Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Curriculum for

S. Y. B. Tech.

(Mechanical Engineering)

Department of Mechanical Engineering

VISION

Excellence in Mechanical Engineering for Global Acceptance

MISSION

- Make spirited mechanical engineers with morals, values and principles for sustainable development of society.
- Strive continuously to impart knowledge and skills of the highest standards.
- Our engineers will respond to the current and future needs of the industry, higher studies as well as research.

Program Educational Objectives:

1. Graduates of the program will become competent engineers suitable for the mechanical engineering based industry and higher education.
2. Graduates of the program will acquire the necessary foundation in fundamental mechanical engineering subjects for development of mathematical and analytical abilities.
3. Graduates of the program will acquire the knowledge and skills in mechanical engineering to provide technological solutions.
4. Graduates of the program will learn managerial, financial and ethical practices such as, project and financial management skills, multidisciplinary approach and soft skills.
5. Graduates of the program will respond to growing demands of society through lifelong learning.

Program Outcomes:

At the end of the program, a student will be able to

1. Engineering knowledge: Apply knowledge of mathematics, science, and engineering with focus on Mechanical Engineering.
2. Problem analysis: Identify, formulate and analyze a problem using principles of basic sciences and Mechanical Engineering.
3. Design/development of solutions: Design a system, component or process to fulfill desired needs within realistic constraints such as manufacturing, economic, environmental, social, ethical, safety and sustainability.
4. Conduct investigations of complex problems: Design and conduct experiments as well as analyze and interpret data.
5. Modern tool usage: Apply techniques, skills, and modern Mechanical Engineering tools such as CAD, CAM and CAE necessary for engineering practice.
6. The engineer and society: Acquire the broad education necessary to understand the impact of mechanical engineering solutions in the context of global, economic, environmental, cultural, legal and social issues.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual and as a member of multidisciplinary team.
10. Communication: Communicate effectively with the engineering community and society
11. Project management and finance: Apply project and financial management principles as a leader and team member in a multidisciplinary environment.
12. Life-long learning: Recognize the need and engage in life-long learning

Program Specific Outcomes:

At the end of the mechanical engineering program, a student will be able to:

1. Apply knowledge of machine design, manufacturing and thermal engineering to describe, formulate and analyze mechanical systems and processes with realistic constraint.
2. Design and analyze machine elements using modern engineering tools.

Second Year B. Tech. Mechanical Engineering (SYBT) - Semester I (Pattern 2018)

Course Code	Course	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
						Formative Assessment			Summative Assessment			
						ISE		CE	ESE	PR/ OR		
			L	T	P	T1	T2					
ES21181ME	Engineering Mathematics III	TH	3	1	-	20	10	20	50	-	100	4
MEUA21182	Manufacturing Processes	TH	3	-	-	20	10	20	50	-	100	3
MEUA21183	Engineering Mechanics*	TH	3	-	-	20	10	20	50	-	100	3
MEUA21184	Thermodynamics*	TH	3	-	-	20	10	20	50	-	100	3
MEUA21185	Instrumentation and Control*	TH	3	-	-	20	10	20	50	-	100	3
MEUA21186	Lab Practice - I	CE-PR/OR	-	-	6	-	-	50	-	50	100	3
MEUA21187	Computer Aided Machine Drawing	CE	2	-	2	-	-	100	-	-	100	3
M2	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	**17**	**1**	**8**	**100**	**50**	**250**	**250**	**50**	**700**	**22**

*Courses have lab practice component of 2 hrs. /week each under Lab practice head.
L: 1Hr. = 1 Credit, P: 2 Hrs. = 1 Credit, T : 1 Hr. = 1 Credit, AU: No Credits

List of Mandatory Courses: Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge

BoS Chairman Dean Academics Director

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Department of Mechanical Engineering

Second Year B. Tech. Mechanical Engineering (SYBT) - Semester II (Pattern 2018)

Course Code	Course	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
						Formative Assessment			Summative Assessment			
						ISE		CE	ESE	PR/ OR		
			L	T	P	T1	T2					
MEUA22181	Material Science	TH	3	1	-	20	10	20	50	-	100	4
MEUA22182	Applied Thermodynamics*	TH	3	-	-	20	10	20	50	-	100	3
MEUA22183	Fluid Mechanics and Machines*	TH	3	-	-	20	10	20	50	-	100	3
MEUA22184	Strength of Materials*	TH	3	-	-	20	10	20	50	-	100	3
ES22185ME	Project Management and Economics	TH	3	-	-	20	10	20	50	-	100	3
MEUA22186	Lab Practice - II	CE-PR/OR	-	-	6	-	-	50	-	50	100	3
MEUA22187	Manufacturing Technology	CE	2	-	2	-	-	100	-	-	100	3
MEUA22188	Design of Machine Elements - I	CE	2	-	-	-	-	100	-	-	100	2
M2	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total		**19**	**1**	**8**	**100**	**50**	**350**	**250**	**50**	**800**	**24**

*Courses have lab practice component of 2 hrs./ week each under Lab practice head.

L: 1Hr. = 1 Credit, P: 2 Hrs. = 1 Credit, T: 1 Hr. = 1 Credit, AU: No Credits

List of Mandatory Courses: Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge

BoS Chairman Dean Academics Director

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Semester - I

Engineering Mathematics III (ES21181ME)

Teaching Scheme
Credits: 4
Lectures: 3 Hrs./week
Tutorial work: 1 Hrs./week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Readers/students are expected to know the following concepts:
- Basics of Derivatives, Integration, Trigonometry, Vector algebra &Partial differentiation.

Course Objectives:
- To develop the ability, to know the concepts of Engineering Mathematics and to apply these to solve engineering problems in various fields. The Tutorial sessions and assignments will help the students to practice more problems on all the topics mentioned in the course contents.

Course Outcomes:
After successful completion of the course, student will be able to
1. Understand the Linear Differential equations.
2. Understand the modelling of mass spring systems, free and forced damped and undamped systems.
3. Understand the Design and analysis of continuous and discrete system, where knowledge of Fourier Transform is used.
4. Know Statistical technique to analyze the data, Know Different Probability Distributions.
5. Introduce Complex variables and Applications CR Equations.
6. Introduce boundary value problems (Wave, Heat, & Laplace equations).

Unit I: Linear Differential Equations

LDE of nth order with constant coefficients, Method of Variation of Parameters, Cauchy's & Legendre's DE.

Unit II: Applications of LD equations

Solution of Simultaneous and Symmetric Simultaneous DE, , Modeling of problems on bending of beams, Modeling of mass spring system.

Unit III: Fourier Transforms

Fourier Transform (FT) : Complex Exponential form of Fourier Series, Fourier Integral Theorem , Sine and Cosine Integrals, Fourier Transform ,Fourier Sine and Cosine Transform and their Inverses, Applications of Fourier Transforms.

Unit IV: Statistics

Moments, Skewness and Kurtosis, Correlation and Regression, Probability Distribution:- Binomial, Poisson and Normal Distributions.

