Sem 5 ME

Syllabus

Course Name: Metal Cutting and Forming [1:0:2=2]

Course Content:

- Fundamentals of metal cutting processes: turning, milling, drilling, abrasive machining, surface finishing processes, planning and shaping, broaching etc.
- Mechanics of Machining: Tool nomenclature, chip formation, cutting forces, surface integrity, power consumption, and temperatures in metal cutting, machine tools, tool Materials, tool wear, cutting fluids and economic considerations.
- CNC Machine Tools and CNC Programming: CNC tooling, manual part programming, preparatory functions, miscellaneous functions, tool length compensation, canned cycles, tool length and cutter-radius compensation.
- Fundamentals of Metal Forming, Rolling: Introduction, flat-rolling, rolling mills, various rolling processes and mills;
- Forging: Introduction, Open-die, Impression-die, closed-die forging; Various forging operations, Forgeability of metals, forging defects, die-design, die-Materials and lubrication, Forging machines;
- Introduction to Extrusion and Drawing, Extrusion types, extrusion defects, Design considerations;
- Sheet-metal forming processes: Introduction, shearing, sheet-metal characteristics and formability; formability tests; Bending of sheets, plates and tubes; Deep drawing, hydro-forming, Spinning, Super-plastic forming, Hot-stamping, Specialized forming processes.

List of Lab experiments:

- Single point cutting tool: visualize its angles in ASA Systems and ORS Systems and define them.
- Grinding of tool angles of a single point lathe tool and its measurement using tool makers microscope;
- Chips: Study of chips and determination of chip reduction co-efficient in turning mild steel by HSS tool by varying the process parameters;
- Tool Life: Effect of process parameters on cutting tool life; Effect of feed and nose radius on surface roughness;
- CNC Programming: Part programming on CNC Turning Center and VMC.
- Metal Forming & Sheet Metal Operations

Course Outcomes:

CO1: Understand the fundamental and design principles governing various metal cutting and forming operations.

CO2: Analyse the process and process parameters affecting the manufacturing processes.

CO3: Develop the designs / concepts to manufacture the mechanical components using various operation.

Textbook:

1. S. Kalpakjian, *Manufacturing Processes for Engineering Materials*, 6th Edition, India: Pearson, 2018.

Reference Book:

1. A.B. Chattopadhyay, *Machining and Machine tools*, 2nd Edition, India: Wiley, 2011.

Course Name: Quality Control Assurance & Reliability [2:0:0=2]

Course Contents:

Basic concepts of probability and probability distribution, Standard probability distribution, Sampling and Confidence intervals, Testing significance, Statistical tolerance, Various types of control charts, Statistical process control techniques, Defect diagnosis and prevention, Basic concepts of reliability, Reliability design evaluation and control, Method of applying total quality management into production process. Understand system reliability, Life-cycle curve, and applications cases of TQM, QFD, SQC etc., Quality and Industry 4.0.

Course Outcomes

CO1: Apply the knowledge of science, maths and computer science to understand the philosophy and concepts of quality control and improvement.

CO2: Analyse quality problems in production systems using statistical process control/ reliability concepts for quality improvement.

CO3: Solve real-life quality management problems using control charts and quality control techniques.

Textbook:

1. J.M. Juran and Frank M. Gryna, *Quality Control Handbook*".

Reference books:

1. Edward G. Schilling, *Quality Control and Industrial Statistics*.
2. David M. MacFadden, Quality Inspection Handbook.
3. Amitava Mitra, Quality Control and Improvement.
4. Farid Dowla, Quality Control and Reliability.
5. K.S. Srinivas, Quality Control and Applied Statistics.

Course Name: Kinematics and Dynamics of Machines [3:0:2=4]

Course Content:

Type of Kinematic Joints, Elements or Links, Classification of Links, Kinematic Pair, Constrained Motion, Kinematic Chain, Mechanism, Types of Mechanisms, Mechanism and Machines, Degrees of Freedom, Degrees of Freedom of Planar Mechanisms, Planar Mechanisms with Lower Pairs Only, Four-Bar Chain, Grashof's Law, Crank–Crank (or Double Crank) Mechanism, Crank–Rocker (or Lever) Mechanism, Rocker–Rocker (or Double Rocker) Mechanism, Inversion of Mechanisms, Inversions of a Four-Bar Chain, Determination of Link Velocities, Relative Velocity Method, Relative Velocity of Points in a Kinematic Link, Forces in a Mechanism, Mechanical Advantage, Four-Bar Mechanism, Slider–Crank Mechanism , Instantaneous Centre Method, Velocity of a Point on a Link, Types of Instantaneous Centres, Location of Instantaneous Centres, Determination of Angular Velocity of a Link, Acceleration Diagrams, Acceleration Diagram for Four-Bar Mechanism, Coriolis Acceleration, Classification of Cams, Types of Followers, Cam Nomenclature, Follower Motions, Simple Harmonic Motion, Motion with Uniform Acceleration and Deceleration, Motion with Uniform Velocity, Cam Profile with Knife-Edge Follower, Radial Knife-Edge Follower, Offset Knife-Edge Follower, Cam Profile with Roller Follower, Radial Roller Follower,, Offset Roller Follower, Fundamental Law of Gearing, Sliding Velocity Between Gear Teeth , Gear Tooth Forms, Involute Tooth Profile, Cycloidal Tooth Profile, Involute Gear Tooth Action, Interference and Undercutting in Involute Gear Teeth, Minimum Number of Teeth, Gear Wheel, Pinion, Rack and Pinion, Comparison Between Spur and Helical Gears, Helical Gear Terminology, Herringbone Gears, Bevel Gears, Overview on Flywheel, working mechanism of flywheel, energy fluctuation in flywheel, numerical solution on flywheel, function of brakes,Working mechanism of shoe brake, band brake and differential band brake, numerical solution on brake, working mechanism of disc clutch, cone clutch, centrifugal clutch, numerical solution on clutch, Overview on dynamometers, working mechanisms of various dynamometers, numerical solution on dynamometers, Introduction to governors, Types of governors, watt governor, Proell, porter and hartnell governor working principle, important terms for designing of governor, numericsl solution of governors,

