M.S. Ramaiah University of Applied Sciences

New BEL Road, MSR Nagar, Bangalore – 560054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

PO, PSO, PEO & CO

Programme: B.Tech. in Mechanical Engineering

Programme Code: 005

Programme Outcome (PO)
Programme Specific Outcome (PSO)
Program Educational Objectives (PEO)
Course Outcomes (CO)

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Bangalore-560058

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Approved in 23rd ACM (Resolution 23.05) held on 15th July 2021

Faculty of Engineering and Technology (FET)

Programme Name: B.Tech. (Mechanical Engineering)

Programme Outcomes (POs)

B. Tech. graduates will be able to:

PO-1. Apply knowledge of mathematics, science, basic engineering fundamentals and engineering specialization concerned for the solution of complex engineering problems

PO-2. Identify, formulate and analyze engineering problems using first principles of mathematics, science and engineering to interpret data and reach substantiated conclusions

PO-3. Provide solutions to engineering problems by designing systems, components or processes to meet the specified needs considering public health, safety, societal andthe environmental considerations

PO-4. Apply the knowledge of laboratory techniques and research methods to solve complex engineering problems through experimental investigations, analysis and interpretation of results

PO-5. Gain proficiency in modelling complex engineering activities by selecting appropriate techniques and IT Tools and utilize available resources effectively

PO-6. Understand the effect of engineering solutions on legal, cultural, social, public health and safety aspects and the consequent responsibilities

PO-7. Develop sustainable engineering solutions and assess their effect on society and environment

PO-8. Understand and apply ethical principles to engineering practices and professional responsibilities

PO-9. Function effectively as an individual or a team player to handle diverse problems in multi-disciplinary settings

PO-10. Make oral and written presentations to communicate technical ideas effectively to engineering community and society at large

PO-11. Apply the knowledge of engineering and management principles to manage projectsin multi-disciplinary environment with consideration to cost and time.

PO-12. Recognize and engage in lifelong learning to adapt to changing needs and advancements in technology

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Programme Specific Outcomes (PSOs)

At the end of the B. Tech. (Mechanical Engineering) program, the graduate will be able to:

PSO-1. Apply the knowledge of Mechanical Design, Thermal Engineering and Manufacturingto develop efficient solutions for complex problems in mechanical engineering and allied areas

PSO-2. Design and develop sustainable solutions using Mechanical Engineering principles, concepts, experimentation and appropriate tools to address industry and societal requirements

PSO-3. Demonstrate ethics, leadership qualities, communication, entrepreneurial skills and involvement in lifelong learning for the betterment of organization, environment and society

Programme Educational Objectives (PEOs)

The objectives of the B. Tech. (Mechanical Engineering) Programme are:

PEO-1. To provide students with knowledge in mathematics, science and core engineering area to enable them to deliver efficient solutions for complex engineering problemsusing analytical and cognitive skills

PEO-2. To enable students to design and develop sustainable innovative solutions for industry and societal requirements by conducting engineering investigations through experimentation and usage of modern tools

PEO-3. To inculcate ethics, communication, leadership, soft, managerial and entrepreneurial skills for a successful career in industries and to engage in lifelong learning

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Course Outcomes (COs)

Course Title & Code: Engineering Mathematics - 1 (MTB101A)

After the successful completion of this course, the student will be able to:

- **CO-1.** State and discuss basic concepts related to single, two variable calculus and matrixalgebra
- **CO-2.** Perform basic operations of matrix algebra and apply them to solve systems of linear equations
- **CO-3.** Solve simple mathematical problems associated with linear algebra, single and twovariable calculus
- **CO-4.** Demonstrate competence with the basic ideas of linear systems, independence, bases and dimension, linear transformations, eigenvalues, eigenvectors and diagonalization
- **CO-5.** Solve complex real-world problems associated with linear algebra, single and two variable calculus

Course Outcomes (COs)

Course Title & Code: Engineering Mathematics - 2 (MTB102A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the fundamentals of ordinary differential equations and Laplace transform
- **CO-2.** Solve standard forms of ordinary differential equations
- **CO-3.** Solve simple problems in ordinary differential equations and Laplace transform
- **CO-4.** Model real world problems using ordinary differential equations and solve complexproblems associated with ordinary differential equations using Laplace transform
- **CO-5.** Apply Laplace transform in solving complex real world engineering problems

Course Outcomes (COs)

Course Title & Code: Engineering Physics and Laboratory (PHB102A)

After the successful completion of this course, the student will be able to:

- **CO-1.** State, explain the concepts of mechanics, electrical conductivity, quantum mechanics, crystal structure and material science, laser and fiber optics
- **CO-2.** Derive standard relationships in mechanics, electrical conductivity, quantum mechanics, crystal structure and material science, laser & fiber optics, and interpret them
- **CO-3.** Discuss the applications of mechanics, electrical conductivity, quantum mechanics, crystal structure and material science, laser and fiber optics
- **CO-4.** Solve problems in mechanics, electrical conductivity, quantum mechanics, crystal structure, material science, laser and fiber optics
- **CO-5.** Plan the experimental set-up, conduct experiments, calculate and plot the graphs to obtain the results and write a laboratory report as per the prescribed format.