Unit V: Complex variables

Complex Variables Functions of Complex Variables, Analytic Functions-R Equations, Conformal Mapping, Bilinear Transformation, Cauchy's Theorem, Cauchy's Integral formula, Laurent's Series, Residue Theorem.

Unit VI: Partial Differential Equations& Applications

Applications of PDE: Modelling of Vibrating string, Wave equation, One and two dimensional heat flow equations.

Tutorials:

List of tutorials:

1. Practice Problems on C.F & P.I
2. Practice Problems on Method of Variation of Parameters, Cauchy's & Legendre's DE.
3. Practice Problems on Fourier Transform (FT) and Laplace Transform(LT)
4. Practice Problems on Applications of Fourier Transforms in Heat equation.
5. Practice Problems on Statistical methods.
6. Practice Problems on Probability
7. Practice Problems on Vector Differentiation, Gradient, Divergence and Curl, Directional Derivative,
8. Practice Problems on Solenoidal, Irrotational and Conservative Fields, Scalar Potential, Vector Identities.
9. Practice Problems on Line integral, Greens Theorem, Gauss divergence Theorem. Stokes theorem
10. Practice Problems on PDE

Text Books:

1. A Text book of Applied Mathematics by P.N. Wartikar, U.N.Wartikar (Pune VidyarthiGrihaPrakashan ,Pune) (Volume II-ISBN 81-85825-07-6)((Volume III-ISBN 81-85825-01-7)
2. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.).(ISBN 978-0-470-45836-5.)

Reference Books :

1. Higher Engineering Mathematics by B.S.Grewal (KhannaPublication,Delhi) (ISBN-13. 978-81-7409-195-5. ISBN-10. 81-7409-195-5)
2. Advanced Engineering Mathematics by Wylie C.R &Barrett L.C.(McGraw-Hill,INC)(ISBN 0 -07 -463841 – 6)
3. Advanced Engineering Mathematics by Peter V.O'Neiol (ISBN-13: 9781111427429 / ISBN-10: 1111427429)

Manufacturing Processes (MEUA21182)

Teaching Scheme
Credits: 3
Lectures: 3 Hrs./week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Engineering Physics, Engineering Chemistry, Engineering Mathematics, Workshop Practice.

Course objectives:

- To familiarize students with major manufacturing processes
- To correlate the material type with the possible fabrication processes
- To describe the operations and tools for major manufacturing processes
- To interpret the knowledge about manufacturing processes, parameters and their effects on performance.

Course Outcomes:

By the end of the course, students by applying mathematical techniques and/or scientific principles and/or engineering concepts will be able to

1. **analyze** heating, pouring and filling up of mould in casting processes.
2. **analyze** bulk deformation processes in terms of power requirement and causes for defects.
3. **explain** merits, demerits, applications and **calculate** energy requirements of various joining and assembly processes.
4. **descibe** various shaping processes for plastics, polymer matrix composites and rubber in terms of their merits, demerits and applications.
5. **design** sheet-metal cutting, bending and drawing processes for various applications.
6. **determine** force and energy requirements, machining time, tool life and necessary calculations for thread cutting and taper turning operations.
7. **describe** new technology research, safety considerations and environmental issues associated with manufacturing processes.

Unit I - Metal Casting Processes

Typical sand mould (important casting terms), Patterns and cores, Moulds and mould making, Sand testing, Heating the metal, Pouring, Gating design, Analysis of pouring and filling up of mould, Aspiration effect, Preventing impurities and turbulence in casting, Gating ratios, Effect of friction and velocity distribution, Solidification and cooling, Riser design, Expandable and permanent moulding processes, casting defects, New Technology Research and Environmental Issues: Metal Casting.

Unit II - Metal Forming

Bulk deformation processes, Material behavior and temperature in metal forming, Rolling, Forging, Other deformation processes related to Rolling and Forging, Extrusion and Wire drawing, Analysis of Rolling, Forging, Extrusion and Wire drawing, Design for Hot Forging, Environmental Issues - Metal Forming, Forming of Components: Recent Advances (Advanced Forming Technologies).

Unit III - Joining and Assembly processes

Physics of welding, classification of welding, Features of a fusion welded joint, Power source of welding, Physics and principle of arc welding, resistance welding, oxyfuel gas welding, Other fusion welding processes, Solid state welding, Weld quality, Weldability, Nomenclature and symbol of welding joints, Design considerations in welding, Welding defects and inspection, Brazing, soldering, Adhesive Bonding, Mechanical Assembly, Threaded fasteners, rivets and Eyelets, Safety in Welding and Allied Processes.

Unit IV- Plastics and Composite Materials

Plastics and Composite Standards, Polymer Composites Sustainability: Environmental Perspective, Future Trends and Minimization of Health Risk. Shaping Processes for Plastics: Extrusion, Production of sheet, film, Injection moulding, Compression and transfer moulding, Blow moulding, Thermoforming, Overview of Polymer Matrix Composites (PMC) and Rubber processing, Open and closed mould processes.

Unit V- Sheet Metalworking

Sheet metal working: cutting and bending operations, drawing, Dies and presses for sheet metal processes, Engineering analysis of sheet-metal cutting, bending and drawing, Stretch forming, Roll bending and forming, Spinning and High-energy rate forming, Environmental aspects of sheet metal forming, Recent trends in sheet metals and their formability in manufacturing automotive panels.

Unit VI– Machining Processes

Theory of chip formation in metal machining, Force relationships and the Merchant equation, power and energy relationships in machining, Cutting temperature, Machining operations and machine tools: Turning, drilling, milling and related operations, Machining Centers and Turning centers, Broaching and Sawing operations, Machining of screw threads, Tool life, Tool materials, Tool geometry, Cutting fluids, Introduction to Sustainable Manufacturing.

Text Books:

1. Hajara Choudhari, Bose S.K. – Elements of workshop Technology Vol. I &II , Asian Publishing House, ISBN 0713136227
2. M.P Grover – Fundamentals of modern manufacturing: Materials and systems, John Wiley & Sons, Inc, New Jersey, 2010, ISBN 978-0470-467008.
3. R. K. Jain, Production Technology, Khanna Publishers, 16th Edition, 2003.
4. R.K. Rajput – Manufacturing Technology, Laxmi Publications (P) Ltd.

Reference Books:

1. B. Ravi – Metal Casting – Computer Aided design and analysis- Prentice Hall of India ISBN: 8120327268, 9788120327269
2. Reikher – Casting: An analytical approach – Springer ISBN 9781846288494
3. Materials and Processes in Manufacturing, DeGarmo, Black, and Kohser, John Wiley & Sons, Inc,New York, 2011.
4. Kalpakjian and Schmid - Manufacturing Engineering and Technology, Prentice Hall, New Jersey, 2013

Engineering Mechanics (MEUA21183)

Teaching Scheme
Credits: 3
Lectures: 3 Hrs./week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Physics, Engineering Mathematics.

