MEC- 401
MATERIAL SCIENCE AND METALLURGY

Unit 1 Ferrous and Non-Ferrous Metals and Alloys: -Properties and application of various steels and cast iron. Effect of impurities in ferrous metals. Effect of common alloying elements on the steels, High speed steels, Stainless steel. Corrosion and its prevention. Composition, microstructure, properties and applications of Aluminium and its principle alloys, Copper and its principle alloys, Nickel and its principle alloys.

UIT-II Mechanical Properties & Equilibrium Diagram: Various mechanical properties like strength, stiffness, elasticity, plasticity, ductility, hardness, impact strength, malleability, brittleness, toughness, resilience, etc Allotropy structure of alloys, lever rule, phase rule, Various types of phase diagrams. Cooling curves, Iron carbon equilibrium diagram . TTT diagrams.

UIT-III Heat Treatment of Metals and Alloys and Powder metallurgy: Heat treatment procedure for steel hardening, hardenability, Surface hardening of steel, Defects in heat treated parts. Strengthening mechanisms. Property and applications of powder metallurgy, Manufacturing of metal powders, Various process and methods of making products by powder metallurgy techniques. Composite materials
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UIT-IV Destructive and Non-Destructive Testings: Tensile, compression, shear, torsion fatigue, impact, hardness tests. Ultrasonic, magnetic, eddy current, radiography tests etc. Metallography. Introduction to instrumental methods of analysis.

UIT-V Discription of Crystal Structure and Dislocation: Seven Crystal System. Bravais lattice. Symmetry and properties of simple crystal structure Millers indices. Direction and planes indices. Edge Dislocation, Screw dislocations slip planes. Stress fields of dislocation. Grain Boundaries. Dislocation Densities. Strength of alloys. Dislocations and crystal growth.
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BOOKS RECOMMEDED
[1] Khanna,O.,P., *Material Science and Metallurgy*, Dhanpat Rai Publications,2005
[2]Nayak, S.,P., *Engineering Metallurgy & Material Science*, Charotara Publications,2000
[3]Narang., *Material Science*, Khanna Publisher-2000
[4] Singh,I. P., *Material Science and Engineering* , Jain Brothers-2003

MEC- 402
THEORY OF MACHINES AND MECHANISM

Unit 1 Basics of theory of machines: Degree of Freedom (Grubler's criterion) ,Inversions of Quadric cycle chain, single and double slider crank mechanism. Grashof's criterion, Types of kinematic synthesis, Chebychev spacing method for 3- positions, Synthesis of four bar function generator, Study Pantograph, Straight line mechanisms, Steering Mechanisms (Ackerman's mechanism, Delay's Steering Gear mechanism).

Unit 2 :Gears: Classification of gears, nomenclature, involutes and cycloidal tooth profile properties, synthesis of tooth profile for spur gears, tooth system, conjugate action, velocity of sliding, arc of contact, path of contact, contact ratio, interference and undercutting, helical, spiral, bevel and worm gears.

Unit 3 Cams: Classification of followers and cams, radial cam nomenclature, analysis of follower motion (uniform, modified uniform, simple harmonic, parabolic, cycloidal), pressure angle, radius of curvature, synthesis of cam profile by graphical approach, cams with specified contours.

Unit 4 Gear Trains: Simple, compound, epicyclic gear trains; determination of gear speeds using vector, analytical and tabular method; torque calculations in simple, compound and epicyclic gear trains.

Unit 5 Gyroscopic: Action in Machines: angular velocity and acceleration, gyroscopic torque/ couple; gyroscopic effect on naval ships; stability of two and four wheel vehicles, rigid disc at an angle fixed to a rotating shaft

RECOMMENDED BOOKS :

- T. Bevan, Theory of Machines, CBS Publications & Distributions,2000

- J. Shigley, Theory of Machines and mechanisms, Oxford University,2006.

- Ambekar AG; Mechanism and Machine Theory; PHI.