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Course Outcomes (COs)

Course Title & Code: Engineering Mechanics (CEF101A)

After the successful completion of this course, the student will be able to:

- **CO-1.** State and describe the laws of Statics, Friction and Dynamics and their contexts of application.
- **CO-2.** Interpret standard mathematical relationships and apply for solving simple staticand dynamic problems in engineering mechanics
- **CO-3.** Calculate moment of inertia, determine centroid, centre of gravity for the structuralmembers
- **CO-4.** Apply the laws of statics and dynamics for the equilibrium analysis of rigid bodieswith and without friction
- **CO-5.** Apply energy methods in analyzing of static and dynamic aspects of engineeringstructures made of rigid bodies

Course Outcomes (COs)

Course Title & Code: Elements of Electronics Engineering and Laboratory (ECF102A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain working principles of PN junction diode, Zener diode, transistors, amplifier configurations, Op-Amps, power supply, logic gates and electronic displays
- **CO-2.** Derive mathematical relationships for electronic devices and circuits
- **CO-3.** Solve simple numerical and design problems related to analog / digital circuits aswell as devices
- **CO-4.** Design and analyse operation of standard analog / digital circuits for a givenapplication
- **CO-5.** Conduct experiments as per the standard procedures and tabulate/calculate/plotthe measured values
- **CO-6.** Interpret and compare with standard results, and draw conclusions and Write report as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Engineering Drawing (MEF103A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the conventions used in projections of geometric entities and interpret thesame
- **CO-2.** Draw orthographic projections for the geometric entities in specified positions
- **CO-3.** Develop lateral surfaces of un-sectioned and sectioned regular solids
- **CO-4.** Develop orthographic projections for given applications
- **CO-5.** Draw isometric projections for the solids and their combinations
- **CO-6.** Demonstrate competency in using CAD tool for drawing projections of geometricentities

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Course Outcomes (COs)

Course Title & Code: Constitution, Human Rights and Law (TSN101A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the key principles of the Indian Constitution
- **CO-2.** Explain Indian legal system and judicial structure that govern the citizens
- **CO-3.** Discuss UN Declaration of Human Rights
- **CO-4.** Discuss the scope and application of Human Rights Principles and Law
- **CO-5.** Suggest strategies for protection of human rights and resolving legal issues incompliance with applicable laws

Course Outcomes (COs)

Course Title & Code: Engineering Chemistry and Laboratory (CYB104A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the basic concepts of electrochemistry, conversion of chemical energy intoelectrical energy, theory of corrosion and principles of metal finishing
- **CO-2.** Differentiate renewable - nonrenewable fuels, primary - secondary electrodes & primary - secondary batteries, batteries - fuel cells, electroplating – electroless plating, thermosetting – thermoplastic polymers and dry corrosion - wet corrosion
- **CO-3.** Discuss the reaction chemistry and stoichiometry of combustion of fuels, remedialmeasures to control oxides of nitrogen, sulphur and carbon, polymerization – methods, mechanism, preparation, properties and applications of some polymers, concepts of nano science and nanotechnology
- **CO-4.** Identify the types of corrosion and methods to prevent corrosion, suitable polymers and nanocomposite materials for engineering applications
- **CO-5.** Derive kinetic rate equations for various chemical systems and equation for electromotive force
- **CO-6.** Analyze the suitability of polymers & composites for various applications and solveproblems related to storage devices, chemical kinetics, electro chemistry, corrosion and metal finishing
- **CO-7.** Plan the experimental set up, conduct experiments, calculate and plot the graphsto obtain results, and write a laboratory report as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Elements of Mechanical Engineering and Workshop Practice (MEF104A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Demonstrate the understanding on Classification of energy sources, energy conversion systems, mechanical power transmission systems, machine tools andprocesses
- **CO-2.** Describe various energy conversion systems, mechanical power transmission systems and machine tools
- **CO-3.** Explain the working principle of refrigeration systems, biomass conversion technologies and machining operations

CO-4. Solve numerical problems on IC engines and mechanical power transmission systems

CO-5. Apply principles of energy conversion systems, power transmission systems, machining processes and mechanical joints to practical applications

Course Outcomes (COs)

Course Title & Code: Elements of Electrical Engineering and Laboratory (EEF105A)

After the successful completion of this course, the student will be able to:

CO-1. State and explain various laws of electric circuits, magnetic circuits and theirsignificance, phasor diagrams for electrical elements

CO-2. Explain construction, principle of operation, working and characteristics of DCmachines, transformers, AC rotating machines and their applications

CO-3. Derive equations for electrical circuits, magnetic circuits and performance ofvarious AC and DC machines

CO-4. Solve problems on electric circuits, magnetic circuits, DC machines, transformers and AC rotating machines

CO-5. Conduct experiments as per the standard procedures and tabulate/calculate/plotthe measured values

CO-6. Interpret and compare with standard results, and draw conclusions and Writereport as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Elements of Computer Science and Engineering and Laboratory (CSF106A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the elements and methodology of Computer Science and Engineering

CO-2. Explain the basic principles and techniques of algorithms and programming

CO-3. Select appropriate approach to solve a computational problem

CO-4. Design an algorithmic solution and draw a flow chart of the solution

CO-5. Develop computer programs for moderately complex problems

CO-6. Test and validate developed computer programs

Course Outcomes (COs)

Course Title & Code: Professional Communication (TSN102A)

After the successful completion of this course, the student will be able to:

CO-1. Apply the concepts of grammar for communication

CO-2. Compose precise paragraphs

CO-3. Demonstrate professional etiquette

CO-4. Demonstrate appropriate verbal and non-verbal communication in the given context