Course Objectives:

- To develop ability to understand the effect of force and motion in design engineering.

Course Outcomes:

Upon completion of the course, students will be able to

8. Determine resultants and apply conditions of static equilibrium to plane force systems
9. Estimate required force to overcome friction.
10. Apply concept of equilibrium to any system with the help of free body diagram (FBD).
11. Determine centroid and mass moment of inertia of mechanical elements.
12. Illustrate relation between velocity and acceleration of particle.
13. Develop solution for single degree of freedom free vibratory systems

Unit I: Introduction to Engineering Mechanics

Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static and kinematic indeterminancy

Unit II: Friction and Basic Structural Analysis

Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.
Basic Structural Analysis: Equilibrium in two dimensions; Method of Sections; Method of Joints; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines

Unit III: Centroid and Centre of Gravity

Centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia-Definition,
Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook

Unit IV: Kinematics & Kinetics of Rectilinear Motion of Particles

Rectilinear motion of particle, Determination of motion of a particle – displacement, velocity, acceleration, Relative and dependent motion. Application of Newton's law and D'Alembert's principle

Unit V: Kinematics & Kinetics of Curvilinear Motion of Particles

Curvilinear motion of particle, Rectangular components, uniform circular motion, Path and polar coordinates. Application of Newton's law and D'Alembert's principle

Unit VI: Kinematics & Kinetics of Rigid Bodies

Types of rigid body motion – translation, rotation about fixed axis, equations defining the rotation of a rigid body about a fixed axis, plane motion, absolute and relative velocity in plane motion, instantaneous center of rotation.

Text Books:

5. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
6. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
7. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications
8. S. S. Rao, "Mechanical Vibrations", 4th Edition, Pearson Education Inc. New Delhi,

Reference Books :

5. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
6. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
7. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press

Thermodynamics (MEUA21184)

Teaching Scheme
Credits: 3
Lectures: 3 Hrs./week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Engineering Mathematics, Engineering Physics and Chemistry

Course Objectives:

- To understand applications of thermodynamics laws to various energy conversion devices.
- To evaluate the changes in properties of substances in various processes.

Course Outcomes:

Upon completion of the course, students will be able to

1. Apply the first law of thermodynamics to analyze thermodynamic devices and ideal gas processes.
2. Explain second law of thermodynamics and concepts of reversibility and irreversibility.
3. Evaluate entropy change during processes.
4. Estimate the available energy/ unavailable energy in a given process.
5. Evaluate various properties of steam using the steam table.
6. Analyze the performance of steam generator.

Unit I : First Law of Thermodynamics

Review of basic terms and definitions, Microscopic and Macroscopic approach, Thermodynamic processes, throttling process, Thermodynamic equilibrium, Point and path function, Heat and work, Perfect gas laws, PMM I, SFEE (Pump, compressor, turbine, boiler, nozzle)
Applications of first law to non-flow processes (Constant Pressure, Constant Volume, Isothermal, Adiabatic, and Polytropic). Calculations of heat transfer, work done, internal energy, enthalpy.

Unit II: Second Law of Thermodynamics

Limitations of First law, Clausius and Kelvin Plank Statement and their equivalence, PMM II, Reversibility and irreversibility, Causes and Conditions of reversibility, Carnot cycle for heat engine, heat pump and refrigerator, Carnot theorem, Clausius inequality.

Unit III: Entropy

Concept of entropy, entropy changes for an ideal gas during reversible process, entropy of isolated system, principle of entropy increase, Definition of Isentropic efficiency for compressors, turbines.and nozzles.

Unit IV: Availability and Irreversibility

Available and unavailable energy, Availability function for systems and Control volumes undergoing different processes, Lost work, Exergy.

Unit V: Properties of Steam

Definition of pure substance, Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-V, T-S and Mollier diagram for steam, Dryness fraction and its determination, Study of steam calorimeters (Barrel, Separating, Throttling and combined) Non-flow and Steady flow vapour processes, Change of properties, Work and heat transfer.

Unit VI: Boiler

Classification of boiler, Boiler mounting and accessories, Boiler draught (natural and artificial draught) Boiler performance calculations-Equivalent evaporation, Boiler efficiency Energy balance. IBR Act
Text Books:
1. Y. Cengel & Boles: Thermodynamics – An Engineering Approach, Tata McGraw Hill Publications, ISBN 13:9780072884951 2. R. K. Rajput, Engineering Thermodynamics, EVSS Thermo Laxmi Publications, ISBN: 978-81-318- 0058-4 3. P. K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publications, ISBN-13: 978-1-25-906256-8
Reference Books :
1. P. L Ballany: Thermal Engineering, Khanna Publishers, ISBN-13: 978-81-7409-031-2 2. C.P. Arora: Engineering Thermodynamics, Tata McGraw Hill Publications, ISBN - 9780074620144

Instrumentation and Control (MEUA21185)

Teaching Scheme
Credits: 3
Lectures: 2 Hrs./week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Electronics and Electrical Engineering

Course Objectives:

- To understand the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical and Electronic Systems

Course Outcomes:

Upon completion of the course, students will be able to

1. Discuss the key elements of mechatronics system and types of sensors and actuators.
2. Explain Electrical Motor and actuators by considering the Mechanical aspects.
3. To Know the Interfacing of Sensors, Actuators using appropriate DAQ/micro-controller
4. Analyze the time and Frequency domain analysis of system model for control application and PID control system.
5. Apply Program Logic Controller for implementation on real time systems.
6. Identify the Stability mechatronics system via identification of poles and zeros

Unit I: Sensors and Actuators

Introduction to Measurement system, characteristics: - Static and Dynamic Sensors: Position Sensors: - Potentiometer, Linear variable differential transformer (LVDT), Limit switches, read switches, Encoders; Proximity sensors: - Optical, Inductive, Capacitive; Motion Sensors:-PIR; Temperature Sensor: Resistance temperature detector (RTD), Thermocouples; Force / Pressure Sensors:- Strain gauges; Flow sensors, Image Sensor.

Unit II: Electrical Actuating System

Basic Principle of Electromechanical Switching, Solenoids, Electrical Relays, Electrical Motor, Lenz Law, Flemings right hand rule, Construction working and Principle: AC Motor, DC Motor, Stepper Motor & Servo Motor, mechanical aspects of motor selection.

Unit III: Microcontrollers and Microprocessors

Basic elements of control systems, Microcontroller: Architecture and terminology, Introduction to Data acquisition system (DAQ) Interfacing of Sensors / Actuators to DAQ system, Introduction, Microprocessor systems, ARM core base processor. Introduction to open hardware platform Arduino/raspberry pi. Communication protocols RS232, RS485, Modbus.

Unit IV: Control System

Open and Closed loop control system, block diagram reduction techniques, Proportional Integral derivative(PID) control systems, Transient response:- Percentage overshoot, Rise time, Delay time, Steady state error, PID tuning.

