Lecture 24

Introduction to Experimental Modal Analysis, Response sensors, Accelerometers and its mounting methods, Eddy current probes, Excitation devices, Shakers, Impact hammer.

Lecture-25

Machine vibration data acquisition, Vibration Severity and Standards,

Lecture 26

Analysis of vibration records, Vibration Monitoring

Lecture 27

Noise and its causes, Subjective response to sound,
Inverse Square Law, Threshold of hearing, Audible Frequency Range, Sound wave propagation,

Lecture 28

The decibel scale; sound pressure/intensity/power levels and relation amongst them,
Summation of Pure tones of different frequencies, R.M.S. sounds pressure. Decibel addition, subtraction and averaging

Lecture -29

Anatomy of human ear: External, middle & inner ear.

Lecture- 30

Sound pressure dependent human response.

Lecture –31

Non-auditory effects of noise on people: Effect on Task performance, speech communication, and Health & reproductive system.

Lecture 32

Radiation Fields of Sound Source, Near field, Far field, Free field, Direct field, Reverberant field, Diffuse field, Loudness and equal loudness contours

Lecture -33

Types of sound fields. Introduction to octave band analysis, One and ones-third octave band analysis,

Lecture -34

Mechanism of hearing, Loudness: equal loudness controus. Phone & sone scales.

Lecture -35

Need of weighting networks, Weighting networks - A,B and C scales.

Lecture –36

Noise standards & limits, Indian standards on ambient emissions. Hazardous noise exposures; legal aspects

Lecture –37

Hearing conservation and Damage Risk criterion; equal energy principle. IS)-1999-1982 and OSHA standards

Lecture –38

Daily dose of noise and its calculation in Industrial applications, Major sources of noise in community & Industries, Industrial noises control: strategies.

Lecture 39

Noise control at source; through vibration control, changing location/orientation of source, changes in Design process, sound enclosures.

Lecture –40

Acoustic Chambers, Anechoic Chamber, Reverberation chamber, Sound absorbing materials, Sound Absorption and Reflection Coefficients, Noise reduction coefficient, Methods of industrial noise control

Subject: ME4631, Hydraulic, Pneumatic & Fluidic Control

HYDRAULIC SYSTEMS

Lecture -1

Introduction to fluid power systems, Difference between mechanical & Fluid control systems, Advantages & disadvantages of mechanical & Fluid control systems

Lecture -2

Difference between hydraulic & pneumatic systems, Advantages & disadvantages of both the systems, Selection and applications of hydraulic & pneumatic systems in different engineering fields

Lecture -3

Basic hydraulic system, explaining a simple circuit showing standard symbols of different hydraulic components

Lecture -4

Properties of hydraulic fluid: different properties of power transmitting fluids. Effect on the performance due to bulk modulus of the fluid, Types of hydraulic fluids

Lecture -5

Positive displacement pumps (Classification), requirement of positive displacement pump in hydraulic power systems.

Lecture -6

Rotary pumps: Gear Pump: a) Internal; b) External.

Lecture -7

Vane pump: Balanced, Unbalanced.

Lecture -8

Lobe Pump, Screw Pump, Pump efficiency

Lecture -9

Reciprocating pumps:

1) axial piston pumps: a) Inline piston pumps: variable plate, inclinable swash plate, cam/crankshaft driven piston pumps b) Bent axis piston pumps.

2) Radial piston pumps: stationary cylinder block rotating cylinder block

Lecture -10

Pressure control valves: Relief, Sequence valves.

Lecture -11

Unloading valve, Counter balancing.

Lecture -12

Pressure reducing valve, Valve characteristics.

Lecture -13

Directional control valves: One-way, Two-way & three-way valves.

Lecture -14

Four-way & Five-way valves, Valve Characteristics

Lecture -15

Center conditions of Directional Control valves: a) Closed center. b) Open center. C) Tandem center & other center conditions & their applications.

Lecture -16

Flow control valves: Restricted type & Pressure compensated flow control valve.

Lecture -17

Hydraulic Servo technique and Solenoid valves

Lecture -18

Hydraulic actuators: Types of actuators (Linear & Rotary), Deceleration Cushions, Stop tubes.

Lecture -19

Numerical Based on hydraulic motors & Actuators

Lecture -20

Hydraulic Reservoir: Design & specification of Hydraulic reservoir.