CO-5. Develop professional written document

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Course Outcomes (COs)

Course Title & Code: Engineering Mathematics - 3 (MTF201A)

After the successful completion of this course, the student will be able to:

- **CO-1.** State and explain the important theorems in Fourier series, transforms and vector integral calculus
- **CO-2.** Solve simple problems in Fourier series, transforms and vector calculus
- **CO-3.** Apply Fourier series, transforms and vector calculus in solving complex real worldengineering problems
- **CO-4.** Implement the programs to solve system of linear equations and non-linear equations ofsingle variable using MATLAB
- **CO-5.** Apply interpolation and numerical integration method in analyzing some real worldproblems

Course Outcomes (COs)

Course Title & Code: Materials Science (MEC201A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain different types and classification of crystalline structures in solids, engineering materials and mechanical properties of metals and their alloys
- **CO-2.** Describe phase diagrams and heat treatment processes of metals
- **CO-3.** Discuss the importance of non-metals and smart materials depending on thefunctionality
- **CO-4.** Solve numerical problems in diffusion of solids and phase diagrams of metals
- **CO-5.** Analyse various modes of failure and correlate it to material behaviour
- **CO-6.** Identify different methods for improving the properties of materials for specificrequirements and applications

Course Outcomes (COs)

Course Title & Code: Engineering Thermodynamics (MEC202A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Define thermodynamic system, properties, processes, thermodynamic equilibrium, workand heat, available and unavailable
- **CO-2.** State and explain Zeroth, First, Second and Third Law of Thermodynamics
- **CO-3.** Explain various thermodynamic processes and cycles on P-V, T-s and h-s diagrams ofsteam and air as working fluids
- **CO-4.** Derive steady flow energy equation and second law efficiencies for given thermodynamic systems
- **CO-5.** Solve numerical using various thermodynamic relations
- **CO-6.** Apply work and heat interactions to evaluate various thermal systems

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Course Outcomes (COs)

Course Title & Code: Fluid Mechanics (MEC203A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe various fluid properties
- **CO-2.** Explain various types of fluid flows, fluid kinematics and dynamics, viscous and turbulentflow through pipes, boundary layer phenomenon and dimensional analysis
- **CO-3.** Derive fluid equations based on Hydrostatic law, Pascal's law, Archimedes principle, Conservation laws, Bernoulli's theorem
- **CO-4.** Discuss the significance of fluid statics, kinematics and kinetics in engineering applications
- **CO-5.** Solve numerical problems on manometers, pitot tube, venturimeters, friction factor and applications of dimensional analysis
- **CO-6.** Apply principles of fluid mechanics to solve practical fluid flow problems

Course Outcomes (COs)

Course Title & Code: Manufacturing Processes (MEC204A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the working principles and operations of equipment required for metal casting,metal forging, welding and sheet metal forming processes
- **CO-2.** Describe the various metal casting, metal forging, metal joining and sheet metal forming processes, their process parameters, defects along with remedial actions
- **CO-3.** Calculate load and power requirement for forging, rolling, welding and sheet metalforming processes
- **CO-4.** Select appropriate manufacturing process for given component based on features and applications
- **CO-5.** Develop a gating system for a given metal casting component

Course Outcomes (COs)

Course Title & Code: Machine Drawing (MEL205A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe ISO notations used in machine drawings
- **CO-2.** Create 3-D models of machine elements/components and produce detailed drawings
- **CO-3.** Create 3-D assembly models and draw 2-D detailed drawings with sectional detailswherever required and prepare BOM for standard assemblies
- **CO-4.** Create 3-D assembly models and draw 2-D detailed drawings with sectional detailswherever required and prepare BOM for standard assemblies
- **CO-5.** Demonstrate competency in using CAD software for machine drawing

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Course Outcomes (COs)

Course Title & Code: Mechanical Dissection (MEL206A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Dissect a given machine/product and identify components
- **CO-2.** Examine components for form, features, functionality and material
- **CO-3.** Develop 2D/3D sketches of components
- **CO-4.** Explain the construction and working of the machine/product
- **CO-5.** Write laboratory report as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Foundry, Forging and Welding Laboratory (MEL207A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Identify forging ,fitting and foundry tools and equipment
- **CO-2.** Test for moulding sand properties and recommend suitable composition
- **CO-3.** Prepare sand moulds using single and split patterns
- **CO-4.** Prepare components through hand forging and fitting as per drawing
- **CO-5.** Examine cast and forged parts and record the defects
- **CO-6.** Write the report as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Environmental Studies (CEN201A)

After the successful completion of this course, the student will be able

- **CO-1.** Define the multidisciplinary nature of environmental studies and recognize the need forpublic awareness
- **CO-2.** Classify and explain the various natural resources and their associated problems,ecosystem and environmental pollution
- **CO-3.** Describe biodiversity at local, national and global levels
- **CO-4.** Discuss various social issues pertaining to environment including sustainable developmentand energy issues
- **CO-5.** Assess the impact of human population on the environment

Course Outcomes (COs)

Course Title & Code: Additional Mathematics - 1 (MTB105A)

After the successful completion of this course, the student will be able to:

- **CO-1.** State and explain the important theorems and solve simple mathematical problems in one variable calculus and vector algebra