Unit V: Program Logic Controller

Introduction to PLC, PLC Architecture, Latching, Timers, Counter, Different scans in PLC, Ladder diagram programming for different types of logic gates, Practical Examples of Ladder Programming, Data Handling, Analog and Digital Input / Output.

Unit VI: Design of Mechatronics System

Introduction to Pneumatic and hydraulic actuation systems, Different components of Hydraulic systems, valves, System modeling (Mechanical), Stability Analysis via identification of poles and zeros, Stages in designing Mechatronics Systems – Case studies of Mechatronics systems- Pick and place Robot.

Text Books:

1. K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Willey Publication. ISBN: 9788126518371.
2. Bolton, Mechatronics - A Multidisciplinary approach, 4th Edition, Prentice Hall. ISBN 13: 9780132407632.
3. Smaili.A and Mrad.F, "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008.
4. Nitaigour Premchand Mahalik, Mechatronics-Principles, Concepts and Applications, Tata McGraw Hill, 1stEdition, 2003 ISBN.No. 0071239243, 9780071239240.

Reference Books :

1. Bishop (Editor), Mechatronics – An Introduction, CRC Press, 2006. ISBN 13: 9780849363580.
2. Mahalik, Mechatronics – Principles, concepts and applications, Tata Mc-Graw Hill publication, New Delhi.ISBN 13: 9780070483743.
3. C. D. Johnson, Process Control Instrumentation Technology, Prentice Hall, New Delhi. ISBN-13: 978-0134413051.
4. Rajput. R.K, A textbook of mechatronics, S. Chand & Co, 2007.

Lab Practice - I (MEUA21186)

Teaching Scheme
Credits: 3
Lectures:-
Laboratory Work: 6 Hrs./week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Course Objectives:

- To develop ability to understand the effect of force and motion in design engineering
- To offer hands on experience with the operation of a various thermal systems like steam generator, steam calorimeter, heat pump and heat engine.
- To understand the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical and Electronic Systems

Course Outcomes:

Upon completion of the course, students will be able to

1. Illustrate experimentally kinematics of particle and rigid body.
2. Investigate single degree freedom vibratory system.
3. Operate the heat pump, heat engine and steam generator to analyze its performance.
4. Determine the performance /operating parameters of a given thermal system using any suitable programming tool.
5. Perform measurements of mechanical parameters using sensors and transducers.
6. Demonstrate different mechanical applications using electronics control system.

[A] Lab Practice: Engineering Mechanics (MEUA21183)

List of Practical: Any 8

1. Find support reaction for a simply supported beam or compound beam.
2. Determine the coefficient of static friction between flat belt and drum.
3. Compare experimentally and analytically equilibrium of particle subjected to forces in space.
4. Verify law of polygon of forces.
5. Determine center of gravity and moment of inertia of connecting rod.
6. Determine mass moment of inertia of flywheel.
7. Demonstrate curvilinear motion of particle.
8. Determine coefficient of restitution for given pair of materials.
9. Determine the natural frequency of damped vibration of single degree freedom system.

[B] Lab Practice: Thermodynamics (MEUA21184)

List of Practical: Any 8

1. Validation of first law of thermodynamics using Joules experiment.
2. Determination of energy interaction in any thermal system using SFEE.
3. Determination of thermal efficiency of heat engine.
4. Determination of Carnot COP of heat pump.
5. Determination of dryness fraction of steam using any one of calorimeter.
6. Demonstration of Boiler mountings
7. Demonstration of Boiler accessories.
8. Performance test on Boiler and its heat balance sheet analysis.
9. Performance estimation of any thermal system using any suitable software.
10. Industrial visit to any processing unit having boiler.

[C] Lab Practice: Instrumentation and Control (MEUA21185)
List of Practical: Any 8 1. Measurement of displacement using load cell/LVDT. 2. Study of different types of sensor using sensor board 3. Interfacing of any one sensor to Data Acquisition System 4. Speed control of DC motor. 5. Demonstration of water level control system using PLC / Microcontroller / Relays System. 6. Demonstration of bottle filling plant using PLC. 7. PLC control system: - ladder logic implementation on real time system. 8. Real Time Temperature / Flow Control using PID Control system. 9. PID control Design, Tuning using suitable Simulation Software 10. Study of Modeling and Analysis of a typical Mechanical System
Text Books:
-
Reference Books :
-

Computer Aided Machine Drawing (MEUA21187)

Teaching Scheme
Credits: 3
Lectures: 2 Hrs./week
Laboratory Work: 2 Hrs./week

Examination Scheme
Formative Assessment : 100 Marks
Summative Assessment : -

Prerequisite: Engineering Graphics and Design

Course Objectives:

- To understand Parametric Modeling concept, create Sketches, Solid Models, assembly models of simple machines
- To develop the ability to apply limits fits, and dimensional tolerances & Geometric Tolerances to components and assemblies in 2D drawings & generate manufacturing drawings.

Course Outcomes:

Upon completion of the course, students will be able to

1. Interpret manufacturing/ industrial drawing as per IS conventions.
2. Generate different part and surface models from drawings.
3. Create the assembly of machine components.
4. Interpret tolerances for machine components.

Unit I :Introduction to Machine Drawing

Introduction – Machine Drawing Standard Conventions,
Representation of machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.

Unit II: Part and Surface Modeling

Solid modeling. Introduction to Graphical User Interface (GUI) of commercially used solid modeling software, Fundamentals apply/modify constraints and dimensions transform the parametric 2-D sketch into 3D solid, Feature operations, Generating Basic Surfaces, Performing Operations.

Unit III: Assembly Modeling

Assembly modeling – defining relationship between various parts of machine, Creation of constraints, Generation of exploded view.

Unit IV: Tolerances and Manufacturing Drawing

Dimensioning Techniques, Geometric Dimensions and tolerances (GD and T), Limit, fits and tolerances, Introduction to Tolerance Stack-up.
Generation of 2-D sketches from parts and assembly of 3-D models, Appropriate dimensioning and tolerance.

Lab Practice:

List of assignments: Any 8

1. Machine Drawing Conventions.
2. Sketcher Workbench.
3. Part Modeling of Machine Components using various Commands and Features of the CAD Software.
4. Solid Modeling of the Components of Machine.
5. Surface Modeling of the Components of Machine.
6. Assembly Modeling of Machines Components.

7. Tolerance stack-up Analysis.
8. Manufacturing Drawings (Manual) of the Parts with Appropriate Tolerance.
9. Manufacturing Drawings (Manual) of the Assemblies with Appropriate Tolerance.
10. Manufacturing Drawings (CAD) of the Parts and Assemblies with Appropriate Tolerance.

Important Note:-*Submission of all above assignments should be in electronic format only (preferably in single CD/DVD for all batches/students)*

Text Books:

1. N. D. Bhatt and V.M. Panchal, Machine Drawing, Charoter Publications ISBN-13:9789380358888
2. Ajeet Singh, "Machine Drawing", Mc Graw Hill Publications, New Delhi 2012.

