ME 010 701 Design of Machine Elements

(Common with AU010 701)

Teaching scheme **Credits:** 4

2 hours lecture, 1 hour tutorial and 1 hour drawing per week

Objectives

To provide basic knowledge on the design considerations and methodology of various machine elements.

Module I (15 Hrs)

System design cycle - Different phases in design process - design factors and considerations - tolerances and fits - Hole basis & Shaft basis system - standardization - selection of materials - stress concentration - Methods to reduce stress concentration - theoretical stress concentration factor - theories of failure - Guest's theory - Rankine's theory - St. Venant's theory - Haigh's theory - Von Mises & Hencky theory - shock and impact loads - fatigue loading - endurance limit stress- Factors affecting endurance limit - Factor of safety - creep and thermal stresses.

Module II (15 Hrs)

Design of riveted joints- Failure of riveted joints and efficiency of joint -boiler and tank joints- structural joints, Cotter and Knuckle joints

Threaded joints - thread standards- thread nomenclature - stresses in screw threads- bolted joints preloading of bolts- eccentric loading- fatigue loading of bolts - Power screws.

Module III (15 Hrs)

Design of welded joints- Representation of welds - stresses in fillet and butt welds- design for static loads - bending and torsion in welded joints- eccentrically loaded welds - design of welds for variable loads.

Springs- stresses and deflection of helical springs with axial loading - curvature effect - resilience - design of spring for static and fatigue loading- surging- critical frequency- stress analysis and design of leaf springs..

Module IV (15 Hrs)

Shafts and axles design- stresses- causes of failure in shafts - design based on strength, rigidity and critical speed- design for static and fatigue loads- repeated loading- reversed bending-

Design of couplings - Rigid and flexible couplings - design of keys and pins.

Note: Any one of the following data book is only permitted for reference in the University examination

1. Machine Design Data hand book by K. Lingaiah, Suma Publishers, Bangalore/ Tata Mc Graw Hill
2. PSG Design Data, DPV Printers, Coimbatore.

Text Books

1. C.S, Sarma, Kamlesh Purohit, Design of Machine Elements, Prentice Hall of India Ltd , New Delhi
2. M. F. Spotts, T. E. Shoup, Design of Machine Elements, Pearson Education.
3. V.B. Bhandari, Design of Machine Elements, McGraw Hill Book Company

Reference Books

1. J. E. Shigley, Mechanical Engineering Design, McGraw Hill Book Company

ME 010 702: Dynamics of Machines

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

- *To understand the basic principles involved in the balancing of rotating and reciprocating masses*
- *To understand the basic concepts of vibration of single degree of freedom systems*
- *To understand the methods of analysis of two degree and multi degree of freedom systems.*
- *To understand the concepts in transient and non linear vibration*
- *To understand the methods of noise control*

Module I (14 hours)

Balancing: - Balancing of rotating masses, static balancing and dynamic balancing, Balancing of several masses rotates in same plane, balancing of several masses rotating in several planes, Balancing machines.
Balancing of reciprocating masses: - The effect of inertia force of the reciprocating mass on the engine. Partial primary balance. Balancing of multi cylinder inline engines, v-engines, Radial engines, Direct and Reverse cranks

Module II (16 hours)
Vibrations: - Definitions, simple harmonic motion. Single degree freedom systems: -
Undamped free vibrations: - Equations of motion Natural frequency, Energy method, Equilibrium methods, Rayleigh's methods, Equivalent stiffness of spring combinations.
Damped free vibrations: - Viscous damping, Free vibrations with viscous damping, Over damped system, Critically damped system, Under-damped system, Logarithmic decrement, viscous dampers, Energy dissipated by damping,
Forced Vibrations: - Forced harmonic excitation, Base Excitation, Vibration isolation and Transmissibility. Vibration measuring instruments.

Module III (14 hours)
Two degree freedom systems: - Principal modes of vibration, Rectilinear and angular modes, systems with damping, vibration absorbers, Centrifugal pendulum damper, Dry friction damper, untuned viscous damper.
Multi-degree of freedom system: - Free vibrations, equations of motion, Influence
Coefficients method, lumped mass systems, distributed mass systems (basics only), Stodola method, Dunkerly's method.
Torsional Vibrations: - Torsionally equivalent shaft, torsional vibration of two rotor, three-rotor, and geared systems

Module IV (14 hours)

Critical speeds of shafts: - Critical speed of a light shaft is having a single disc without damping.

Transient vibration: - Laplace transformation, response to an impulsive input, response to a step input, phase plane method, shock spectrum.

Non-linear vibrations: - Phase plane, undamped free vibration with non-linear spring forces, hard spring, soft spring, Forced vibration with nonlinear forces, Duffings equation, self excited vibrations - problems.