- Sharma CS; Purohit K; Theory of Mechanism and Machines; PHI.

- Thomas Bevan; Theory of Machines; Pearson/ CBS PUB Delhi.

- Rao JS and Dukkipati; Mechanism and Machine Theory; NewAge Delhi.

- Dr.Jagdish Lal; Theory of Machines; Metropolitan Book Co; Delhi –

- Ghosh,A,.Mallik,AK; Theory of Mechanisms & Machines, 2e,; Affiliated East West Press,

List of experiments (expandable)

1. Study of cam and follower and finding velocity and acceleration of follower
2. Study of slider crank mechanism
3. Study of diffrent kinematic pairs
4. Generation of involute teeth profile for diffrent gears
5. Performance of interference and undercutting of tooth (by ploting)
6. Study of gyroscopic effect using gyroscope
7. To study working of differential gear mechanism.
8. To study working of sun and planet epicycle gear train mechanism using models

MEC-403
THERMAL ENGINEERING AND GAS DYNAMICS

Unit I Steam generators: classification, conventional boilers, water tube boiler and Fire tube boiler. Low pressure boiler. Babcock and Wilcox boiler Cochran boiler locomotive boiler. Lancashire boiler high-pressure boilers-Lamont, Benson, Loffler and velox steam generators,

Unit II Heat balance sheet, performance and rating of boilers, equivalent evaporation, boiler efficiency, combustion in boilers, super critical boilers, fuel and ash handling, boiler draught, natural draught Artificial draught overview of boiler codes.

Unit III Gas dynamics: speed of sound, in a fluid Mach number, Mach cone, stagnation properties, one-dimensional isentropic flow of ideal gases through variable area duct-Mach number variation, area ratio as a function of Mach number, mass flow rate and critical pressure ratio, effect of friction, velocity coefficient, coefficient of discharge, diffusers, normal shock.

Unit IV Air compressors: classification and working of reciprocating compressor, and rotary compressor , work input for single stage compression , compression processes, volumetric efficiency isentropic & isothermal and mechanical efficiency, multi stage compression, inter - cooling, condition for minimum work done.

Unit V Steam nozzles: nozzle convergent. Divergent nozzle isentropic flow of vapors, flow of steam through nozzles, condition for maximum discharge, effect of friction, super-saturated flow Types of steam condensers,

References:
- R.K.Rajpuat
- R.Yadav Thermal Engg.
- Ganesan; Gas turbines; TMH
- P.K.Nag; Basic and applied Thermodynamics; TMH
- Thermodynamics by Gordon J. Van Wylen
- R. Yadav Steam and Gas Turbines
- Kadambi & Manohar; An Introduction to Energy Conversion – Vol II. Energy conversion cycles

List of Experiments (Please Expand it) (Thermal Engg and gas dynamics):

1. Study and working of Babcock and Wilcox boilers.
2. Study and working of Cochran boilers.
3. Study and working of high pressure boiler Lamont.
4. Study and working of high pressure boiler Benson.
5. Study of Induced draft/forced and balanced draft by chimney.
6. Study of different types of steam turbines.
7. Study of multistage Compressor.
8. Determination of Calorific value of a fuel
9. Determination of thermal efficiency of steam power plant

MEC- 404
Fluid Mechanics

UNIT I

PROPERTIES OF FLUID: Fluid and continuum, Physical properties of fluids. Newtonian and non-Newtonian fluids. Pressure transducers, Pascal's law, pressure variation in a fluid at rest, Hydrostatic law, Manometer, Hydrostatic force on submerged body, Buoyancy and Flotation.

UNIT II

FLUID KINEMATICS: Langragian and Eulerian approach, Type of fluid flow. Continuity equation, acceleration of a fluid particle, motion of fluid particle along curved path, Normal and tangential acceleration, Rotation and Vorticity, circulation, stream and potential function, flow net. Liquid in relative equilibrium.

