**MEE2001: ENGINEERING ECONOMICS [3 0 0 3]**

**Course Outcomes:** On completion of this course, student shall be able to –

1. Describe various economic decision-making concepts and types of estimates.
2. Assess the financial viability of engineering projects.
3. Discuss budget and budgetary control concepts.
4. Analyse for replacement analysis and break-even analysis.
5. Estimate the projects for economic feasibility by risk analysis to enhance entrepreneurship skills.

**Syllabus**: Concept and Value analysis Economic Decision Making, Types of Estimates, Accounting and Control – Elements of Cost, Prime Cost, Overheads, Types of Cost, Process Cost & Cost of Production, Break Even Analysis Inventory Control & Management, EOQ, Financial Analysis, Simple payback, Return on Investment, NPV (Net Present Value), IRR (Internal rate of Return), Life Cycle Cost Method, Sensitivity Analysis, Project Financing Options. Budget and Budgetary Control, Concept of Budgeting, Type of Budgets. Risk - Risk vs Return. System Concept and Value Analysis – System Analysis & System Engineering, Value Analysis. Replacement Analysis, Depreciation, Network Analysis Network Techniques – PERT (Programme evaluation and review technique), CPM (Critical Path Method).

**Reference Books:**

1. R. Panneerselvam, *Engineering Economics*, Prentice Hall of India.
2. Riggs, D.D. Bedworth and S.U. Randhawa, *Engineering Economics*, McGraw Hill Education.
3. P.L. Mehta, Managerial Economics, Sultan Chand & Sons.
4. E.L. Grant, W.G. Ireson and R.S. Leavenworth, *Principles of Engineering Economic Analysis*, John Wiley.
5. G,J. Tuesen, W.J. Fabrycky and H.G. Tuesen, *Engineering Economy*, Prentice Hall of India.

**MEE 2101: MATERIAL SCIENCE & METALLURGY [4 0 0 4]**

**Course Outcomes:** On completion of this course, student shall be able to –

1. On completion of this course student shall be able to –
2. Identify the basic concept of Crystal imperfections.
3. Compare microstructure of different engineering materials.
4. Select materials for different engineering application.
5. Identify suitable heat treatment process for attainment of desirable property in metals to enhance employability.
6. Describe applications of advanced materials.

**Syllabus**: Classifications, application and properties of engineering materials, Crystal structure, Crystal directions and planes, Miller indices, Polymorphism or Allotropy, Diffusion processes. Crystallization, Imperfections in Crystals: Point, line and surface defects. Plastic deformation of metals and alloys, Role of dislocation; slip and twinning, grain growth. Solidification of metals and alloys, Phase diagrams-Phase and Lever Rules, Iron- Carbon equilibrium diagram, Time-Temperature-Transformation Diagram, Heat treatment processes, Powder metallurgy, Corrosion of Metal and Alloys, Mechanical properties of

metals, Microstructural characterization Non-destructive testing of materials. Polymeric materials, Structure and properties of ceramics, Composites Materials, Biocomposites, Nanocomposites, Smart materials, Biomaterials, Nanomaterials.

**Reference Books**:

1. Materials Science and Engineering, Callister William D & R. Balasubramaniam, Wiley Student Edition.
2. Elements of Material Science and Engineering, Lawrence H. van Vlack, Pearson Education.
3. Materials Science and Metallurgy, K. I. Parashivamurthy, Pearson Education.
4. Materials Science and Engineering, William F Smith, Javad Hashmi and Ravi Prakash,
5. Tata Mcgraw Hill Education Private Limited, New Delhi.
6. Mechanical Metallurgy, George E. Dieter, SI Metric Edition McGraw Hill Book Company, London.

## MEE2102: THERMAL ENGINEERING [3 1 0 4]

**Course Outcomes:** On completion of this course student shall be able to –

1. Apply different laws and basic concept of thermodynamics in engineering applications.
2. Compute the performance parameters of power and refrigeration cycles.
3. Understand the application of air compressors and steam turbines.
4. Compare the performance of thermal systems.
5. Calculate availability of close and open systems.