Module V (12 hours)

Acoustics: - Sound propagation, decibels, acceptance noise levels, Air columns, acoustical measurements, Doppler Effect, microphones and loud Speakers. Recording and reproduction of sound, Fourier's theorem and musical scale, Acoustic impedence filters.

Environmental noise control: Industrial noise control strategies Noise ratings, human ear. human tolerance levels, equivalent sound level and loudness contours - Noise control through barriers and enclosures and absorbent linings - problems.

References

1. Theory of Machines - Thomas Bevan
2. Theory of Machines - P.L. Ballaney
3. Mechanical Vibrations, V edition - G.K. Groover
4. Theory of Vibrations with applications, III Edn - W.T. Thomson
5. Mechanical Vibrations - S. Graham Kelly, Schaum's outlines
6. Fundamentals of Vibrations - Leonard Meirovitch, Mac Graw Hill
7. A text book of sound - L.P. Sharma & H.C. Saxena
8. Engineering Noise Control - D.A. Bies & C.H. Hausen.
9. Noise & Vibration Control - Leo N. Beraneck

ME 010 703: Gas Dynamics and Jet Propulsion

Teaching scheme **Credits:** 3

2 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of dynamics and thermodynamics of gas flow.*

Module I (7 hours)

Introduction: Continuum- Control Volume and System approaches- Continuity and Momentum equations for control volume- Mach number- Velocity of sound- Classification of flow based on Mach number- Physical difference between incompressible, subsonic and supersonic flow- Mach angle- Karman's rule of supersonic flow- Effect of Mach number on compressibility- General features of one dimensional flow of compressible fluid.

Module II (10 hours)

Isentropic flow of an ideal gas: General features and governing equations- stagnation properties and state- Reference velocities- Dimensionless velocity- Crocco number- Bernoulli equation- Isentropic flow through variable area- Comparison of isentropic and adiabatic flow- Mach number variations- Area ratio- Impulse function- Mass flow rate, Chocking in Isentropic flow- Variation of flow parameters in isentropic flow- Performance of convergent and De lavel nozzle- Performance of real nozzles- Applications of Isentropic flow.

Module III (10 hours)

Simple frictional flow: Governing equations- Fanno curves- Limiting conditions- Fanno flow equations- Variation of flow properties- Variation of Mach number with duct length- Choking due to friction. Isothermal flow with friction: Basic equations- Limiting conditions- Variation of flow properties. Flow with heat transfer: Governing equations- Rayleigh curves- Limiting condition- Rayleigh flow relations- Variation of flow properties- Maximum heat transfer- Thermal choking.

Module IV (9 hours)

Normal shock: Development of a shock wave- Governing equations- Intersection of Fanno and Rayleigh lines- Prandtl-Meyer relation- Properties of flow across normal shock- Thickness of shock waves- Shock strength- Determination of Mach number of supersonic flow- Variation of flow parameters through normal shock.

Module V (9 hours)

Air craft propulsion: Types of gas turbine engines- Components of a gas turbine engine- Energy flow through jet engines- Propeller and jet Thrust- propulsive and overall efficiency- Ramjet, Pulsejet and Scramjet engine. Rocket Propulsion: Types of rocket engines- Liquid propellant

rockets and propellant feed system- Solid propellant rocket motors- Restricted and unrestricted burning- Rocket propulsion theory- Applications.

Text Books

1. S M Yahya, *Fundamentals of compressible flow with aircraft and rocket propulsion*, New Age International.
2. P Balachandran, *Fundamentals of compressible fluid dynamics*, Prentice Hall of India.
3. V Babu, *Fundamentals of gas dynamics*, Ane Books India.

Reference Books

1. A. H. Shapiro, *Dynamics and thermodynamics of compressible fluid flow (Vol-1)*, The Ronald Press Company.
2. Anderson, *Modern compressible flow with historical perspective*, Mc Graw Hill
3. James John & Theo Keith, *Gas Dynamics*, Pearson International.
4. Liepmann and Roshko, *Elements of gas dynamics*, Dover publications.
5. Zucrow M. J. & Jeo D Holfman ,*Gas dynamics (Vol 1)*, John Wiley

ME010 704: Refrigeration and Air Conditioning
(Common with AU010 704)

Teaching scheme **Credits:** 3

2 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of Refrigeration and Air Conditioning*
- *To develop a sound physical understanding of the subject so that the learner will demonstrate the ability to design a refrigeration or air-conditioning equipment that meets the required specifications*

Module 1 (8 hours)

Principles of refrigeration: Thermodynamics of refrigeration – Carnot, reversed carrot cycle, heat pump, and refrigerating machine- coefficient of performance -unit of refrigeration- refrigeration methods - conventional refrigeration systems. Air refrigeration system -Bell Coleman cycle -C.O.P –capacity, work and refrigerant flow requirements in Bell Coleman cycle.