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CO-2. State theorems and solve simple problems in two variable calculus
CO-3. Solve complex real world problems associated with one and two real analysis
CO-4. Illustrate fundamentals of MATLAB programming and write simple programs
CO-5. Solve complex mathematical problems associated with linear algebra and compare the results with that of solutions obtained using MATLAB

Course Outcomes (COs)

Course Title & Code: Engineering Mathematics - 4 (MTB104A)

After the successful completion of this course, the student will be able to:

CO-1. Define and explain the concepts of correlation, regression, random variables, probability distribution, partial differential equations and complex analysis
CO-2. State theorems and solve simple problems in partial differential equations, complex analysis, probability, probability distributions
CO-3. Apply numerical methods to solve ordinary and partial differential equations using MATLAB
CO-4. Solve complex engineering problems associated with numerical methods using MATLAB
CO-5. Analyze real world problems associated with probability, probability distributions, partial differential equations and complex analysis
CO-6. Construct the Bar chart, pie chart, Histogram, Box-plot and fitting of curves usingMATLAB

Course Outcomes (COs)

Course Title & Code: Fluid Machines (MEC208A)

After the successful completion of this course, the student will be able to:

CO-1. Explain the types, working principle and applications of fluid machines
CO-2. Construct velocity triangles for performance analyses of axial and radial flow machines
CO-3. Describe various design and performance parameters of fluid machines
CO-4. Solve numerical problems to examine fluid machine performance
CO-5. Apply steady flow energy equation to determine energy exchange across a fluid machineand derive the Euler turbine equation
CO-6. Select the relevant fluid machine suitable for different field applications based on the performance parameters

Course Outcomes (COs)

Course Title & Code: Mechanisms and Kinematics of Machines and Laboratory (MEC209A)

After the successful completion of this course, the student will be able to:

CO-1. Describe basic concepts and principles of kinematics of machines
CO-2. Illustrate kinematic construction and working of commonly used planar mechanisms
CO-3. Determine displacement, velocity and accelerations in planar mechanisms usinggraphical and analytical methods
CO-4. Construct cam profile and arrive at a gear arrangement for the desired kinematic motion

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CO-5. Solve problems on kinematic analysis of planar mechanism, construction of cam profileand gear drive

CO-6. Develop simulation model of planar mechanisms and analyse for position, velocity and accelerations using ADAMS

Course Outcomes (COs)

Course Title & Code: Strength of Materials (MEC210A)

After the successful completion of this course, the student will be able to:

CO-1. Describe various types of forces, stresses, strains and elastic constants

CO-2. Explain Hooke's law, stress strain behavior of materials, bending of beams, torsion of shafts, shear force and bending moments, thick and thin cylinders, columns and struts

CO-3. Derive standard mathematical relationships for structural elements subjected to different loading and boundary conditions to analyse stresses, strains and deflections

CO-4. Solve numerical problems on stress/strain/deflection analysis for various structuralelements

CO-5. Apply principles of strength of materials to solve problems of practical importance

Course Outcomes (COs)

Course Title & Code: Conventional Machining Processes (MEC211A)

After the successful completion of this course, the student will be able to:

CO-1. Describe conventional machining processes and their applications

CO-2. Explain working principles and construction details of machine tools, different types ofcutting tools and accessories

CO-3. Select appropriate material removal process with process parameters for achieving required dimensions and surface finish based on the part features

CO-4. Select machine tools, cutting tools and cutting fluids based on part features

CO-5. Calculate the material removal rate, cutting forces, tool wear and tool life

Course Outcomes (COs)

Course Title & Code: Fluid Mechanics and Machines Laboratory (MEL212A)

After the successful completion of this course, the student will be able to:

CO-1. Plan the experimental setup to achieve the stated aim

CO-2. Conduct experiments as per the standard procedures and tabulate the measured values

CO-3. Calculate the required parameters and plot the results

CO-4. Interpret, compare with standard results and draw conclusions

CO-5. Write laboratory report as per the prescribed format

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Course Outcomes (COs)

Course Title & Code: Material Science and Strength of Materials Laboratory (MEL213A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Plan the experimental setup to achieve the stated
- **CO-2.** Conduct experiments as per the standard procedures and tabulate the measuredvalues
- **CO-3.** Calculate the required parameters and plot the results
- **CO-4.** Interpret, compare with standard results and draw conclusions
- **CO-5.** Write laboratory report as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Machine Shop Practice (MEL214A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Identify the machine tools, cutting tools and accessories for turning, milling, drilling and grinding processes
- **CO-2.** Operate the machine tools and perform machining operations like turning, milling, gear cutting, drilling and grinding.
- **CO-3.** Conduct experiments as per the standard procedure and tabulate measured values
- **CO-4.** Select appropriate instruments for measuring dimensional accuracy of developed models
- **CO-5.** Write laboratory report as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Additional Mathematics - 2 (MTB106A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the fundamentals of ordinary differential equations State theorems and solve simple problems in two variable calculus
- **CO-2.** Solve standard forms of ordinary differential equations Illustrate fundamentals of Linear algebra
- **CO-3.** Model real world problems using ordinary differential equations and solve complex problems associated with ordinary differential equations
- **CO-4.** Apply numerical methods to solve nonlinear equations in one variable, system of linear equations, interpolation and numerical quadrature, and implement the same using MATLAB
- **CO-5.** Solve complex problems associated with nonlinear equations and linear systems, interpolation and numerical integration using MATLAB

Course Outcomes (COs)