**Syllabus**: Heat & Work, Thermodynamic Properties, Properties of steam, Laws of Thermodynamics: Applications to Non flow and flow processes, Carnot principle, Absolute thermodynamic temperature scale, Clausius Inequality, Entropy, Principle of increase-in-Entropy, Entropy generation; Availability: Concept of Available Energy, Availability of closed & open systems, Irreversibility; Gas Power cycles: Air standard cycle- Otto, Diesel, Dual, Brayton Cycle, Vapour Power: Rankine Cycle. Reverse Carnot Cycle, Vapour Compression Refrigeration Cycle, Air compressor: working and performance parameters, Steam turbines: impulse and reaction turbine, turbine efficiencies.

**References Books:**

1. P.K. Nag, *Engineering Thermodynamics*, (6e), McGraw Hill,Latest edition.
2. Y.A. Cengel and M A Boles, *Thermodynamics: An Engineering Approach*, (8e), McGraw Hill, Latest Edition.

## MEE2103: STRENGTH OF MATERIALS [2 1 2 4]

**Course Outcomes**: On completion of this course student shall be able to –

1. Describe concepts of stresses and strains in solids and structures under different types of loadings.
2. Apply concept of stress strain transformation in 2D and 3D structures.
3. Analyse determinate and indeterminate structures under axial and torsional loading.
4. Compute shear force and bending moment for beams subjected to transverse loading.
5. Explain theory of failure for different class of Materials.

**Syllabus**: Concept of Stress, Strain Stress-strain diagram, Stress and strain at a point: stress and strain tensors, different state of stresses and strains: stress and strain transformations, Principal stresses, and strains. Mohr's circle concept. Deformations in axial loaded members. Bending of beams: shear force and bending moment diagrams, pure bending, normal and shear stresses in beams, deflection in beams. Torsion of circular members, Columns: Euler's theory, Buckling load for different end conditions, Rankine-Gordon's formula for columns, Theories of failures. Experiments on Izod and Charpy Impact testing, Rockwell, Vicker's Brinell, Hardness Testing. Torsion, Tensile, Compression, Bending, Shear Testing.

**References Books:**

1. F.P. Beer, R.J. Johnson, J. Dewole and D. Mazurek, Mechanics of Materials, (7e), McGraw Hill, 2015.
2. S.B. Timoshenko, J.M. Gere J.M, Mechanics of Materials, (2e), CBS Publishers, 2006.
3. B.C. Punamia, A.K Jain, Mechanics of Materials, Laxmi Publications, 2006.
4. R.C. Hibbeler, Mechanics of Material, Pearson Education, Low Price Edition, 2007

## AUT2130: COMPUTER-AIDED DRAWING LAB [0 0 2 1]

**Course Outcomes:** On completion of this course student shall be able to –

1. Execute commands selecting specific options to draw 2D drawings and 3 D modelling using Creo software.
2. Model two-dimensional sketches and three-dimensional parts.
3. Perform assembly of vehicle components using Creo software to enhance employability.
4. Understand the sheet metal modelling for the vehicle body.

**Syllabus**: Introduction: CAD software and its applications. Software: Creo. 2D Part Drawing, 3D Part modelling, assembly of vehicle components, Sheet metal modelling.

**References Books:**

1. Toogood R. Creo Parametric 9.0 Tutorial. Sdc Publications; 2022.
2. Rider M. Designing with Creo Parametric 9.0. SDC Publications; 2022.

**AUT2131: AUTOMOTIVE ENGINES LAB [0 0 2 1]**

**Course Outcomes**: On completion of this course student shall be able to –

1. Demonstrate engine parts and sub-systems.
2. Analyse the effect of input parameters on engine performance.
3. Perform engine tuning, servicing, and fuel conditioning to enhance employability.

**Syllabus**: Study of Special engine tools, equipment and safety, Assembling and Dismantling of single cylinder, multi cylinder engines, 2 stroke engine, valve & port timing. Performance testing on single cylinder, multi cylinder petrol & diesel engines, heat balancing, VCR engine performance test with CNG and LPG Kit, FIP calibration test Engine tuning and overhauling, Fuel Conditioning.

**References Books:**

1. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi, 2005
2. J B Heywood, Internal Combustion Engine Fundamentals, (India Edition), McGraw Hill Publishers, 2011.
3. V Ganesan, Internal Combustion Engines, (4e), McGraw Hill, 2011.