Module 2 (10 hours)

Vapor compression system: simple cycle -comparison with Carnot cycle, theoretical and actual cycles- COP- effect of operating parameters on COP- wet, dry and superheated compression- sub cooling - actual cycle representation on TS and PH diagrams- simple problems. Advanced vapor compression systems – multistage vapor compression systems- flash chamber- multiple compression and evaporation systems- cascading -simple problems.

Module 3 (10 hours)

Vapor absorption systems: simple cycles-actual cycle- ammonia water and lithium bromide water systems – COP -Electrolux system. Refrigerant and their properties: Nomenclature- suitability of refrigerants for various applications -unconventional refrigeration methods- vortex tube, steam jet, magnetic (Cryogenics) refrigeration and thermoelectric refrigeration- applied refrigeration: house hold refrigerator –unit air conditioners and water coolers- ice plant -cold storage

Module 4 (7 hours)

Refrigeration system components (Theory Only): water and air cooled condensers- evaporative condensers- expansion devises -capillary tube -constant pressure expansion valve- thermostatic expansion valve- float valve and solenoid valve. Evaporators: natural convection coils -flooded evaporators -direct expansion coils. Reciprocating compressors: single stage and multistage compressors- work done -optimum pressure ratio -effect of intercooling- volumetric efficiency -

effect of clearance- isothermal and adiabatic efficiency. Rotodynamic compresors: Screw and vane type compressors- principle of operation- hermetic, semi hermetic and open type refrigeration compressors.

Module 5 (10 hours)

Principles of air conditioning: Psychrometry and psychrometric chart - human comfort- effective temperature- comfort chart. Applied psychrometry: sensible heat factor- psychometric process – problems. Winter air conditioning- heating load calculations- humidifiers and humidistat. Summer air conditioning- cooling load calculations- year round air conditioning -unitary and central systems -principles of air distribution -design of air duct systems.

Text Books

1. Stoecker W.F. and Jones J.W, *Refrigeration and Air-Conditioning*, McGraw- Hill
2. Jordan and Prister, *Refrigeration and Air-Conditioning,* Prentice Hall of India.

Reference Books

1. Dossat., *Principles of Refrigeration*, John Wiley and Sons
2. Robert H. Enerick, *Basic Refrigeration and Air-Conditioning*, Prentice Hall.
3. Arora C.P., *Refrigeration and Air-Conditioning*, Tata McGraw- Hill

ME 010 705: Industrial Engineering
(Common with AU010 705)

Teaching scheme **Credits:** 4

2 hours lecture and 1 hour tutorial per week

Objectives

- *To provide an exposure to the fundamental tools and techniques in Industrial Engineering for integration and improvement of inter related work activities and productivity management.*

Module I (9 hours)

Introduction: Evolution of industrial Engineering, Branches and Fields of application of Industrial Engineering, Functions of Industrial Engineer. Types of production- Productivity- Productivity index- factors affecting productivity-techniques for productivity improvement.

Product development and design: Requirements of a good product design- product development process- product analysis. Value Engineering: Fundamental Concepts- reasons for poor values- types of values- Applications and benefits of Value Engineering.

Module II (9 hours)

Facility planning: Plant location-Procedure for site selection- Plant layout-Objectives and principles of plant layout- types of layout- Factors influencing layout- introduction to layouts based on group technology, just-in-time and cellular manufacturing systems.

Material Handling: Functions and Principles of material handling, Selection of material handling equipments-types of material handling equipments.

Module III (9 hours)

Materials Management: Objectives, functions and scope of materials management. **Purchasing** - Objectives and functions-purchasing procedure- buying techniques- Vendor development and rating system- Stores management.

Inventory Control: Objectives of inventory control-inventory costs-Determining inventory level- EOQ model-Models with shortages-Continuous and Periodic Review systems-ABC analysis- Make or buy decision-Vendor Managed Inventory.

Module IV (9 hours)

Methods engineering: Work study-Procedure for motion study- Recording Techniques- Micro motion study- Work measurement techniques- Time study.

Industrial Ergonomics: Introduction to Ergonomics-Objectives of Human Engineering- Aspects of Man- Machine System- Workplace design.

Job Evaluation and Merit Rating: Objectives of Job evaluation, methods of job evaluation, merit rating, Types of merit rating.

Module V (9 hours)

Inspection and Quality Control: Objectives and kinds of inspection-methods of inspection-Objectives of quality control- Statistical quality control-control charts, problems- Acceptance sampling-Total quality management- ISO systems-QFD- Benchmarking.

Text Books

1. Verma A.P., *Industrial Engineering,* S. K. Kataria & Sons.
2. Sharma S. C. & Banga T. R., *Industrial Organization and Engineering Economics,* Khanna Publishers.