Course Title & Code: Applied Thermodynamics (MEC301A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain fuels and their properties, combustion process, various air standard and vaporpower cycles

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CO-2. Discuss thermal efficiency, work output and performance parameters for steam turbine,IC Engines and reciprocating compressors

CO-3. Solve numerical on combustion thermodynamics of fuels, air standard cycles, vapor power cycles and reciprocating compressors

CO-4. Analyze the cycles for the thermodynamic properties, work and heat interactions andcompare actual cycles with air standard and vapor power cycles

CO-5. Select and evaluate appropriate thermodynamic cycle suitable to various practicalapplications

Course Outcomes (COs)

Course Title & Code: Dynamics of Machinery (MEC302A)

After the successful completion of this course, the student will be able to:

CO-1. Explain basic concepts and principles of dynamics of machines

CO-2. Describe basic concept and principles of mechanical vibrations, model and analyse simple mechanical systems for vibration behaviour

CO-3. Determine static and dynamic forces in planar mechanism

CO-4. Analyse mechanical systems with rotating and reciprocating masses for static and dynamic balancing and assess the influence of gyroscopic effect due to rotating masses

CO-5. Apply Solve problems to calculate inertia forces at various joints, balancing force,gyroscopic forces and vibration parameters

Course Outcomes (COs)

Course Title & Code: Design of Machine Elements - 1 (MEC303A)

After the successful completion of this course, the student will be able to:

CO-1. Describe basic concepts and principles of machine component design

CO-2. Identify the loading conditions on a machine element and predict state of stress at critical locations

CO-3. Calculate design stress based on appropriate failure theory and select suitable material

CO-4. Design machine elements like shafts, keys and couplings, power screws, riveted andwelded joints

CO-5. Perform iterative design calculations to achieve induced stress values well within design stress values for various machine elements and verify results using appropriate design software

Course Outcomes (COs)

Course Title & Code: Automation in Manufacturing (MEC304A)

After the successful completion of this course, the student will be able to:

CO-1. Explain the need, significance and types of automation in manufacturing and the working principles and operations of CNC machine tools

CO-2. Describe the types of CNC machines, elements and accessories of automation systems and layout required for automating a manufacturing line

CO-3. Discuss aspects of automation in material handling, storage, part identification, assembly

CO-4. Solve simple problems on material handling, automated production and assemblylines

CO-5. Select appropriate automation layout for production of components and subassemblies

CO-6. Develop NC part programming for machining a given part drawing

Course Outcomes (COs)

Course Title & Code: Mechanical Measurements, Metrology and Laboratory (MEC305A)

After the successful completion of this course, the student will be able to:

CO-1. Explain generalized measurement system, errors in measurement systems, calibration procedure, system of limits and fits and measuring techniques

CO-2. Describe sensors, transducers, signal conditioning and output devices employed in measurement systems

CO-3. Select appropriate measurement systems for measuring displacement, strain, force, torque, pressure and temperature

CO-4. Apply Geometric Dimensioning & Tolerance techniques for dimensional control

CO-5. Analyze maximum and minimum material conditions for the design of Go and No Go gauges using Taylor's principle

CO-6. Utilize appropriate instruments for measurement of physical and geometrical parameters for a given application

Course Outcomes (COs)

Course Title & Code: Applied Thermodynamics Laboratory (MEL306A)

After the successful completion of this course, the student will be able to:

CO-1. Plan the experimental setup to achieve the stated aim

CO-2. Conduct experiments as per the standard procedures and tabulate the measured values

CO-3. Calculate the required parameters and plot the results

CO-4. Interpret, compare with standard results and draw conclusions

CO-5. Write laboratory report as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Dynamics and Simulation Laboratory (MEL307A)

After the successful completion of this course, the student will be able to:

CO-1. Perform dynamic analysis of various mechanisms through simulation

CO-2. Plan the experimental setup to achieve the stated aim

CO-3. Conduct experiments as per the standard procedures and tabulate the measured

CO-4. Calculate the required parameters and plot the results

CO-5. Interpret, compare with standard results and draw conclusions

CO-6. Write laboratory report as per the prescribed format

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Course Outcomes (COs)

Course Title & Code: Computer Aided Manufacturing (CAM) Laboratory (MEL308A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the process of NC part programming
- **CO-2.** Develop manual and CAM based NC part programme for simple turning and millingoperations using appropriate software
- **CO-3.** Simulate machining operations, generate CNC codes and tool path using appropriatesoftware
- **CO-4.** Evaluate the cutting time by comparing different tool path generation
- **CO-5.** Write a report as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Heat and Mass Transfer (MEC309A)

After the successful completion of this course, the student will be able to:

- **CO-1.** State the laws of heat and mass transfer
- **CO-2.** Explain the principles of conduction, convection, radiation, boiling, condensation and diffusion
- **CO-3.** Develop finite difference equations of heat transfer for various conditions
- **CO-4.** Design heat exchangers using LMTD and NTU methods
- **CO-5.** Solve conduction, convection, radiation heat transfer and mass transfer problems

Course Outcomes (COs)

Course Title & Code: Finite Element Methods and CAE Laboratory (MEC310A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the basic concepts of finite element method and its role in engineering analysis
- **CO-2.** Outline the general procedure of finite element analysis and element formulation
- **CO-3.** Develop element equations for simple one dimensional, two dimensional elements for structural and thermal analysis
- **CO-4.** Solve simple structural static, dynamic and thermal analysis problems
- **CO-5.** Model and analyse simple linear static, dynamic and thermal problems using ANSYS