Reference Books :

1. Ibrahim Zeid, Mastering CADCAM, McGraw-Hill ISBN-10: 0072868457 ISBN-13: 978-0072868456
2. Help Manuals and Tutorials of Referred CAD Software.

Semester - II

Material Science (MEUA22181)

Teaching Scheme
Credits: 4
Lectures: 3 Hrs./week
Tutorial work: 1 Hrs./week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Engineering Physics, Engineering Chemistry

Course Objectives:

- To Describe importance of crystal structure
- Importance phase diagram and co-relation of different phases with different mechanical properties.
- Perform various heat treatments tests for material properties and characterization of industrial samples

Course Outcomes:

Upon completion of the course, students will be able to

1. Define the basics of crystal structure and structure of metal
2. Compare deformation in different metals.
3. Define importance of equilibrium diagram with reference to Metallurgy and Mechanical Engineering
4. Draw the Iron Carbon equilibrium diagram and classify different types of steels
5. Justify the difference between alloy steels and cast iron based on Iron Carbon equilibrium diagram.
6. Explain proper heat treatments and their importance in steels

Unit I: Structure of Materials

Crystal Structure: Unit cells, Metallic crystal structures, Miller direction. Imperfection in solids: like Point, line defects; dislocation plastic of single crystal and deformation mechanisms like twinning and slip, hot and cold working, Annealing and its stages.

Unit II: Mechanical testing

Study of destructive testing, Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, Numerical based on Evolution of properties, compression test, different hardness tests-Vickers, Rockwell, Brinell, Poldi, Micro Hardness Test, Durometers, Impact test, fatigue test, creep test

Unit III: Metallography, NDT and Introduction to Equilibrium diagrams

Microscopy, macroscopy, sulphur printing, flow line observations. Introduction to different Non-destructive test and its uses. importance. Importance of Equilibrium diagram with basic terms . Hume Rotheyr's rule of solid solubility, allotropy and polymorphism, study of eutectic system and uses of eutectic alloys .

Unit IV: Iron-Carbon Equilibrium Diagram

Plotting of Iron-iron carbide equilibrium diagram, critical temperatures and application of lever rule for finding out different phases and its percentage in slowly cooled steels. non-equilibrium cooling of steels, Classification and application of plain carbon steels specification of steels.

Unit V: Alloy Steels and cast Irons

Introduction to cast Iron and its basic types, Effect of different alloying elements on IC diagram, Introduction to tool steel, transformation products of austenite, time temperature transformation diagrams and its plotting, critical cooling rate.

Unit VI: Heat- treatment of Steels and Introductions to Non ferrous Materials

Heat treatment of steels like Annealing, normalizing, hardening & tempering, retention of austenite : effects of retained austenite, elimination of retained austenite, Basics Introduction to non ferrous materials (Basics of Brasses and Bronzes)

Tutorials:

List of Tutorials (Any eight):

1. Numerical based on Indexing, Atomic packing factor, Density
2. Study and trial on Brinell hardness test
3. Study and trial on Vickers hardness test
4. Study and trial on impact test
5. Study and performance on magnetic particle & dye penetrant test
6. Study of metallurgical microscope
7. Study & demonstration of specimen preparation for microscopic examination
8. Study and drawing of microstructure of steels and cast Iron.(min 2)
9. Heat treatment of plain carbon steel and determination of relative hardness

Text Books:

1. Dr. V.D. Kodgire & S. V. Kodgire, "Material Science & Metallurgy For Engineers", Everest Publication 2008, ISBN 81-86314-00-8.
2. K. Bhargava, C.P. Sharma "Mechanical Behavior & Testing Of Materials",. P H I Learning Private Ltd.., ISBN: 978-81-203-4250-7

Reference Books :

1. Donald R. Askland, Phule P. P., "Science and engineering of materials", Thomson Learning, 2003.ISBN: 0534553966.
2. Callister W. D, "Materials Science and Engineering", John Wiley, ISBN 9780470419977
3. Higgins R. A., "Engineering Metallurgy", Viva books Pvt. Ltd., 2000, ISBN 0340568305.
4. Raghvan V. "Material Science & Engg.", Prentice Hall of India , New Delhi. 2003
5. Avner, S.H. Introduction to Physical Metallurgy, Tata McGraw-Hill, 1997. ISBN 10: 0074630067

Applied Thermodynamics (MEUA22182)

Teaching Scheme
Credits: 3
Lectures: 3 Hrs./week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Thermodynamics, Engineering Mathematics

Course Objectives:

- To apply concepts of thermodynamics to power producing and power absorbing devices in order to understand their functioning and improve their performance.

Course Outcomes:

Upon completion of the course, students will be able to

1. Estimate performance parameters of various thermodynamic cycles.
2. Determine stoichiometric air required for fuel combustion.
3. Use of Psychrometric charts and estimate various properties related to Psychrometry and processes.
4. Analyze flow through nozzles and turbine.
5. Illustrate construction and working of reciprocating air compressor and analyze its performance.
6. Analyze centrifugal air compressor performance.

Unit I : Thermodynamic cycles

Carnot Cycle, Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, Basic Rankine cycle , Reversed Carnot Cycle, Vapor compression refrigeration cycles.

Unit II: Combustion Thermodynamics

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

Unit III: Psychrometry Basics

Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, concept of dew point.

Unit IV: Flow through Nozzle and Steam turbines

Flow of steam nozzle, super saturation- compressible flow in diffusers, efficiency of nozzle and diffuser, Analysis of steam turbines, velocity and pressure compounding of steam turbines.

Unit V: Reciprocating Compressor

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Unit VI: Centrifugal Compressors

Classification of compressors, Construction, velocity diagram, flow process on T-S Diagram, Euler's work, slip and slip factor, actual work input, performance characteristics, various losses in centrifugal compressor, Surging & Chocking.

Text Books:

1. Y. Cengel & Boles: Thermodynamics – An Engineering Approach, Tata McGraw Hill

Publications
2. R. K. Rajput, Engineering Thermodynamics, EVSS Thermo Laxmi Publications
3. P. L Ballany: Thermal Engineering, Khanna Publishers
4. 4. C.P. Arora: Engineering Thermodynamics, Tata McGraw Hill Publications

Reference Books :

1. Domkundwar, Thermal engineering, Dhanpat Rai & Co.
2. P. K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publications

Fluid Mechanics and Machines (MEUA22183)

Teaching Scheme
Credits: 3
Lectures: 3 Hrs./week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Engineering Mechanics, Engineering Mathematics - I, II & III, Engineering Physics

Course Objectives:

- To understand various fluid properties and learn fluid statics and dynamics.
- To understand the importance of dimensional analysis and energy losses in pipes.
- To obtain the velocity and pressure variations in various types of simple flows
- To analyze the flow in water pumps and turbines.

Course Outcomes:

Upon completion of the course, students will be able to

1. Explain the significance of fluid properties and apply fluid static systems.
2. Apply Continuity and Bernoulli's equations in solving the problems in fluids.
3. Calculate energy losses through various pipes and apply dimensionless numbers in fluid system.
4. Analyze the internal flow through pipe and external flows over the bodies.
5. Evaluate the performance of Centrifugal pump.
6. Evaluate the performance of hydraulics turbines.