Reference Books

1. Tompkins J.A and White J.A. , *Facilities Planning,* John Wiley, N.Y.,1984.
2. Tony Arnold, J.R, *Introduction to materials management,* Prentice hall inc, N.J,1998.
3. Tayyari and Smith J.L., *Occupational Ergonomics; principles and Applications*, Chapman and Hall publication, U.K., 1997

ME 010 706 L01: PLANT ENGINEERING AND MAINTENANCE

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

- *The course is designed to develop an understanding of maintenance tools and techniques in the new industrial world.*

Module 1 (12 hours)

Fundamentals of plant engineering - Plant facilities - Layout of facilities, basic amenities etc. Types of maintenance- breakdown, preventive, periodic or predictive, condition based maintenance- deterioration and failure analysis- planning, scheduling, and controlling of maintenance work- organization for maintenance.

Module 2 (12 hours)

Wear: Sliding wear tests – Archard wear equation – unlubricated wear of metals - wear regime maps for metals – mechanism of sliding wear of metals : plasticity dominated wear, Oxidative wear – lubricated wear of metals – fretting wear of metals – wear of ceramics and polymers.

Module 3 (12 hours)

Reliability: concept and definition-chance failure and wear out failure -application of stochastic model for reliability studies- reliability of series, parallel and stand by systems- estimation of parameters of failure distribution- maintainability and availability.

Replacement: causes of deterioration and obsolescence- sudden and gradual obsolescence and deterioration- economic analysis- MAPI method- simple problems.

Module 4 (12 hours)

Condition based maintenance using Vibration Signature, SOAP, ferrography, hot ferrography, Infra Red Camera, fluorescent dye, Particle Analyzers and other diagnostic techniques.

Reliability Centered Maintenance- Total Productive Maintenance- Tero-technology and its influence on plant engineering and maintenance. Overall equipment effectiveness (OEE) – Reliability Availability and Maintainability analysis (RAM).

Module 5 (12 hours)

Safety management: fire protection and prevention - safety against mechanical hazards, chemical hazards- accident prevention program- Industrial noise - Pollution control- Waste disposal - Recycling of waste - Energy conservation, management and audit - legal provisions for safety in industry.

Text Books

1. Collacott R.A., *Mechanical fault Diagnosis and Condition Monitoring*, Chapman and Hall Ltd.
2. Sushikumar Srivastava, *Industrial Maintenance Management*, S. Chand and Co. Ltd., New Delhi.

Reference Books

1. Rosaler R., *Handbook of Plant Engineering*, McGraw Hill.
2. Mobley K., Higgins L.R., *Handbook of Maintenance Engineering*, McGraw Hill.
3. Hutchings I. M., *Trobology: friction and wear of engineering materials*, Edward Arnold
4. Robinowicz Ernest, *Friction and wear of materials*, John Wiley

ME010 706L02: Turbo Machines

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

- *To impart the basic concepts of various turbo machines like blowers, fans, compressors and turbines.*

Module I (12 hours)

Principles: Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.

Module II (12 hours)

Centrifugal Fans and Blowers: Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, characteristics curves and selection, fan drives and fan noise.

Module III (12 hours)

Centrifugal Compressor: Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

Module IV (12 hours)

Axial Flow Compressor: Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple stage design problems and performance characteristics.

Module V (12 hours)

Axial and Radial Flow Turbines: Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, and testing and performance characteristics.

Text Books

1) Yahya, S.H., *Turbines, Compressor and Fans*, Tata Mc Graw Hill Publishing Company, 1996.
2) B K Venkanna, *Fundamentals of Turbomachinery*, Prentice Hall of India, 2009

Reference Books

1. Bruneck, *Fans*, Pergamom Press, 1973.
2. Earl Logan, Jr., *Hand book of Turbomachinery*, Marcel Dekker Inc., 1992.
3. Dixon, S.I., *Fluid Mechanics and Thermodynamics of Turbomachinery*, Pergamom Press, 1990.
4. Shepherd, D.G., *Principles of Turbomachinery*, Macmillan, 1969.
5. Stepanff, A.J., *Blowers and Pumps*, John Wiley and Sons Inc., 1965
6. Ganesan .V. *Gas Turbines*, Tata Mcgraw Hill Pub.Co., New Delhi, 1999.

ME010 706 L03 Theory of vibration

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

- *To understand the basic concepts and issues related to vibration*

Module I (12 hours)

Fundamentals of vibration

Introduction, Definitions, Vector method of representing harmonic motions, Additions of two Simple Harmonic Motions of the same Frequency, Beats Phenomenon.

Undamped free vibrations of single degree of freedom

Introduction, Derivation of differential equation, Solution of differential equation, Torsional Vibrations, equivalent stiffness of Spring Combinations, Energy Method.