Introduction to balancing, Rotational balancing, reciprocating balancing, numerical solution on balancing. Introduction to gyroscope, gyroscopic couple, gyroscopic effect on aeroplane, ships, automobiles, numerical solution on gyroscopic effect, Introduction to vibration. Freqency calculation for longitudinal, transverse and torsional vibration, damped and undamped vibration, vibration isolation techniques.

Course Outcomes:

CO1: Apply the basic concepts of kinematic of motion to design linkages and Mechanism.

CO2: Analysis of different Mechanisms.

CO3: Design and analysis of mechanical elements used in machines.

CO4: Understand vibration response of a system.

Textbooks:

1. Theory of Machines by S S Ratan , TMH

Reference books:

1. Theory of Mechanism and Machine by Ghosh and Mallick ,East West Press
2. Mechanism of Machine theory by Rao and Dulchipati, New Age Publication
3. Theory of machine by R K Bansal, Laxmi Pub. Pvt. Ltd.

Course Name: IC Engines & Automobile Engineering [2:0:2=3]

Course Content:

Introduction: Introduction and Classification of IC Engines, Engine nomenclature, Working Principles, Valve timing diagram of SI & CI Engines, Comparison of SI and CI engine, Engine operating and performance parameters.

Thermodynamic Analysis of cycles: Significance of Fuel-Air & Actual cycles of I.C. engines. Comparison with Air Standard Cycles. Analysis of Fuel-Air & Actual cycles

Conventional & Alternative Fuels: Fuels of SI and CI engine, Fuel additives, Properties, potential and advantages of alternative liquid and gaseous fuels for SI and CI engines, biofuels, CNG, hydrogen engines,

Air and Fuel Induction Techniques: Air and Fuel induction techniques in SI and CI engines, Mixture Requirements at Different Loads and Speeds, Carburetion, Factors Affecting Carburetion, Principle of Carburetion, Simple Carburetor, and its drawbacks.

Electronic Fuel Injection Systems: Electronic Engine Management, ECU, Injection Timing, Gasoline Direct Injection, Common Rail Direct Injection DTSI, MPFI

Combustion: Combustion, Stages of combustion in SI and CI engines, effects of engine variables on flame propagation and ignition delay, Abnormal combustion, Preignition & Detonation, Theory of Detonation. Effect of engine variables on Detonation, control of Detonation. Diesel Knock & methods to control diesel knock.

Engine friction and lubrication: Need of lubrication, Types of losses, lubrication of engine components, lubrication systems, properties of lubricants and additives

Engine Cooling: Need for a cooling system, Characteristics of an efficient cooling system, Types of cooling systems, Liquid cooled systems, Air-cooled systems, Comparison, Advantages and Disadvantages

Emission formation and Control: Formation of NOx, HC/CO mechanism, Smoke and Particulate emissions, Green-House Effect, Methods of controlling emissions, Three-way catalytic converter and Particulate Trap, Emission (HC, CO, NO and NOx) measuring equipment, Smoke and Particulate measurement, emission norms.

Recent Trends and Future IC Engine Technologies: VVT – Cam changing & cam phasing, EGR, Turbocharging, supercharging, Dual fuel engines, hybrid vehicles etc.

List of Lab Experiments:

- Determine flash point and fire point of a given fuel / lubricating oil.
- Heat balance test on 4-stroke, Single cylinder petrol / diesel engine.
- Morse-test on multi cylinder petrol engine.
- Load test / Performance test and combustion along with emission test on 4-stroke single cylinder (VCR) diesel engine.

Course Outcomes:

CO1: Understand the fundamental concepts of IC Engines, automobile systems, thermodynamic cycles, combustion processes and emission issues.

CO2: Analyse the various parameters affecting the engine power output.

CO3: Develop the strategies for best engine performance as per emission standards.

Textbook:

1. V. Ganesan, *Internal Combustion Engines*, 4th Edition, New Delhi: McGraw-Hill Pub. Co. Ltd, 2013.

Reference Book:

1. P K Nag, *Engineering Thermodynamics*, 4th Edition, New Delhi: McGraw-Hill Pub. Co. Ltd, 2016.