**AUT2170: PROJECT-BASED LEARNING 1 [0 0 2 1]**

**Course Outcomes**: On completion of this course student shall be able to -

1. Conduct a literature review to identify research gaps in the field of interest.
2. Design their projects for entrepreneurship skill enhancement.
3. Assess the viability of the project
4. Present the project to the evaluators.

**Syllabus**: Introduction to project-based learning, Selection of a project topic and defining project scope, Research methodology and literature review, Project planning and time management, Data collection and analysis, Presentation, and communication skills.

**Flexi Core 1:**

**AUT2120: CONVENTIONAL & HYBRID ENGINES [4 0 0 4]**

**Course Outcomes**: On completion of this course student shall be able to –

1. Describe engine parts and subsystems.
2. Analyse the engine performance for specific applications.
3. Compare the conventional and modern subsystems of engines.
4. Analyse the effect of engine modification to enhance employability.

**Syllabus**: Engine cylinder layouts and configurations. Firing order. Engine balancing. Fuel feed systems, Carburetor, Petrol injection systems, FIP's, CRDI, ignition systems, cooling system, Engine Lubrication systems. Two stroke engines. Scavenging processes. Supercharging and turbocharging, Combustion in SI & CI Engines –Knocking, abnormal combustion, dual fuel and multi-fuel engines, wankel, free piston, lean burn, stratified charged & HCCI Engines. Engine modifications in hybrid vehicles.

**References:**

1. J B Heywood, Internal Combustion Engine Fundamentals, (India Edition), McGraw Hill Publishers, 2011.K K Ramalingam, Two Wheelers, (2e), Scitech Publications Pvt. Ltd., 2014.
2. V Ganesan, Internal Combustion Engines, (4e), McGraw Hill, 2011.

## AUT2201: VEHICLE ARCHITECTURE [3 0 2 4]

**Course Outcomes:** On completion of this course student shall be able to –

1. Describe the different types of loads carrying structure and its application on automotive frames.
2. Explain braking and regenerative braking systems and its importance in automobiles.
3. Analyse practical problems of braking based on stopping distance, brake efficiency and weight transfer during braking to enhance employability.
4. Analyse practical problems of Axle and suspension systems based on vehicle requirements to enhance employability.

**Syllabus**: Automotive chassis and frames, functions, requirements, classification. chassis layout for conventional and electric vehicles, Braking systems: requirements, principle of operation, classification, different types of vehicle brakes. Steering systems: condition for true steering, steering linkages, and power steering. Suspension systems: classification, functions, rigid and independent suspension systems and suspension for electric vehicle. Automotive wheels and tyres. Dismantling and assembling of different types of braking systems, steering systems and suspension systems. Wheel balancing and alignment, battery pack layouts.

**References Books:**

1. P.M. Heldt, Automotive Chassis, Chilton and Co,1987.
2. G.B.S. Narang, Automobile engineering, Khanna Publications, New Delhi, 2018.
3. T.R. Banga and N. Singh, Automobile Engineering, Khanna Publications, 2020.
4. N.K. Giri, Automotive Mechanics, Khanna Publications, New Delhi, 2003.
5. C. Mi, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Wiley Publication, 2017.

## AUT2202: VEHICLE CONTROL SYSTEMS [4 0 0 4]

**Course Outcomes:** On completion of this course student shall be able to –

1. Identify elements and structures of feedback control systems.
2. Apply Routh-Hurwitz criterion, Root Locus, Bode Plot and Nyquist Plot to determine the domain of stability of linear time-invariant systems.
3. Determine the steady-state response, errors of stable control systems and design compensators to achieve the desired performance.
4. Illustrate the working of different types of electrical machines and vehicle systems using control system.
5. Analyse and solve practical problems of vehicle systems using PLC to enhance employability.

**Syllabus**: Introduction to Control Theory, Mathematical Models of Electrical: mechanical and electro-mechanical systems, block diagram Time Response Stability: Routh - Hurwitz criterion, frequency domain specifications, working and control of BLDC motor, Automotive Control System design process, Powertrain Control systems for air-fuel ratio, Vehicle Control System for cruise and headway, vehicle stability, active suspension, ABS, Traction control, Intelligent transportation systems, advanced vehicle control system, longitudinal and Lateral motion control. Introduction of PLC, Automatic opening and closing door, Verify the Operation of Different Logic Gates, Direct online Starter.