Lecture -21

Filters & strainer specification, Hydraulic sensors

Lecture -22

Design of Hydraulic circuits & Pneumatic circuits.

PNEUMATIC SYSTEMS & FLUIDICS:

Lecture -23

Introduction to Pneumatic systems, Properties of air, Air quality & quality standards Air quality requirement in different industries.

Lecture -24

Air- compressors. Construction & operation, Advantages & limitations Application, Types (reciprocating, diaphragm, sliding vane, lobe rotor & liquid ring type

Lecture -25

Filtration of air, types of filters & their working, Advantages & limitations of different types of filters

Lecture -26

Effect of humidity pneumatic systems, Acceptable humidity levels, types & selection of dehumidifiers & air driers

Lecture -27

Lubrication of air, Advantages & limitations of lubricated air. Types & selection of air lubricator

Lecture -28

Types of pneumatic cylinders & motors, Selection of pneumatic cylinders & motors

Lecture -29

Comparison of hydraulic & pneumatic symbols

Lecture -30

Basic hydraulic & Pneumatic circuits, Hydraulic press

Lecture -31

Regenerative, Meter-in, Meter-out & Bleed-off Circuits.

Lecture -32

Sequence operations (Direct), Sequence operations (Indirect)

Lecture -33

Full automatic control of two double acting cylinders, Accumulator & Unloading circuits

Lecture -34

Applications of pneumatic systems in Industrial Process Control, PID Control (Lecture-I)

Lecture -35

Steady state analysis of pneumatic components

Lecture -36

Introduction to fluidics, Coanda effect & theory of wall attachment

Lecture -37

Types of amplifiers (Bi-stable, Proportional, Turbulent & Vortex),

Lecture -38

Fluidic sensors: Digital & Analog (different types)PID Control (Lecture-II)

Lecture -39

Logic Circuits: Timing, delay etc.

Lecture -40

Equivalent electrical circuits & its graphical characteristics

Subject: ME46018, Automobile Engineering

Lecture -1

Vehicle Structure: Integral body construction, Description and functions of body components, Floor chassis description

Lecture -2

Body Sub frames, Sound proofing of Interior, Collision Safety, Body and Chassis Alignment Checks

Lecture -3

Engine transmission Mountings, Reasons of flexible mountings, Rubber Mfg., Axis of Oscillation, Positioning of Engine and Gear box, Engine and transmission Vibrations, Transmissibility

Lecture -4

Types of Rubber flexible mountings, Double Shear paired sandwich, Double Inclined Wedge Inclined Inter Leaf rectangular, Double Inclined wedge, Metacentric bush, Double Inclined rectangular sandwich, Flanged sleeve bobbin mfg, Hydrostatic engine mfg.

Lecture -5

Steering: Steering gear box ratios, Basic steering Mechanism (Screw & Nut), Forward and Reverse efficiency of Steering System, Relation between forward and Reverse efficiency, Layout of Steering System

Lecture -6

Cam and peg Steering Gear box, Wormed Roller type, Re-circulating ball nut & rocker lever, Re-circulating rack and sector

Lecture -7

Need for Power assisted steering, External dissect Coupled power assisted steering (Rigid axle) Independent and, Function of Control Valve

Lecture -8

Rack & Pinion Power assisted steering, Function of rotary control Valve

Lecture -9

Integral Power steering, Function of Control Valve

Lecture -10

Operation of hydraulic pump, Pressure relief valve, Ball joints.

Lecture -11

Coefficient of adhesive friction, Grip Control with Vehicle speed, tyre wear, nature of road surface degree of surface wetness, Road surface texture, Breaking characteristics on wet roads, Rolling Resistance, Fracture and breaking efforts, Type reaction due to longitudinal & Lateral forces

Lecture -12

Tyre Materials, Properties of rubber, Mechanical properties, Natural and synthetic rubber, Comparison between natural & synthetic rubber

Lecture -13

Tyre Construction, Tread Considerations, Selection of tread patterns, Three zone concept of tyre to ground contact on a wet surface, Aqua planning, Type Profile and Aspect ratio

Lecture -14

Tyre contact patch, Cornering force, Slip angle, Cornering Power, Pneumatic trial, Self aligning torque, Camber thrust, Camber scrub, Comber steer

Lecture -15

Lateral weight transfer, Directional stability along a straight track, Directional stability along a Curved tack, Tyre marking identifications