Course Outcomes (COs)

Course Title & Code: Design of Machine Elements-2 (MEC311A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe basic concepts and principles of machine component and system design understatic and fluctuating loads
- **CO-2.** Identify appropriate governing criteria / standard for designing machine componentsbased on its criticality under fluctuating load conditions

CO-3. Design machine components like springs, clutches, brakes, gears, wire ropes, chains andsliding contact bearings

CO-4. Select appropriate rolling contact bearing for an application

CO-5. Perform iterative design calculations to achieve induced stress values well within designstress values for various machine elements

Course Outcomes (COs)

Course Title & Code: Control Systems Engineering and Laboratory (MEC312A)

After the successful completion of this course, the student will be able to:

CO-1. Explain the basic concepts of control system and associated terminologies

CO-2. Develop mathematical models of mechanical systems and determine their transferfunctions

CO-3. Discuss time and frequency response analysis and stability of a system

CO-4. Design controller for a system and analyse performance of the system

CO-5. Perform stability analysis for a given system and interpret results

CO-6. Apply control system techniques to a given application and analyse the response forsuitability of design using standard software

Course Outcomes (COs)

Course Title & Code: Industrial Engineering and Management (MEC313A)

After the successful completion of this course, the student will be able to:

CO-1. Describe productivity and its types, the methods of measuring productivity and measuresfor improving productivity

CO-2. Explain various principles of management, functions of industrial engineering, materials management and organization structure with their applications

CO-3. Discuss human factors and ergonomics in industries

CO-4. Apply concepts of industrial engineering, materials management, and qualitymanagement for a given application

CO-5. Select location for setting up a facility by considering the economic and noneconomicfactors

Course Outcomes (COs)

Course Title & Code: Engineering Economics and Cost Estimation for Mechanical Engineers (MEC314A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the basic aspects of business economics with respect to manufacturing industries, book keeping, depreciation of assets and its types

CO-2. Explain the concepts of cash flow diagram, law of supply and demand, principles of microeconomics, costing and economic analysis for manufacturing industries and industrial robots

CO-3. Discuss the behavior of manufacturing firms in a competitive market for short and long term

CO-4. Estimate the total cost incurred for implementing a manufacturing process and developing an

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industrial/service robot and evaluate its worthiness by calculating PBP, NPV, ARR, IRR and PI

CO-5. Analyze financial decisions mathematically using a production function and interpret financial information for an organization

Course Outcomes (COs)

Course Title & Code: Seminar (MES316A)

After the successful completion of this course, the student will be able to:

CO-1. Prepare and deliver seminar on a given topic.

CO-2. Write a report on the seminar topic

Course Outcomes (COs)

Course Title & Code: Heat and Mass Transfer Laboratory (MEL315A)

After the successful completion of this course, the student will be able to:

CO-1. Plan the experimental setup to achieve the stated aim

CO-2. Conduct experiments as per the standard procedures and tabulate the measured values

CO-3. Calculate the required parameters and plot the results

CO-4. Interpret, compare with standard results and draw conclusions

CO-5. Write laboratory report as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Advanced Mechanics of Materials (MEE411A)

After the successful completion of this course, the student will be able to:

CO-1. Explain material behaviour under various loading conditions

CO-2. Perform stress analysis for given loading and boundary condition from the first principles

CO-3. Identify the critical region of the structure and use appropriate failure model to analysethe failure

CO-4. Develop mathematical models to predict material behaviour under various loadingconditions

CO-5. Apply principles of mechanics of materials and solve problems to predict material behavior under different loading conditions like elastic loading, plastic loading and timedependent loading

Course Outcomes (COs)

Course Title & Code: Advanced Manufacturing Technologies (MEE412A)

After the successful completion of this course, the student will be able to:

CO-1. Explain the working principles, operations, merits and demerits of non-traditionalmachining and additive manufacturing processes

CO-2. Describe the types of non-traditional machining and additive manufacturing processesand the effect process parameters

CO-3. Compare the suitability of non-traditional machining and additive manufacturingtechnologies for various applications

CO-4. Develop CAD model, slicing and tool path generation for additive manufacturingprocesses

CO-5. Select appropriate process for manufacturing a given component and criteria

Course Outcomes (COs)

Course Title & Code: Fluid Power Systems (MEE413A)

After the successful completion of this course, the student will be able to:

CO-1. Explain the principles and components of fluid power systems

CO-2. Describe the working of fluid power systems

CO-3. Select cylinders, actuators and control valves for given application

CO-4. Develop hydraulic or pneumatic systems with circuit diagrams

CO-5. Design and analyze hydraulic/pneumatic circuit for a given application

Course Outcomes (COs)

Course Title & Code: Operations Research (MEE414A)

After the successful completion of this course, the student will be able to:

CO-1. Describe different problem solving methods for optimal utilization of resources

CO-2. Formulate appropriate mathematical models in order to obtain the optimal solution and analyze their sensitivity

CO-3. Solve numerical problems for obtaining optimal solution by considering the objectives and constraints of a system and draw conclusions

CO-4. Compute normal and standard time of an activity and estimated times for completion ofa project

CO-5. Optimize a given system by adhering to the constraints and achieving the desiredobjectives

Course Outcomes (COs)

Course Title & Code: Robotic Systems and Automation (MEE415A)

After the successful completion of this course, the student will be able to:

CO-1. Explain the evolution and future of robotic systems and applications

CO-2. Describe the anatomy of given robotic system

CO-3. Discuss the need, significance and types of automation in manufacturing

CO-4. Select appropriate end effector for the robotic application

CO-5. Determine various robot configurations and robot cell features in automation

Course Outcomes (COs)

Course Title & Code: Probability and Statistics (MTE401A)

After the successful completion of this course, the student will be able to:

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- **CO-1.** Explain the concepts of random variables, probability distribution, joint probabilitydistribution and sampling distribution
- **CO-2.** Explain the principles of convex optimization, regression, confidence interval andhypothesis testing
- **CO-3.** Solve simple problems associated with probability distribution, regression, confidenceinterval and hypothesis testing
- **CO-4.** Model real word problems by using probability distribution and regression
- **CO-5.** Solve complex problems associated with probability distribution, regression, confidence interval and hypothesis testing

Course Outcomes (COs)

Course Title & Code: Advanced Mathematics (MTE411A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Define and explain Legendre and Bessel differential equation, curvature, torsion,geodesics, manifolds and tensors
- **CO-2.** State the results and theorems and solve simple problems in Legendre differentialequations, Bessel differential equation, theory of curves and surfaces
- **CO-3.** Apply differential geometry techniques to compute Gaussian curvature, mean curvature, principal curvature and torsion
- **CO-4.** Solve complex engineering problems associated with Bessel differential equation, theoryof curves and surfaces, orthogonal curvilinear coordinates and spherical curvilinear system
- **CO-5.** Analyze real world problems associated with Bessel differential equation and curvature ofspace curves

Course Outcomes (COs)

Course Title & Code: Noise Vibration and Harshness (MEE421A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the phenomena of noise, vibration, harshness and their sources in machines.
- **CO-2.** Determine vibration parameters of multi degree freedom of system and interpret results
- **CO-3.** Discuss models of sound waves, sound sources and solid structure interaction with sound waves.
- **CO-4.** Outline techniques of measurement and control of noise and vibration.
- **CO-5.** Identify and analyse sources of noise in mechanical machinery.
- **CO-6.** Solve noise and vibration problems in mechanical components like gears, rotors and shaft, bearing, fans, etc.

Course Outcomes (COs)

Course Title & Code: Advanced Materials and Processes (MEE422A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the importance, properties and applications of advanced materials and surface engineering processes

CO-2. Describe the principles, properties and usage of advanced alloys, ceramics, polymers and composites for different applications

CO-3. Discuss the various advanced materials and surface engineering techniques used invarious applications

CO-4. Identify an appropriate advanced materials and surface modification technique forapplications based on sustainable technology

CO-5. Select an appropriate processing method for advanced materials and surface modification technique to achieve required functionality

Course Outcomes (COs)

Course Title & Code: Computational Fluid Dynamics (MEE423A)

After the successful completion of this course, the student will be able to:

CO-1. Explain different models of fluid flow, boundary conditions, discretization schemes,viscous and turbulence models

CO-2. Discuss the importance, applications of CFD and stability of a discretization scheme

CO-3. Formulate fluid flow equations for different models

CO-4. Apply appropriate model and discretization scheme for solution of fluid flow problems

CO-5. Solve fluid flow problems using CFD methods and software

Course Outcomes (COs)

Course Title & Code: Supply Chain Management (MEE424A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the concepts of logistics and supply chain management

CO-2. Explain the role of supply chain drivers in achieving competitive advantage at various decision phases

CO-3. Determine capacity and inventory requirements for optimality and interpret results

CO-4. Select factors to design distribution and supply chain network for achieving feasibility in managing supply and demand

CO-5. Apply principles and concepts of logistics and supply chain in manufacturing and service based organizations for performance improvement

Course Outcomes (COs)

Course Title & Code: Robot Kinematics and Dynamics (MEE425A)

After the successful completion of this course, the student will be able

CO-1. Explain basics of planar and spatial description, transformation, kinematics, dynamics andtheir importance in robotics

CO-2. Describe D-H convention and its application in robotic system

CO-3. Develop kinematics equations and analyze for forward and inverse kinematics

CO-4. Solve for time varying position and orientation of robotic manipulator

CO-5. Analyze for joint forces and torque required to operate manipulators

Course Outcomes (COs)

Course Title & Code: Data Sciences Foundation (CSE421A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the facilities—features, constructs, idioms, patterns and packages—of Python programming platform for building data science tasks
- **CO-2.** Explain the applicability of the Python programming constructs for a given task
- **CO-3.** Choose/recommend appropriate facilities of Python for data science tasks
- **CO-4.** Design data science tasks using the facilities of Python platform
- **CO-5.** Use parallelization and advanced programming constructs in the design of data sciencetasks
- **CO-6.** Synthesize and test data science tasks employing the Python platform facilities

Course Outcomes (COs)

Course Title & Code: Optimization Techniques – 1 (MTE421A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe fundamentals of convex and concave functions, linear programming andconstraint nonlinear optimization
- **CO-2.** State and explain important classical techniques and numerical methods of constraint optimization
- **CO-3.** Demonstrate the skill to analyze a problem by choosing effective optimization tools
- **CO-4.** Apply optimization techniques to model real world problems
- **CO-5.** Solve complex problems associated with linear programming and constraint optimizationof function of several variables

Course Outcomes (COs)

Course Title & Code: Project Work -1 (MEP401A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Recognise the need for developing a new or improving an existing engineering product/system through an organised survey of literature
- **CO-2.** Define engineering design specifications.
- **CO-3.** Design, model, solve analyse the product/system to meet the design specifications.
- **CO-4.** Evaluate the performance of the modelled system and justify its performance.
- **CO-5.** Demonstrate the system working and make a presentation
- **CO-6.** Write a technical report.