Unit I: Fluid Properties and Statics

Fluid Properties - Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, viscosity index, compressibility and surface tension.
Fluid Statics – Introduction, Hydrostatics law, Pascal's law, Total pressure, Center of pressure

Unit II: Fluid Kinematics and Dynamics

Fluid Kinematics – Introduction, flow visualization, flow classifications, Continuity equation, velocity and acceleration, stream function and velocity potential function.
Fluid Dynamics – Introduction, Euler's equation of motion, Bernoulli's equation and its Applications.

Unit III: Flow through pipes and Dimensional Analysis

Flow Through Pipes - Energy losses in pipes, Darcy Weisbach's equation, pipes in series and parallel, siphon, Moody's diagram, thermal expansion.
Dimensional analysis – Need, methods, Buckingham's Pi theorem, Dimensionless numbers.

Unit IV: Internal and External Flows

Internal flow – Laminar flow through circular pipe, laminar flow between parallel plates.
External flow – Concept of boundary layer, flow over a flat plate, measure of boundary layer thickness, separation of boundary layer and methods of controlling it.

Unit V: Centrifugal Pump

Euler's equation of rotodynamic machines, velocity triangles of rotor (series of radial curve vanes). Centrifugal pump – Introduction, classification, working principle, velocity triangle, heads and efficiencies, work done by the impeller, specific speed, priming and cavitations in pumps, NPSH, performance curves.

Unit VI: Hydraulic Turbines
Pelton wheel – Introduction, classification of water turbines, working principle heads and efficiencies, velocity triangle and analysis, specific speed and unit quantities. Francis and Kaplan Turbine – Introduction, working principle, velocity triangles and analysis. Draft tube , cavitations, performance characteristics.
Text Books:
1. Dr. R. K. Bansal , " Fluid mechanics & Hydraulic machines" , Laxmi Publication Pvt. Ltd. , New Delhi, ISBN : 13: 978-8131808153. 2. Dr. P. M. Modi & Dr. S. M. Seth, "Hydraulics & Fluid Mechanics", Standard Book House, ISBN: 978-81-89401-26-9. 3. Cengel & Cimbla, "Fluid Mechanics" Tata McGraw - Hill.
Reference Books :
1. V.P. Vasandani, Theory of Hydraulic Machinery Khanna Publishers, Delhi,ISBN 10: 0-07-0643419-X. 2. Kundu, Cohen, Dowling, "Fluid Mechanics" Elsevier, India. 3. White, "Fluid Mechanics" Tata McGraw - Hill. 4. B. U. Pai, "Turbomachnies", Wiley India, ISBN 13: 9788126539550.

Strength of Materials (MEUA22184)

Teaching Scheme
Credits: 3
Lectures: 3 Hrs./week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Engineering Mathematics, Engineering Mechanics.

Course Objectives:

- Mechanical behavior of the body by determining the stresses, strains and deflections produced by the loads up to the elastic limit.
- Fundamental concepts related to deformation, strain energy, moment of inertia, load carrying capacity, slope an deflection of beams, shear forces, bending moments, torsional moments, column and struts, principal stresses and strains.

Course Outcomes:

Upon completion of the course, students will be able to

1. Analyze the structural members subjected to different stresses using the fundamental concepts..
2. Explain the shear force and bending moment distribution across the beam
3. Investigate the effect beam cross section on bending and shear stresses.
4. Evaluate the strains and deformation due to the elastic stresses developed within the materials
5. Solve problems relating to torsional deformation of bars and other simple structures
6. Ability to design and conduct experiments, as well as to analyze and interpret data.

Unit I: Simple Stress and strain

Deformation in solids-Stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains, thermal stress and strain.

Unit II: Principal Stresses and Theories of Failure

Principal stresses and principal planes- Mohr's circle., Maximum Principal stress theory, Maximum shear stress theory, Maximum Principal strain theory, Maximum strain energy theory, Numerical treatment

Unit III: Shear Force and Bending Moment Diagram

Types of beams, shear forces & bending moment diagrams (Cantilever, Simply supported and Overhang beams) subjected to concentrated loads, uniformly distributed loads, uniformly varying loads & couples, Relationship between rate of loading, shear force and bending moment. Maximum bending moment & positions of points of contra-flexure.

Unit IV: Bending and Shear Stress

Bending stresses: Theory of simple bending, assumptions, flexural formula, moment of resistance, section modulus, bending stresses in symmetrical sections. Bending stress distribution diagram (rectangular, I,T).
Shear stresses: Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections, maximum and average shear stress.

Unit V: Slope and Deflection

Boundary condition, Computation of slopes and deflection in beams for standard cases, deflection of a beam using Macaulay's Method.

Strain Energy: Concept, strain energy stored in the member and stresses due to gradually applied load, suddenly applied load, impact load.

Unit VI: Torsion

Theory of torsion & assumptions, stresses in solid & hollow circular shaft, strength and rigidity criterion for design of shaft, power transmitted by solid & hollow circular shaft, shafts in series and parallel.

Text Books:

1. S. Ramamurtham and R. Narayanan, "Strength of Materials", 18th Edition, Dhanpat Rai Publication, ISBN: 81-87433-54-X.
2. S.S. Rattan, "Strength of Material", 2nd Edition, Tata McGraw Hill Publication Co. Ltd., ISBN: 978-0-07-107256-4
3. R. K Bansal, "Strength of Materials", 6th Edition, Laxmi Publication, ISBN: 978-81-318-0814-6.
4. S.S. Bhavikatti, "Strength of Materials", Vikas Publishing, 4th Edition ISBN: 9789325971578.
5. Rajput R. K., "Strength of Materials", S. Chand Publication. ISBN-10 : 8188458104

Reference Books :

1. Ferdinand Beer, Jr., E. Russell Johnston, John DeWolf, David Mazurek, 6th Edition, "Mechanics of Materials", Tata McGraw Hill Publication Co. Ltd., ISBN-13: 978-0073380285
2. Timoshenko S. P. and Young D. N., "Strength of Materials", Affiliated East-West Press PVT. LTD. New Delhi, 2006, ISBN: 8176710199.
3. Singer and Pytel, "Strength of Materials", Addison Wesley Publishing Corporation, 1999, ISBN 0 321 04541 6.

Project Management and Economics (ES22185ME)

Teaching Scheme
Credits: 3
Lectures: 3 Hrs./week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Basic Concepts of Statistics and Probability

Course Objectives:

- To provide students a strong foundation in project management for entry-level to mid-level professionals.
- To learn the basics of economics and cost analysis relevant to engineering so as to take economically sound decisions.

Course Outcomes:

Upon completion of the course, students will be able to

1. Demonstrate the understanding of project management and project evaluation techniques
2. Allocate project resources considering risk management.
3. Identify HRM issues in project procurement and material management
4. Calculate rate of return, interest rate and tax.
5. Perform cost analysis.
6. Critically examine present worth and future worth.