Lecture -16

Wheel balancing Static, Dynamic, Methods of balancing in two separate plane (Static & dynamic), Method of balancing, Wheel and tyre run out lateral run out, Radial run out

Lecture -17

Suspension: Suspension Geometry (Camber, King Pin Inclination, Castor) Offset of Swivel joint, Suspension roll centers Short Swing, Long Swing, Transverse double wishbone suspension

Lecture -18

Parallel trailing double arm vertical pillar strut., McPherson Strut suspension, Semi Trailing arm Rear suspension, Rigid axle beam suspension longitudinally located semi elliptic, Pan hard Rod, Diagonal tie rod, Transverse wait linkage

Lecture -19

Body roll stability analysis, Comparison of rigid axle beam and independent suspension body roll stiffness Anti roll bar function

Lecture -20

Rear suspension, Live rigid, hotch kiss drive, Four link, coil spring, Torque tube rear wheel dive, Rigid, Non drive rear suspension, Rear Independent Suspension

Lecture -21

Frictional Clutch: Clutch fundamentals, Angular driver plats Cushioning and torsional damping, Clutch Material

Lecture -22

Clutch drive and driver member inspection clutch miss-alignment

Lecture -23

Poll type diaphragm clutch, Multi plate diaphragm type clutch

Lecture -24

Hydraulically operated automatic transmission clutch, Semi centrifugal clutch, Performance Characteristic

Lecture -25

Introduction to tractive-effort weight, Introduction to axial Load, Aerodynamic forces

Lecture -26

Vehicle power plant, Transmission characteristics

Lecture -27

Transmission characteristics prediction operating fuel Economy, Electrical System

Lecture -28

Self-Starting Mechanism, Battery charging system

Lecture -29

Lighting and wiring system for horn, wiring system for lamp indicators

Lecture -30

Air conditioning for vehicle, Refrigerant, Maintenance of Air conditioning for vehicle, Load calculation of Air conditioning

Lecture -31

Auto inspection Motor vehicle acts

Lecture -32

Emission Standard, Bharat – I, Bharat – II Etc., Effect of Sox, Nox & Co ppm on atmospheres, Sox emission control

Excess air phenomenon, Co ppm system

Lecture -33

Braking fundamentals, (Energy of motions & work done in braking), Brake stopping distance and efficiency collision factor

Lecture -34

Brake shoe and pad fundamentals, (Brake shoe self-energization), Retarding wheel & brake drum torque, Drum shoe arrangement, (two leading shoe), (Two trailing shoe) Due servo shoe

Lecture -35

Principle of disc brakes

Subject: ME46218, Mechatronics and Automation

Lecture –1

Introduction to Mechatronics. Definition and scope. Mechatronics approach.

Lecture –2

Elements of control system, Types of control system and performance specification.

Lecture –3

Control system design process and introduction of block diagram.

Lecture –4

Block reduction method and problem on block diagram.

Lecture –5

Laplace transformation, introduction of transfer function, Problem on transfer function for Translational mechanical system.

Lecture –6

Problem on transfer function for rotational mechanical system, electrical system.

Lecture –7

Introduction of Poles and Zeroes, introduction of order of systems.

Lecture –8

Dynamic response of first order and second order system and problems.

Lecture –9

Introduction Routh Hurwitz stability criteria and problems.

Lecture –10

Stability of control system, Root locus method and problems.

Lecture –11

Frequency response of mechatronics systems. Analysis with Bode plots. Performance specifications.

Lecture –12

Closed Loop Controllers. Proportional, derivative, integral controller.

Lecture –13

Combinations of proportional, integral and derivative controllers.

Lecture –14

Performance comparison and limitations of PID controllers and controller tuning.

Lecture –15

Introduction of Digital Logic: Logic gates.

Lecture –16

Boolean algebra.

Lecture –17

Electro-mechanical engineering devices (EMD). Electric motors, relays, solenoids.

Lecture –18

Electrical: Electrical actuation systems, D.C., A.C. motors and generators; series and stepper motors

Lecture –19

Characteristics of electric motor.

Lecture –20

Control action of electric motor

Lecture –21

Introduction of Pneumatic and Hydraulic systems; Pressure and Directional control valves, rotary actuators.

Lecture –22

Introduction of basic circuit and reference circuit for Pneumatic and Hydraulic systems.