Module II (12 hours)

Damped free vibrations of single degree of freedom system

Introduction, Different types of Damping, Free Vibrations with viscous damping, Logarithmic decrement, Viscous dampers, Dry Friction or Coulomb damping, Solid or Structural damping.

Module III (12 hours)

Forced vibrations with constant harmonic excitation

Introduction, Forced Vibrations with constant harmonic excitation, Forced Vibrations due to excitation of the Support, Energy dissipated by damping, Forced vibrations with Coulomb damping, Forced vibrations with Structural damping, Determination of Equivalent viscous damping from frequency-response curve, Vibration isolation and transmissibility, Vibration measuring instruments, Critical speed of shafts

Module IV (12 hours)

Two degree of freedom systems

Introduction, Principal modes of Vibration, Other cases of simple two degrees of freedom systems, Combined rectilinear and angular modes, Systems with damping, Undamped forced

vibrations with Harmonic excitation, Vibration absorbers, Vibration Isolation Natural frequencies and mode shapes (eigenvalues and eigenvectors), orthogonal properties of normal modes, Introduction to Model analysis,

Module V (12 hours)

Continuous systems – vibrating strings - axial vibration of rod – transverse vibration of beams – torsional vibration of shafts.

Text Books

1. Leonard Meirovitch, "Fundamentals of Vibrations", International Edition, McGraw-Hill, 2001.

2. Singiresu S Rao, “Mechanical Vibrations", Fourth Edition, Pearson.

3. V. P. Singh, “Mechanical Vibrations", Dhanpat Rai & sons

4. William T Thomson, “Theory of Vibration with applications", Prentice Hall, 1993.

ME010 706 L04 Sales and Marketing Management

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Module 1 (12 hours)

Marketing: Definition- Marketing concepts- Market segmentation- Market demand- Product- Value and satisfaction- Exchange and transactions- Marketing channels- Competition- Marketing environment- Marketing mix.
Marketing Management: Functions-Sales forecasting-Pricing-Distribution- Advertising- Sales promotion- Marketing research.

Module 2 (12 hours)

Strategic Planning: Strategic business unit (SBU)- Business strategic planning- SWOT analysis. Marketing decision support system.

Module 3 (12 hours)

Product life cycle: Marketing strategies in the different stages of product life cycle.
New product development: Idea generation- Concept development and testing conjoint analysis.
Introduction to Relationship marketing, International marketing and on line marketing.

Module 4 (12 hours)

Consumer behaviour: Major factors affecting consumer buying behavior- Consumer decision making process.
Organizational buying behavior: Buying situations- the buying center-Purchasing process.

Module 5 (12 hours)

Sales management: Evolution of Sales management- Objectives of Sales management- Personal selling situations- Theories of selling- Basic selling styles- Recruitment, selection and training of sales personnel-Sales territory-Sales quotas.

References

1. Marketing Management - Philip Khotler
2. Sales Management - Richard, Edward & Norman
3. Industrial Engg & Management - O.P.Khanna
4. Industrial Organisation & Management - Banga & Sarma
5. Organisational Behaviour - Fred Luthans

6. Consumer Behaviour - Schifman & Kanuk
7. Basic marketing - Gundiff
8. Marketing Management for small units - Jain
9. Sales Engg - Lester
10. Salesmanship concept - Thomson

ME010 706 L05 Failure Analysis and Design

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives:

- *To introduce basic concepts of reliability in analysis and design*
- *To study fracture, fatigue and other modes of failure*

Module1 (12 hours)

Reliability: Reliability concept and hazard function, life prediction, condition monitoring, application of Poisson, exponential and Weibull distribution for reliability - bath tub curve - parallel and series system - mean time between failures and life testing.

Stresses in a body: Two dimensional and three dimensional state of stress, Mohr's circle two and three dimensions, hydrostatic stress, Von-mises, maximum shear stress (Tresca), octahedral shear stress, torsional stresses for large plastic strain.

Module 2 (12 hours)

Fracture: Types of fracture, Griffith crack theory, stress analysis of cracks, metallographic aspects of fracture. Brittle, ductile fractures, notch effects, fracture curve, R curve, fracture under combined stresses, effect of hydrostatic pressure on fracture, probabilistic aspects of fracture mechanics, toughness of materials.

Module 3 (12 hours)

Fatigue: Statistical nature of fatigue, S-N curve, low cycle fatigue, strain life equations, structural feature of fatigue, fatigue crack propagation, effect of stress concentration, size, surface properties, metallurgical variables on fatigue, case studies, designing against fatigue, detail design, improvements after failure and service, fatigue of bolts, welded and adhesive joints.

Fatigue tests: Purpose, specimen, fatigue test procedures, evaluation of fatigue test results, crack growth measurement.