Unit I: Introduction to Project Management

Project Management Fundamentals, Project Management overview, Project Life cycle & Feasibility Analysis, Project identification, Sources of Project ideas, Project Evaluation Techniques, Monitoring and control of projects, Project Information System (PIMS), Summary illustrative review problems.

Unit II: Project Resource Allocation & Risk Management

Project scheduling with unlimited Resources, Project scheduling with limited Resources, Risk Identification, Management and Planning, Enterprise Resource planning, Capital budgeting techniques, Risk and technical analysis, Summary illustrative review Problems

Unit III: Project Human Resource, Procurement & Materials Management

Project Organization Structure, Leadership Style, Effective Project Teams, Managing Conflicts, HRM issues in project management, Project Total Quality Management, Project Contract Management, Project Procurement & Materials Management, Summary illustrative review problems

Unit IV: Introduction to Economics

Engineering Decision-Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy. Engineering Economic Decision, Maze. Law of demand and supply, Law of returns,
Interest and Interest factors: Interest rate, Simple interest, Compound interest, Cash - flow diagrams, Personal loans and EMI Payment, Tax concepts, Income tax

Unit V: Fundamentals of Finance and Costing

Components of costs such as Direct Material Costs, Direct Labor Costs, Fixed Over-Heads, Factory cost, Administrative Over-Heads, First cost, Marginal cost, Selling price, Estimation for simple components.
Statements of Financial Information: Introduction, Source of financial information, Financial statements, Balance sheet, Profit and Loss account, relation between Balance sheet and Profit and Loss account

Unit VI: Worth Comparisons

Present-Worth Comparisons: Conditions for present worth comparisons, Basic Present worth comparisons, Present-worth equivalence, Net Present worth, Assets with unequal lives, infinite lives, Future-worth comparison, Pay-back comparison,
Equivalent Annual-Worth Comparison methods, Situations for Equivalent Annual-Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income

Text Books:

1. Total Project Management – The Indian Context by P. K. Joy, Macmillan Publishers India Ltd., ISBN No.: 0333-92624-2
2. Chan S. Park "Contemporary Engineering Economics", 3rd Edition,PHI Publications.

Reference Books :

1. Chandra, P., Projects, Planning, Analysis, Financing, Implementation and control, Tata McGraw Hill, Fifth Edition
2. Maylor, H., Project Management, Pitman Publication, Second Edition.
3. Ghattas, R.G. & Mc Kee, S.L., Practical Prokject Management, Pearson Education Asia.
4. Pinto, P.K., Project Management, Pearson Education, First Edition
5. Wyzocki, R.K. & Mc Gary R., Effective Project Management, Wiley. First Edition
6. Leland T. Blank and Anthony J. Tarquin , "Engineering Economy" 4th Edition ,McGraw Hill Publication .
7. Dr.K.K.Dewett and M. H. Navalur ," Modern Economic Theory"Revised Edition,S Chand Publication.

Lab Practice - II (MEUA22186)

Teaching Scheme
Credits: 3
Laboratory Work: 6 Hrs./week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Course Objectives:

- To offer hands on experience with the operation of a various thermal systems like compressor, nozzle
- To find coefficient of discharge, viscosity of liquids, stability of body and major losses in pipes.
- To plot performance characteristics of hydraulic machines.
- To offer hands-on experience of different tests on Universal Testing machine and experimental verification of beams under different loading conditions.

Course Outcomes:

Upon completion of the course, students will be able to

1. Operate and analyze various thermal systems to determine its performance parameters.
2. Determine the properties of solid, liquid and gases fuel.
3. Determine coefficient of discharge, viscosity of liquids, stability of body and major losses in pipes.
4. Conduct trial & plot performance characteristics of hydraulics machines.
5. Conduct various tests to obtain different material properties.
6. Analyze the behavior of structural elements and machine parts under different loading conditions

[A] Lab Practice: Applied Thermodynamics (MEUA22182)

List of Practical: Any 8

1. Determination of theoretical COP of vapor compression cycle.
2. Determination of calorific value using Bomb calorimeter.
3. Determination of calorific value using Junker gas calorimeter.
4. Measurement of fuel properties such as Flash point, Pour point, Cloud Point.
5. Demonstration of Psychrometric processes.
6. Determination of performance of air Nozzles.
7. Performance test on reciprocating air compressor.
8. Study and trial on centrifugal air compressor and plotting its characteristics
9. Performance estimation of any thermal system using any suitable software.
10. Visit to any processing industry having steam turbine.

[B] Lab Practice: Fluid Mechanics and Machines (MEUA22183)

Lab practice consist of *any eight* experiments of the following

1. Study and Demonstration of pressure measuring devices
2. Determination of viscosity of liquids by using Redwood's viscometer.
3. Verification of modified Bernoulli equation.
4. Determination of stability of floating body.
5. Determination of coefficient of discharge of V notch / Venturimeter.
6. Determination of major/minor losses in various pipes fittings.
7. Laminar and Turbulent flows by Reynolds' apparatus.
8. Verification of impulse momentum principle.
9. Determination of the performance characteristics of Pelton wheel/Francis Turbine.
10. Determination of the performance characteristics of Centrifugal pump.
11. Industrial visit to any hydropower plant / pumping station and report based on it.

[C] Lab Practice: Strength of Materials (MEUA22184)

Lab Practice shall consist of the following : Any 8

1. Shear test of ductile material on Universal Testing Machine
2. Tensile test on ductile and brittle materials on Universal Testing Machine
3. Experimental verification of flexural formula in bending for cantilever beam
4. Experimental verification of flexural formula in bending for simply supported beam
5. Torsion test on circular bar
6. Impact test on metals
7. Study of Shear force and bending moment diagrams with different end conditions using customize solvers.
8. Experimental verification of Slope and deflection in standard beams
9. Experimental study of Buckling of columns with different load conditions
10. Principal stresses through graphical and analytical method

Text Books:

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Reference Books :

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Manufacturing Technology (MEUA22187)

Teaching Scheme
Credits: 3
Lectures: 2 Hrs./week
Laboratory Work: 2 Hrs./week

Examination Scheme
Formative Assessment : 100 Marks
Summative Assessment : -

Prerequisite: Engineering Physics, Engineering Chemistry, Engineering Mathematics, Manufacturing Processes and Workshop Practice.

Course Objectives:

- To select suitable instrument / gauge / method of inspection for determining geometrical and dimensional measurements
- To correlate the material type with the possible fabrication processes
- To describe the operations and tools for major manufacturing processes
- To interpret the knowledge about manufacturing processes, parameters and their effects on performance.

Course Outcomes:

Upon completion of the course, students will be able to

1. Measurements Standards and gauges ,comparators, interferometry, surface roughness, geometric form ,thread and gear metrology
2. Evaluate economics of machining processes understanding machining mechanics at different cutting conditions
3. Characterize (process parameters and response) of advance machining processes for various applications.
4. Design Jigs and fixtures considering the Principles of locating and clamping.