Lecture –23

Operation of Meter-in, Meter-out and Bleed off circuit in Pneumatic and Hydraulic systems.

Lecture –24

Applications of hydraulics in mechatronics systems. Examples.

Lecture –25

Controlled Motion. Path control. Position control. Motion control hardware and software.

Lecture –26

Motion control Applications in machine tools and robotics.

Lecture –27

Motion control using stepper motors. Control circuits.

Lecture –28

Motion control using servo motors. Servo control circuits.

Lecture –29

Examples and applications of motion control using stepper and servo motors.

Lecture –30

Feedback system: linear and rotary encoders.

Lecture –31

Feedback system: resolvers, tachometers.

Lecture –32

Application of feedback system in automation.

Lecture –33

Signal conditioning: Operational amplifier. Applications of op-amp as summing amplifiers, integrator, differentiator, switch, etc.

Lecture –34

Filters in circuits. Different types of filters like band pass, notch etc. Filter circuits.

Lecture –35

Introduction of Digital Signals Processing. Comparison between analog and digital systems.

Lecture –36

Digital to analog conversion. Analog to Digital Conversion. Common AD and DA conversion circuits and block diagrams.

Lecture –37

Introduction of Data acquisition systems.

Lecture –38

Introduction and application of Microprocessor in mechatronics system.

Lecture –39

Introduction and application of Micontroller in mechatronics system.

Lecture –40

Factors Considered While Selecting a Microprocessor and Microcontroller

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Subject: Advance Machine Design, ME 46219

Lecture -1
Different types of Stresses in rotating disc, distribution of stresses in the disc.

Lecture -2
Effect of drilled hole in the disc

Lecture -3
Disc of uniform thickness and uniform strength

Lecture -4
Design of flywheel

Lecture -5
Design of Pulley

Lecture -6
Stress in curved beam

Lecture -7
Design of crane hook.

Lecture -8
Design of chain link and clamp

Lecture -9
Differentiating Symmetrical and Unsymmetrical bending, finding principal axis, neutral axis,

Lecture -10
Stress distribution in unsymmetric section,

Lecture -11
Design of sections subjected to unsymmetrical bending

Lecture -12
Defining shear centre, significance locating shear centre

Lecture -13
Locating shear centres for different sections

Lecture -14
Design of section subjected to torsional shear stress

Lecture -15
Introduction to deformation beyond elastic limit and design analysis

Lecture -16
Simple cases of deformations beyond elastic limits

Lecture -17
Introduction to probabilistic design approach, associated terminology, calculation of reliability of machine components.

Lecture –18
Reliability based design of machine elements subjected to tension and compression

Lecture -19
Reliability based design of machine elements subjected to bending

Lecture -20
Reliability based design of machine elements subjected to torsion

Lecture -21
Requirement of speed variation in a machine tool, methods distributing speeds steps in the range

Lecture -22
Selection of Structure formula, structural diagram for gear box

Lecture -23
Ray diagram for gear box and selection of ray diagram, gear box layout

Lecture -24

Design of speed box for machine tool

Lecture -25

Introduction to different Experimental method for stress analysis and their application in design,

Lecture -26

Strain gauges types, application, selection, mounting procedure, stress calculation using strain gauges,

Lecture -27

Combinations of strain gauges for different application

Lecture -28

Photo elastic technique for stress analysis and application in design

Lecture -29

Brittle coating technique for stress analysis

Lecture -30

Human factors in design: Introduction to human – machine system, human factors, applications in system design,

Lecture -31

Human physical activities, human control of systems, shapes, coding of control.

Lecture -32

Effect of Climatic conditions like temperature, lighting, noise and vibration

Lecture -33

Requirement of gear box in the I C engine-based vehicle, power torque characteristics of I C engine, power torque requirement of vehicle, types of automotive trans mission, manual automatic.

Lecture -34

Design requirements of gear box, engine fuel map, engine emission map.

Lecture -35

Different load on the vehicle, road load, driving load, acceleration load, gradient load, wind load

Lecture -36

Load calculation on axle and wheel, power train kinematics and traction

Lecture –37

Driving condition diagram, Power-speed chart

Lecture -38

Selection of gear ratios, highest gear ratio, first gear ratio, intermediate gear ratio, Finalization of gear ratios

Lecture -39

Power train layout and manual transmission structure

Lecture -40

Power flow and gear ratios, components of manual transmission