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Course Outcomes (COs)

Course Title & Code: Internship (MEI401A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Write a report on experiences during internship.
- **CO-2.** Make a presentation to a panel of examiners.

Course Outcomes (COs)

Course Title & Code: Fatigue and Fracture Mechanics (MEE431A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe basic concepts of metal fatigue and fracture mechanics
- **CO-2.** Explain different types fatigue loading, fatigue design methods and fracture mechanics principles
- **CO-3.** Discuss fatigue and fracture phenomena and governing laws applied to machinery design
- **CO-4.** Solve problems of metal fatigue analysis involving simple mechanical components
- **CO-5.** Apply theory of fracture mechanics to carry out stress analysis of cracked components and structures

Course Outcomes (COs)

Course Title & Code: Additive Manufacturing (MEE432A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the various principles and concepts of statistically designed experiment
- **CO-2.** Explain the guiding principles of designing experiments and their applications for building robustness in product/process
- **CO-3.** Discuss the process of experimentation adopting suitable designs namely, single factor, factorial, special and Taguchi techniques
- **CO-4.** Formulate problems to conduct experiments for arriving at optimal solutions
- **CO-5.** Determine optimal process parameters for a given problem and interpret result
- **CO-6.** Apply experimental design techniques to given situation and analyze results for optimal criteria

Course Outcomes (COs)

Course Title & Code: Power Plant Engineering (MEE433A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain plant layout, working and various sub components of conventional and renewable power plants
- **CO-2.** Discuss energy scenario, maintenance, small scale power generation and selection of sitefor power plant
- **CO-3.** Solve simple numerical problems on power plant performance
- **CO-4.** Select appropriate power plant for a specified power generation capacity
- **CO-5.** Analyze the potential of various energy sources suitable for power generation

Course Outcomes (COs)

Course Title & Code: Quality by Design (MEE434A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the various principles and concepts of statistically designed experiment
- **CO-2.** Explain the guiding principles of designing experiments and their applications for building robustness in product/process
- **CO-3.** Discuss the process of experimentation adopting suitable designs namely, single factor, factorial, special and Taguchi techniques
- **CO-4.** Formulate problems to conduct experiments for arriving at optimal solutions
- **CO-5.** Determine optimal process parameters for a given problem and interpret result
- **CO-6.** Apply experimental design techniques to given situation and analyze results for optimalcriteria

Course Outcomes (COs)

Course Title & Code: Robot Programming and Control (MEE435A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain various methods of robot programming
- **CO-2.** Describe various robot languages and commands for robot operation, robot controlsystem modules and their response
- **CO-3.** Design a controller to meet error, stability and relative stability specifications
- **CO-4.** Develop programs using high level robotic programming languages to control robotic operations
- **CO-5.** Select suitable drives and control circuits for developing a physical control

Course Outcomes (COs)

Course Title & Code: Data Analytics (CSE441A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss data analytics application development using knowledge representation, data warehousing, machine learning and data mining techniques
- **CO-2.** Choose appropriate techniques and technology for data warehousing, machine learning and Data mining for knowledge discovery.
- **CO-3.** Design data analytics processes using data warehousing, machine learning and data mining techniques for knowledge representation and discovery
- **CO-4.** Analyze the data andthe performance of data analytics applications.
- **CO-5.** Synthesize data analytics applications using machine learning and data mining techniques and enterprise platforms.
- **CO-6.** Solve problems associated with large scale data analysis, machine learning and data

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Course Outcomes (COs)

Course Title & Code: Advanced Numerical Methods (MTE431A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Illustrate various methods of numerical computation of Eigen values
- **CO-2.** Illustrate various methods to solve partial differential equations
- **CO-3.** Apply numerical methods to solve partial differential equations using MATLAB
- **CO-4.** Analyze real world problems associated with computing eigenvalues and partial differential equations
- **CO-5.** Solve complex problems arising in real world using finite volume and finite elementsmethods to solve partial differential equations

Course Outcomes (COs)

Course Title & Code: Optimization Techniques – 2 (MTE441A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe fundamental of integral equations, variational problems and unconstrained optimization
- **CO-2.** State and explain important classical techniques to solve integral equations and numerical methods of unconstrained optimization
- **CO-3.** Demonstrate the skill to analyze variational problem and choose effective optimizationtools
- **CO-4.** Apply optimization techniques to model real world problems involving linear and non-linear optimization
- **CO-5.** Solve complex problems associated with integral equations, calculus of variations and unconstrainted optimization of function of several variables

Course Outcomes (COs)

Course Title & Code: Project Work -2 (MEP402A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Recognise the need for developing a new or improving an existing engineering Product /system through an organised survey of literature
- **CO-2.** Define engineering design specifications.
- **CO-3.** Design, model, solve analyse the product/system to meet the design specifications.
- **CO-4.** Evaluate the performance of the modelled system and justify its performance
- **CO-5.** Demonstrate the system working in a virtual environment and make apresentation.
- **CO-6.** Write a technical report.

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