Unit I: Metrology

Tolerance, Limits and fits ,Gauge design, Comparators, Interferometer, Surface roughness measurement, Geometric form, Thread and Gear metrology

Unit II: Mechanics and Economics of Machining Processes

Theories on mechanics of metal cutting, Thermal aspects of metal machining, Mechanics, material removal rate and machining time: Shaping, Planning, Drilling, Milling, Boring and Broaching operations. Surface finish in machining, Economics of machining operations, Optimizing cutting parameters for minimum cost, Optimizing machining cost for maximum production and optimum cutting speed for maximum efficiency.

Unit III: Advanced Machining Processes

Introduction, classification of advanced machining processes, selection of process, Mechanics, process parameters, summary of process characteristics, advantages, limitations and applications of abrasive jet machining (AJM), ultrasonic machining (USM), chemical machining, electrochemical machining (ECM), electric discharge machining (EDM), electron beam machining (EBM), laser beam machining (LBM) and plasma arc machining (PAM). Comparison of advanced machining processes.

Unit IV: Jigs and fixtures

Definition and concept of Jig and Fixture, Advantages, main components and principle of jigs and fixture design, degrees of freedom, principles of location, locating and clamping devices, Principles of clamping, types of clamps, Materials used for locating and clamping devices, Types of Jigs: Channel jig, Template jig, Plate jig, Angle plate jig, Turn over jig, Box jig, and Latch type jig. Types of Fixtures: Turning fixture, Welding fixture, Milling fixture, Indexing fixtures. Concept, elements and advantages of modular fixture, Pokayoke concept in jigs and fixtures.

Lab Practice:

List of Practical:

1. Demonstration of linear and angular measuring instruments, slip gauges and their applications.
2. Error determination of linear / angular measuring instruments and determination of linear and angular dimensions of given part, (MSA: Gauge R & R).
3. Turning Optimization Experiment
4. Verification of dimensions and geometry of given components using Mechanical /Pneumatic comparator
5. Machine tool alignment testing on machine tool – Lathe / Drilling / Milling.
6. Demonstration of surfaces inspection using optical flat/interferometers. / Demonstration of surface roughness measurement using surface roughness tester.
7. Material Removal Experiment
8. Measurement of spur gear parameters using Gear Tooth Vernier / Span Micrometer / Gear Rolling Tester.
9. Two views of at least one jig and one fixture designed, for a component on a half imperial sheet.(manual drafting)
10. Industrial visit to: EDm machining Industries

Text Books:

1. Hajara Choudhari, Bose S.K. – Elements of workshop Technology Vol. I &II , Asian Publishing House, ISBN 0713136227
2. M.P Grover – Fundamentals of modern manufacturing: Materials and systems, John Wiley & Sons, Inc, New Jersey, 2010, ISBN 978-0470-467008.
3. R. K. Jain, Production Technology, Khanna Publishers, 16th Edition, 2003.
4. P. C. Sharma, Production Engineering, S. Chand Publication

Reference Books :

1. B. Ravi – Metal Casting – Computer Aided design and analysis- Prentice Hall of India ISBN: 8120327268, 9788120327269
2. Reikher – Casting: An analytical approach – Springer ISBN 9781846288494
3. Black, and Kohser, Materials and Processes in Manufacturing, DeGarmo, John Wiley & Sons, Inc,New York, 2011.
4. Kalpakjian and Schmid - Manufacturing Engineering and Technology, Prentice Hall, New Jersey, 2013
5. Production technology –HMT, Tata McGraw Hill publication
6. Lindberg, Roy A., Processes and materials of manufacture, P H I Learning
7. P. N. Rao, CAD/CAM Principles and Applications, McGraw Hill Education, Third Edition

Design of Machine Elements - I (MEUA22188)

Teaching Scheme
Credits: 2
Lectures: 2 Hrs./week

Examination Scheme
Formative Assessment : 100 Marks
Summative Assessment : -

Prerequisite: Engineering Graphics, Engg Mechanics, Engineering Mathematics, CAMD

Course Objectives:

- Student shall gain appreciation and understanding of the design function in Mechanical Engineering, different steps involved in designing and the relation of design activity with manufacturing activity.
- Student shall gain design knowledge of the different types of elements used in the machine design process, for e.g. fasteners, shafts, couplings etc. and will be able to design these elements for each application.

Course Outcomes:

Upon completion of the course, students will be able to

1. Identify failure modes for mechanical elements and design of machine element based on strength.
2. Design of Coupling for industrial applications.
3. Design of Power Screws for various applications
4. Design of Belt & chain drives.

Unit I: Introduction to Design Procedure

Introduction to stresses, FOS, Basic Procedure of machine design , Design considerations, Use of preferred series, Standards and codes

Unit II: Design of Joints and Coupling

Design of cotter joint, Introduction of Coupling, Types of Coupling, Design steps for Coupling, Design of flange coupling and flexible bushed pin coupling.

Unit III: Design of Power Screws

Forms of threads, multiple start screws, torque analysis and design of power screws with square threads, self-locking screw, collar friction torque, stresses in power screws, design of a c-clamp. Trapezoidal threads, Design of screw jack, Differential and compound Screw.

Unit IV: Belts and Chain Drives

Belt drive: Materials and construction of flat and V belts, geometric relationships for length of belt, power rating of belts, concept of slip & creep, initial tension, effect of centrifugal force, maximum power condition, selection of flat from manufacturer's catalogue, belt tensioning methods,
Chain Drives : Types of power transmission chains, Geometry of Chain,
Polygon effect of chain, Modes of failure for chain, Lubrication of chains, Timing belts.

Assignments and Design Project shall consist of
1. Two design projects on Assemblies covering above syllabus.
The design project shall consist of half imperial sheets (A2 size) involving assembly-drawing with a bill of material and overall dimensions and drawings of individual components. The Project should be assigned to a group of three to five students.
Project 1 shall be based on any one of the following topics-
i) Cotter joint for a specified application.
ii) Coupling for specified application.
Project 2 shall be based on any one of the following topics-
i) Bench vice/Machine vice for specified applications.
ii) Bottle type/toggle jack for vehicles.
iii) Lead screw for machine tool/other applications.
Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary for selection of standard components.

Text Books:

1. Bhandari V.B. – " Design of Machine Elements" – Tata McGraw Hill Publ. Co. Ltd., ISBN-0070681791
2. Shigley J.E. and Mischke C.R. – "Mechanical Engineering Design" McGraw Hill Publ. Co. Ltd., ISBN- 0071077839

Reference Books :

1. Spotts M.F. and Shoup T.E. – "Design of Machine Elements" – Prentice Hall International. ISBN-8177584219.
2. Design Data Book– P.S.G. College of Technology, Coimbatore.
3. Juvinal R.C. – "Fundamentals of Machine Components Design" – John Wiley and Sons. ISBN-1118214110