**References Books:**

1. Ogata, K., Modern Control Engineering, Prentice-Hall, [2002]
2. M.Gopal , “Digital Control and State Variable Methods” , Tata McGraw Hill New Delhi , 2005
3. Kuo, B.C., “Digital Control Systems”, Oxford University press, 1992.
4. C. Mi, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Wiley Publication, 2017.

## AUT2230: VEHICLE CONTROL SYSTEM LAB [0 0 2 1]

**Course Outcomes:** On completion of this course student shall be able to –

1. Understand the fundamental principles of vehicle control systems and their applications in modern automotive technology.
2. Develop proficiency in analysing and optimizing vehicle dynamic performance.
3. Gain hands-on experience in designing, simulating, and implementing vehicle control systems to enhance employability.

**Syllabus**: Modeling of Vehicle Dynamics, Controller Design and Vehicle Stability Control MAT lab software, Adaptive Cruise Control and Collision Avoidance, basics of autonomous vehicle control.

**References Books:**

1. Rajamani, “Vehicle Dynamics and Control,” Springer, 2nd Ed., 2012
2. Wong, “Theory of Ground Vehicles”, John Wiley & Sons, 4th Ed., 2008.

## AUT2231: AUTOMOTIVE DATA ANALYTICS LAB [0 0 2 1]

**Course Outcomes:** On completion of this course student shall be able to –

1. Explore the data analytic techniques for specific applications.
2. Identify the appropriate data analysis technique for the given data set.
3. Perform inferential statistical analysis to draw useful conclusions from the acquired data set.
4. Select advanced techniques to conduct thorough and insightful analysis and interpret the results to enhance problem-solving skills.

**Syllabus**: Practice on Minitab: Data entry, classification, normality test, hypothesis testing for parametric- comparing means- z test, independent t test and paired t test, comparing variance- chi square test, F test and non-parametric tests- Mann whitney, Sign, Wilcoxon signed- rank and Kruskal wallis test, Correlation and regression analysis, DoE, factorial design, ANOVA.

**References:**

1. Brunton, S. L., & Kutz, J. N. (2022). Data-driven science and engineering: Machine learning, dynamical systems, and control. Cambridge University Press.
2. Dunn, P. F., & Davis, M. P. (2017). Measurement and data analysis for engineering and science. CRC press.
3. Roy, S. S., Samui, P., Deo, R., & Ntalampiras, S. (Eds.). (2018). Big data in engineering applications (Vol. 44). Berlin/Heidelberg, Germany: Springer.
4. Middleton, J. A. (2021). Experimental Statistics and Data Analysis for Mechanical and Aerospace Engineers. Chapman and Hall/CRC.
5. Robinson, E. L. (2017). Data analysis for scientists and engineers. In Data Analysis for Scientists and Engineers. Princeton University Press.

## AUT2220: AUTOMOTIVE PNEUMATIC & HYDRAULIC SYSTEMS [4 0 0 4]

**Course Outcomes:** On completion of this course student shall be able to –

1. Describe the types of fluid flow and its application in automobiles.
2. Compute flow rate through venturi meter, orifice meter, and notches and its applications in automobiles.
3. Determine shear stress and velocity distribution through, circular pipe and between two fixed parallel plates.
4. Describe pumps, pneumatic & hydraulic valves, and their importance in automobiles to enhance employability.
5. Develop Pneumatic circuits for automotive component to enhance the employability skills.

**Syllabus**: Properties of fluids, hydrostatic law, manometers, Fluid statics: Hydro static forces and Centre of Pressure on plane surfaces, hydrostatic applications in braking systems, clutch cylinder, hydrostatic drives, Types of fluid flow; laminar flow, turbulent flow applications in engines, Continuity equation, Bernoulli's energy equation, Venturi meter, Orifice meter, Pitot tube and Notch, Viscous Flow: Reynolds

Number, Minor and Major losses, Darcy and Chezy equation. Linear and rotary actuators in automobiles, Automotive Pneumatic Hydraulic valves: Hydraulic & Pneumatic circuits.