UNIT III

FLUID DYNAMICS: Euler's equation of motion along a streamline, Impulse momentum equation, Momentum of Momentum equation, Kinetic energy and momentum correction factor, forces on fixed and moving vanes and applications. Fluid Measurements, Velocity measurement, flow measurement.

UNIT IV

LAMINAR FLOW: Reynolds's experiment, Hagen-Poiseuille Equation, flow of viscous fluids between two parallel plates, Drop of pressure head. Effect of turbulence, Expression for loss of head due to friction in pipes**.** Loss of energy in pipes, Hydraulic gradient and total energy line, pipe in series and parallel, equivalent pipe power transmission through pipe, water hammer in pipes.

UNIT V

DIMENSIONAL ANALYSIS: Methods of dimensional analysis, Rayleigh's method, Buckingham's theorem. Model analysis: Dimensionless number and their significance, model laws, Type of models, scale effect in model, limitation of hydraulic similitude.

Reference Books:

1. Fluid Mechanics- Yunush A. Cengel, John M. Cimbala- TMH,Delhi
2. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar– Kataria & Sons – New Delhi
3. A text of Fluid Mechanics – R. K. Rajput – S. Chand & Company Ltd., Delhi\
4. Fluid Mechanics & Hydraulics Machines-R.K.Bansal-Laxmi Publications, Delhi
5. Engineering Fluid Mechanics –K.L. Kumar, Eurasia Publication House, Delhi
6. Mechanics of Fluid – B.S. Massey – English Language Book Society (U.K.)
7. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas- TMH, Delhi
8. Hydraulics and Fluid Mechanics Including Hydraulic Machine- PN Modi,& SM Seth-Standard, Delhi

List of Experiments:

Note: Ensure to conduct at least 10 experiments from the list:

1. To determine the meta-centric height of a ship model.
2. To verify Impulse Momentum Principle.
3. To calibrate a Venturimeter and study the variation of coefficient of discharge.
4. To calibrate an orifice-meter.
5. Flow measurement using Pitot tube.
6. To determine the hydraulic coefficients (C_c, C_d and C_v) of an orifice.
7. To determine the coefficient of discharge of a mouth piece.
8. To study the variation of friction factor for pipe flow.
9. To determine the head loss for a sudden enlargement
10. To determine the head loss for a sudden Contraction.
11. To determine of head loss in various pipe fittings.
12. To study of Reynolds experiment for demonstration of stream lines & turbulent flow.

MEC – 405
Industrial Robotics

Unit I
INTRODUCTION: Need and importance, basic concepts, structure and classification of industrial robots, terminology of robot motion, motion characteristics, resolution, accuracy, repeatability, robot applications.

Unit II
END EFFECTORS AND DRIVE SYSTEMS: Drive systems for robots, salient features and comparison, different types of end effectors- Mechanical - Magnetic -Vacuum – Adhesive - Drive systems and controls; design and applications of end effectors.

Unit III
SENSORS: Sensor evaluation and selection, Piezoelectric sensors, linear position and Displacement, sensing, revolvers, encoders, velocity measurement, proximity, tactile, compliance and range sensing, Image Processing and object recognition.

Unit IV
INDUSTRIAL APPLICATIONS : Application of robots in manufacturing, processing operations like Welding, painting, Assembly, machining, Welding, Assembly, Material transfer and machine loading/unloading, CIM and hostile and remote environments - safety considerations.

Unit V
SAFETY AND ECONOMY OF ROBOTS: Work cycle time analysis, economics and effectiveness of robots, safety systems and devices, concepts of testing methods and acceptance rule for industrial robots.