Module 4 (12 hours)

Wear failures: Type of wear, role of friction in wear, lubricated and non-lubricated wear, analysing wear failures, wear tests SOAP, ferrography.

Corrosion failures: Factors influencing corrosion failures, analysis of corrosion failures, overview of various types of corrosion, stress corrosion cracking - sources, characteristics of stress corrosion cracking, procedure of analysing stress corrosion cracking, various types of hydrogen damage failures, corrective and preventive action.

Module 5 (12 hours)

Elevated temperature failures: Creep, stress rupture, elevated temperature fatigue, metallurgical instabilities, environmental induced failure, elevated temperature effects on certain gas turbine components and petroleum refinery components, tests for analysis of failure at elevated temperatures.

References

1. Jaap Schijve, “Fatigue of Structures and Materials”, Kluwer Academic Publishers, 2001.
2. ASM Metals Handbook, "Failure Analysis and Prevention", ASM Metals Park, USA, Vol. 10, 10th Edition, 1995.
3. Richard W Hertzberg,“Deformation and Fracture Mechanism of Engineering Materials”,John Wiley & Sons,Inc.,1995.
4. George E Dieter, “Mechanical Metallurgy”, McGraw Hill Book Company, 1988.

ME 010 706 L06 Foundary and Welding Technology

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Foundary Technology

Module 1 (12 hours)

Degassing: Gas Porosity – **Molten Metal Filtration**: sources of inclusions, methods for removal of inclusions – **Castability**: factors influencing fluidity, hot tearing - **Semisolid Metal Processing** - viscosity evolution during continuous cooling - **Rapid Solidification**: microstructural modification, heat flow - **Solidification during Casting of Metal-Matrix Composites**:- incorporation of reinforcements, reinforcement-metal wettability, solidification, distribution of reinforcements.

Module 2 (12 hours)

Hot Isostatic Pressing of Castings:- Reasons for using HIP, effect of HIP on mechanical properties, effect of HIP on the shape and structure of castings, problems encountered in HIP, economics of HIP – **Low Pressure Metal Casting**:- conventional methods, low-pressure furnace and tooling, cores, vacuum riserless/pressure riserless casting – **High Pressure Die Casting**:- die casting alloys and processes, hot and cold chamber, advantages, disadvantages - **Hot and Cold Chamber Die Casting**:- melting process, injection components, distinctions between hot and cold chamber processes, gate and runner design, temperature control.

Module 3 (12 hours)

Vacuum High-Pressure Die Casting:- vacuum riserless casting, high-vacuum die casting – **Semisolid Casting** (SSM):introduction, fundamentals: advantages of SSM processing, SSM processing - **Aluminum and Aluminum Alloy Castings**: effects of alloying and impurity elements, structure control, secondary dendrite arm spacing, nondendritic microstructures, grain structure, grain-refinement, welding, molten metal fluidity, hot cracking - **Titanium and Titanium Alloy Castings**: effects of alloying elements, microstructures of titanium castings, cast microstructure of Ti - 6Al - 4V, melting and pouring, molding methods, postcasting practice, welding, heat treatment **- Nickel and Nickel Alloy Castings**: structure and property correlations, melting practice and metal treatments, foundry practice, pouring practice, gating systems, risers, welding, heat treatment and applications.

Welding Technology

Module 4 (12 hours)

Heat Flow in Fusion Welding - Fluid flow phenomena during Welding: mass transport in the arc in gas tungsten arc welding, deep-penetration electron beam and laser welds, in gas metal arc welding, in submerged arc welding.

Module 5 (12 hours)

Transfer of Heat and Mass to the base metal in gas metal arc welding - Arc Physics of Gas - Tungsten Arc Welding: electrode regions and arc column - Introduction to **Special Welding processes**: **Underwater** Welding: underwater welding pyrometallurgy, micro structural

development of underwater welds, heat sources, applications - welding for **cryogenic** service - welding in **space** and low - gravity environments: metallurgy of low-gravity welds.

TEXT BOOKS:

1. ASM Handbook, Volume 15, Casting, ASM International, Metals Park, Ohio, USA.
2. ASM Metals Handbook. Volume 6, Welding Brazing and Soldering, ASM International, Metals Park, Ohio, USA, 1993.