**References Books:**

1. Y Cengel, J M Cimbala, Fluid Mechanics, Tata Mcgraw-Hill Publications, New Delhi, 2013.
2. F N White, Fluid Mechanics, Tata Mcgraw-Hill Publications, New Delhi, 2011.
3. C T Crowe, D F Elger, B C Williams, J A Roberson, Engineering Fluid Mechanics, John Wiley and Sons, New Jersey, 2009.
4. J. J. Pipenger, Industrial Hydraulics, McGraw Hill, 2018

## AUT2240: KINEMATICS AND DYNAMICS OF AUTOMOBILE [3 0 0 3]

**Course Outcomes:** On completion of this course student shall be able to –

1. Identify a specific mechanism for a given automotive application.
2. Analyze the velocity and acceleration of mechanisms analytically and synthesis of problems.
3. Analyse the kinematics of cam and gear-train mechanisms to improve problem-solving skills.
4. Explain Inertia force and inertia torque in reciprocating engines and equivalent dynamical systems.
5. Assess the characteristics of governors and gyroscopic effects.

**Syllabus**: Mechanism and inversions. Degrees of freedom. Mathematical analysis of velocity and accelerations of simple mechanisms. Synthesis of cams and gears. Gear trains. Static and dynamic force analysis of linkages. Balancing of rotating and reciprocating masses. Governors and its characteristics. Gyroscope and gyroscopic effect on automobiles, Hooks joint.

**References Books:**

1. Uicker, Jr, J. J., Pennock, G. R., & Shigley, J. E. Theory of Machines and Mechanisms (6th ed.). Cambridge: Cambridge University Press, 2023.
2. R.L Norton, Kinematics & Dynamics of Machinery, (5e), McGraw Hill Educations, 2017
3. S. S. Rattan, Theory of Machines (5e), McGraw Hill Educations, 2019

## AUT2241: TWO AND THREE-WHEELED VEHICLE SYSTEMS [3 0 0 3]

**Course Outcomes:** On completion of this course student shall be able to –

1. Classify two-wheelers and three-wheelers for their specific applications.
2. Explain the types of components used in two or three-wheeled vehicles.
3. Perform assembling and dismantling of two and three-wheeled vehicles.
4. Service the 2 & 3-Wheeler for attaining employability skills.

**Syllabus**: Classification, technical specification, and layouts, Chassis and Sub Systems: Chain and shaft drive, Clutches, CVT, gear boxes, three-wheeler drive line & chassis, Powertrain customization- Types, purpose, gear controls and shifting mechanism. Front and Rear suspension system. Steering mechanisms and Handlebar. Brakes and Wheels, Rims and Tires, Electrical Systems, Moped cranking mechanism,

Road Performance: Road holding & vehicle stability, seating and rider ergonomics, Various Safety measures & arrangements, Brake performance, Rear & front brake overhauling & adjustments. Maintenance, Trouble shooting, causes and remedies. Electric 2 & 3 wheelers.

**References:**

1. D U Panchal, Two and Three-Wheeler Technology, (2e), PHI Learning Private Limited, 2015.
2. K K Ramalingam, Two Wheelers, (2e), Scitech Publications Pvt. Ltd., 2014.
3. A De, Vehicle Dynamics, (1e), Galgotia Publications Pvt. Ltd., 2011.

## AUT2242: PRODUCT DESIGN AND DEVELOPMENT [3 0 0 3]

**Course Outcomes:** On completion of this course student shall be able to –

1. Analyse various stages of product design and development processes.
2. Apply the methodologies for product design, development, and management.
3. Employ systematic methods in product development management to meet customer requirements to cultivate entrepreneurial skills.
4. Understand product lifecycle management (PLM) and implement various PLM strategies.
5. Identify Intellectual Property Rights types for specific applications.

**Syllabus**: New product development, characteristics, challenges, economics, value, concurrent and reverse engineering. Product development process: planning, concept development, system-level design, detailed design, testing and refinement, production ramp-up. Identifying Voice of Customer: Product opportunity identification, Perceptual mapping, Kano model, Quality function deployment, benchmarking, product specifications, conjoint analysis, Failure mode & effects analysis. concept selection, testing and prototyping, Product Architecture: Integral and modular design, Robust design, Industrial design, Design for manufacturing, Design for X, Product Lifecycle Management, Intellectual Property Rights: Patents, copyrights, trademarks, geographical indicators.

**References Books:**

1. Ulrich K. T., Eppinger S.D, and Yang, M.C., Product Design and Development, Tata McGraw Hill 7e, 2020.
2. Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI 7e, 2013.
3. Jamnia., A., Introduction to Product Design and Development for Engineers, CRC Press, 2018