References:
1. Mittal RK, Nagrath IJ; Robotics and Control; TMH
2. Groover M.P,Weiss M, Nagel,OdreyNG; Industrial Robotics-The Appl□; TMH
3. Groover M.P; CAM and Automation; PHI Learning
4. Spong Mark and Vidyasagar; Robot Modelling and control; Wiley India
5. Yoshikava ; Foundations of Robotics- analysis and Control; PHI Learning;
6. Murphy ; Introduction to AI Robotics; PHI Learning
7. FU KS, Gonzalez RC, Lee CSG; Robotics □Control, sensing□; TMH
8. Shimon, K; Handbook of Industrial Robots; John Wiley & Sons,.
9. Ghosal Ashitava; Robotics Fundamental concepts and analysis; Oxford
10. Saha S; Introduction to Robotics; TMH
11. Yu Kozyhev; Industrial Robots Handbook; MIR Pub.
12. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.
13. Mikell P. Groover, mitchell Weiss, " Industrial robotics, technology, Programming and Applications ", McGraw Hill International Editions, 1986.
14. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, " Robotic engineering - An Integrated Approach ", Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.

List of Experiments (Please Expand it):
1) Study of different types of robots
2) Study of different types of end effectors
3) Study of different robot arm motions
4) Study of sensors used in robots
5) Experiments on robot programming
6) Modeling of robots

MEC-406
PROGRAMMING WITH C++
UNIT-I

Principles of Object Oriented Programming:- Procedure-Oriented Programming, Object Oriented Programming paradigm, Basic concepts of Object Oriented Programming, Benefits of Object Oriented Programming, Object Oriented languages, Application of Object Oriented Programming. Beginning with C++:- What is C++?, Application of C++, C++ statements, Structure of C++ program, Creating the Source file, Compiling and Linking.

UNIT-II

Tokens, Expressions and Control Structures:- Tokens, Keywords, Identifiers, Basic Data Types User-defined data types, Derived Data types, Symbolic Constants, Type compatibility, declaration of variables, Dynamic initialization of variables, Reference Variables, Operators in C++, Memory Management Operators, Manipulators, Type cast operator, Expression and Implicit conversions, Operator precedence, Control Structures.

UNIT-III

Classes and objects: - Introduction to Class, Class Definition, Classes and Objects, Access Specifiers – Private, Public and Protected. Member functions of the class. Constructor and Destructor: Constructors, Overloading Constructors, Destructor. Polymorphism: Types of polymorphism. Function Overloading: - Function overloading, Precautions to be taken while overloading functions. Static Class Members, Static Member Functions, Friend Functions.

UNIT-IV

Operator Overloading: - Introduction to Operator Overloading, Operator Overloading Fundamentals. Implementing the operator functions, Inheritance Reusability, Inheritance concept-single inheritance. Using the derived class, Constructor and destructor in derived class, Object initialization and Conversion, Nested classes (Container classes), Multilevel inheritance, Multiple inheritance., Hybrid Inheritance. Virtual base class.

UNIT-V

Abstract and Virtual function:- Abstract Class, Virtual Function. Pure Virtual Function. Templates. Exception handling, Advanced File Input Output:- Input/output with files. Open a file, closing a file

REFERENCES:
1. Herbert Schildt, "C++ the Complete Reference ", III edition, TMH 1999
2. Balagurusamy, Entrepreneurial "Object Oriented programming with C++", TMH
3. Barkakatin "objects oriented programming in C++" PHI 1995

LIST OF EXPERIMENTS:-
1.   Problems involving sequence, selection and iteration.
2.   Small problems mainly computational to illustrate expression and operator precedence.
3.   Programmes such as: GCD, Sum of series, Fibonacci Series, Even and Odd series, Finding root of a function, Sequence of a numbers, Checking prime number, Largest among given number etc.
4.   Problems relating to arrays: Print, Reverse, Sum, Maximum and Minimum, Insert and Delete elements etc.
5.   Problems related to classes and objects
6.   Problems to illustrate constructor & destructor
7.   Problems related to inline functions.
8.   Problems related to friend functions.
9.   Problems related to operator overloading.
10.   Problems related to default arguments, function overloading, functions overriding.
11.   Problems related to different types of inheritance.