REFERENCE BOOKS:

1. Amstead B.H., Phillip E Ostwald and Myron L.Begeman, "Manufacturing Processes" John Wiley & Co., New York.
2. American Welding Society, Welding handbook, Vol. 1 and 2, 7th edition.
3. AWS Welding Handbooks, AWS, New York, 1995.
4. Flimm, Fundamentals of Metals Casting, Addison Wesley.
5. Gourd L.M., Principles of Welding Technology, ELBS/ Edward Arnold.
6. Howard B Cary., Modern Welding Technology, 4th edition, Prentice Hall, New Jersey, USA, 1997.
7. Koenigsberger and Adaer, Welding Technology, Macmillan.
8. Lancaster, The Physics of Welding; Pergaman Press.
9. Lancster and George Allen, The Metallurgy of Welding, Unwin Ltd. U.K.
10. Lincoln Electric Co, Procedure Handbook of ARC Welding; Lincoln Electric Co. USA.
11. Richard W.Heine, Carl R.Loper and Phlip C.Rosenthal, "Principles of Metal Casting", Tata McGraw Hill, New Delhi.
12. Rossi, Welding Technology, McGraw Hill.
13. Salman and Simans, Foundry Practice, Issac Pitman.
14. Tylecote, The Solid Phase Welding of Metals, Edward Arnold Pvt. Ltd.

ME 010 707 Mechanical Measurements Laboratory

Teaching scheme **Credits:** 2

3 hours practical per week

Objectives

- *To provide an exposure to the fundamentals of metrology*
- *To understand the need of precision measurement and measuring instruments*

1. Study and use of laser interferometer for calibration of linear measurements.
2. Study of slip gauges – wringing – surface roughness - standards.
3. Study of surface plates, straight edges, angle plate, V-block etc and applications.
4. Measurement of out of roundness using roundness measuring instrument, V block and dial indicator etc. - reasons for out of roundness etc.
5. Measurements of straightness using sprit level and auto collimator.
6. Measurement of thread parameters using three wire method.
7. Measurement of tool angles of single point tool using tool maker's microscope.
8. Measurement of gear parameters using profile projector.
9. Evaluation of straightness error using autocollimator, sprit level, straight edge etc.
10. Calibration and determination of uncertainties of the following;
    a. Strain gauge load cells
    b. Bourdon tube pressure gauge
    c. LVDT
    d. Thermocouples
    e. Tachometers and stroboscopes, etc.
11. Study and measurement of surface roughness using surface roughness instrument.
12. Study and measurements with coordinate measuring machines.
13. Experiments on limits and fits.
14. Study and use of ultrasonic flaw detector.
15. Study of different types of dial indicators - stands and holders for dial gauges.
16. Study and use of different types of comparators.
17. Exercises on measurement system analysis
18. Study and making measurements with precision vernier calipers, dial calipers, spline micrometer, point micrometer, wire groove micrometer, depth micrometer, V- anvil micrometers, depth gear tooth micrometer, thread micrometer, disc micrometer, thread pitch gauge, vernier height gauge, slip gauges, optical flat, three pin micrometer,

pyrometer, RTD, bore dial gauge, depth gauge, pitch gauge, thickness gauge, radius gauge, hole test, bench center etc.

19. Angular measurements using bevel protractor, sine bar, clinometers etc.
20. Measurement of vibration.
21. Analysis of automobile exhaust gas and flue gas.
22. Study and determination of area using planimeter.
23. Polishing, etching and determination of grain size and microstructure studies using optical microscope.

TEXT BOOKS:

1. Sharp K.W.B., Practical Engineering Metrology, Sir Isaac Pitman and sons Ltd, London, 1958.
2. Shotbolt C.R. and Gayler J.F.W, Metrology for Engineers, 5th edition, ELBS, London.

REFERENCE BOOKS:

1. Figliola, Richard S, and Beasley, Donald E, “Theory and Design for Mechanical Measurements”, Third edition, John Wiley and Sons Inc.
2. Collett, C.V. and Hope, A.D, “Engineering Measurements”, Second edition, ELBS/Longman.
3. Tarasevigh Y. and Yavosih E., Fits, Tolerances and Engineering Measurements, Foreign language publishing house, Moscow.

ME 010 708 Advanced Machine Tools Laboratory

Teaching scheme **Credits:** 2

3 hours practical per week

Objectives

- *To understand the different process parameters involved in shaping, slotting, milling, grinding machines.*
- *To analysis the causes for the variation on surface roughness obtainable in different machining process.*

PART – A

1. Experiment on shaping machine: - flat surfaces, dovetail cutting – grooving, keyway cutting etc. **- 2 practices.**

2. Experiment on slotting machine: - flat surfaces, dovetail cutting – grooving, keyway cutting etc. - making hexagonal hole using slotting machine. **- 2 practices.**

3. Study of milling machines – nomenclature of milling cutters – different types of milling cutters – attachments for milling:- vertical milling and universal milling attachment, high speed milling attachment, rack milling and slot attachments, parking bracket, rotary table, universal dividing head, vices, arbors, adaptors and collet chucks. **- 1 practice.**

4. Experiment on milling machine: - 1 - plane milling, keyway cutting, cutting of splines. **- 1 practice.**

5. Experiment on milling machine: - 2 – cutting of spur, helical and bevel gears – study of different methods of indexing - multi slot cutting on milling machine by indexing. **- 3 practices.**

6. Study of surface grinding machine and demonstration of grinding of plane surface - study of cylindrical grinding machine and demonstration of plane cylindrical grinding – study and demonstration of planing machine – study and demonstration of broaching machine. **- 2 practices.**

PART – B

Preparation of control charts - preparation of laboratory layout - facilities layout analysis– materials requirement planning – inventory analysis –preparation of process plan and cost estimation for the manufacture of various products – study of a jig and a fixture for drilling and milling operation - fabrication of simple bending dies – Preparation of process plans using CAPP software. **- 3 practices.**

Besides to the skill development in performing the work, oral examination should be conducted.

A detailed report on the work carried out on part – B is also to be prepared. Observation and record books are to be maintained for both part A and B.

The student's assessment, continuous evaluation, awarding of sessional marks, record bonafides, oral examination etc and University examination shall be carried out by the faculty members (Assistant professor and above).

TEXT BOOKS:

1. Acharkan. N., Machine Tool Design Vol. 1 to 4, MIR Publication.

REFERENCE BOOKS:

1. Chapman, Workshop Technology, Vol II, ELBS.
2. HMT, Production Technology, Tata McGraw Hill.
3. Yoram Koren, Numerical Control of Machine Tools, McGraw-Hill.

ME 010 709 Seminar

Teaching scheme **credits: 2**

2 hours practical per week

The seminar power point presentation shall be fundamentals oriented and advanced topics in the appropriate branch of engineering with references of minimum seven latest international journal papers having high impact factor.

Each presentation is to be planned for duration of 25 minutes including a question answer session of five to ten minutes.

The student's internal marks for seminar will be out of 50. The marks will be awarded based on the presentation of the seminar by the students before an evaluation committee consists of a minimum of 4 faculty members. Apportioning of the marks towards various aspects of seminar (extent of literature survey, presentation skill, communication skill, etc.) may be decided by the seminar evaluation committee.

A bona fide report on seminar shall be submitted at the end of the semester. This report shall include, in addition to the presentation materials, all relevant supplementary materials along with detailed answers to all the questions asked/clarifications sought during presentation. All references must be given toward the end of the report. The seminar report should also be submitted for the viva-voce examination at the end of eighth semester.

For Seminar, the minimum for a pass shall be 50% of the total marks assigned to the seminar.

ME 010 710 Project Work

Teaching scheme **credits: 1**

1 hour practical per week

Project work, in general, means design and development of a system with clearly specified objectives. The project is intended to be a challenge to intellectual and innovative abilities and to give students the opportunity to synthesize and apply the knowledge and analytical skills learned in the different disciplines.

The project shall be a prototype; backed by analysis and simulation etc. No project can be deemed to be complete without having an assessment of the extent to which the objectives are met. This is to be done through proper test and evaluation, in the case of developmental work, or through proper reviews in the case of experimental investigations.

- The project work has to be started in the seventh semester and to be continued on to eighth semester.
- Project work is to be done by student groups. Maximum of four students only are permitted in any one group.
- Projects are expected to be proposed by the students. They may also be proposed by faculty member (Guide) or jointly by student and faculty member.
- Students are expected to finalise project themes/titles with the assistance of an identified faculty member as project guide during the first week of the seventh semester.

The progress from concept to final implementation and testing, through problem definition and the selection of alternative solutions is monitored. Students build self confidence, demonstrate independence, and develop professionalism by successfully completing the project.

Each student shall maintain a project work book. At the beginning of the project, students are required to submit a project plan in the project book. The plan should not exceed 600 words but should cover the following matters.

- ❖ Relevance of the project proposed
- ❖ Literature survey
- ❖ Objectives
- ❖ Statement of how the objectives are to be tackled

- Time schedule
- Cost estimate

These proposals are to be screened by the evaluation committee (EC- minimum of 3 faculty members including the guide) constituted by the head of department, which will include a Chairman and the EC will evaluates the suitability and feasibility of the project proposal. The EC can accept, accept with modification, request a resubmission, or reject a project proposal.

Every activity done as part of project work is to be recorded in the project book, as and when it is done. Project guide shall go through these records periodically, and give suggestions/comments in writing in the same book.

The students have to submit an interim report, along with project work book showing details of the work carried out by him/her and a power point presentation at the end of the 7^{th} semester to EC. The EC can accept, accept with modification, request a resubmission, or extension of the project.

The student's internal marks for project will be out of 50, in which 30 marks will be based on day to day performance assessed by the guide. Balance 20 marks will be awarded based on the presentation of the project by the students before an evaluation committee consists of a minimum of 3 faculty members including the guide.

For Project, the minimum for a pass shall be 50% of the total marks assigned to the Project work.