Detailed Curriculum for Undergraduate Degree
B. Tech in Automobile Engineering
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum of 3rd semester

Course Name:	**Engineering Mechanics**		
Course Code:	ES-AUE301	**Category:**	Engineering Science Course
Semester:	Third	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	No-prerequisite
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to preparing a good foundation for taking up advanced courses in the area in the subsequent semesters.
2	A working knowledge of statics with emphasis on force equilibrium and free body diagrams provides an understanding of the kinds of stress and deformation, and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions.
3	To develop the ability to analyze the motion of bodies under the action of forces using Newton's laws, energy and momentum principles, collision theory, and basic vibration concepts, enabling students to solve practical engineering problems involving dynamic systems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Statics of Particles and Rigid Bodies:** Fundamental Concepts: Basic units and dimensions, introduction to vector algebra (Scalar and Vector products). System of Forces: Coplanar and non-coplanar force systems; Resultant of force systems. Equilibrium: Free-Body Diagrams (FBDs), Equations of equilibrium for particles and rigid bodies. Distributed Forces: Centroid and Center of Gravity of lines, areas, and volumes. Moment of Inertia: Area and Mass Moment of Inertia; Parallel and Perpendicular axis theorems.	8L+2T
2	**Structural Mechanics:** Trusses: Analysis of plane trusses using the Method of Joints and Method of Sections. Frames: Analysis of simple frames and machines. Virtual Work: Principle of Virtual Work and its application to stable structures	6L+2T

3	**Friction and Applications:** Friction: Laws of friction, Angle of friction, and Cone of friction. Mechanical Applications: Wedge-and-Ladder friction. Screw Jacks, Belt-Pulley Systems, and flat/V-belt drives, Rolling friction.	6L+2T
4	**Kinematics of Particles and Rigid Bodies:** Rectilinear & Curvilinear Motion: Position, velocity, and acceleration in Cartesian, Cylindrical, and Spherical polar coordinates. Projectile Motion: Range, time of flight, and trajectory. Rigid Body Kinematics: Translation and Rotation; Instantaneous Center of Rotation (ICR); General plane motion.	6L+2T
5	**Dynamics and Kinetics:** Newton's Second Law: D'Alembert's Principle and Inertia Forces. Work and Energy: Work-energy theorem, Kinetic and Potential energy, Conservation of energy. Impulse and Momentum: Linear and Angular impulse-momentum principles; Law of conservation of momentum. Collision: Elastic and plastic collision; Law of Restitution. Lagrange's Equation: Introduction to Lagrangian mechanics	6L+2T
6	**Introduction to Vibrations:** Single Degree of Freedom (SDOF) Systems: Free and forced undamped vibrations. Spring-Mass Systems: Determination of natural frequency	4L+2T
Total:		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Resolve complex 2D and 3D force systems into equivalent components and determine the static equilibrium of rigid bodies using vector-based Free Body Diagrams.
2	Perform structural analysis on plane trusses and evaluate the mechanical advantage of friction-based machine elements like screw jacks and belt drives.
3	Predict the position, velocity, and acceleration of particles and rigid bodies using Cartesian, Polar, and Path coordinate systems for various engineering mechanisms.
4	Apply Energy-Momentum principles and Lagrangian formulations to analyze central impacts, dynamic systems, and the natural frequency of single-degree-of-freedom vibrations.

Learning Resources:	
1	B. Bhattacharyya, *Engineering Mechanics*, 2nd ed. Oxford: Oxford University Press, 2014.
2	Ferdinand P. Beer and E. Russell Johnston Jr., *Vector Mechanics for Engineers*, Vol. I (Statics) & Vol. II (Dynamics), 9th ed. New Delhi, India: Tata McGraw-Hill, 2011.
3	Irving H. Shames, *Engineering Mechanics*, 4th ed. New Delhi, India: Prentice Hall, 2006.
4	R. K. Bansal, *A Textbook of Engineering Mechanics*, 8th ed. New Delhi, India: Laxmi Publications, 2015.
5	Shanes and Rao, *Engineering Mechanics*, 4th ed. India: Pearson Education, 2006.
6	J. L. Meriam and L. G. Kraige, *Engineering Mechanics*, Vol. 1 (Statics) & Dynamics, 3rd ed. New York, USA: John Wiley & Sons, 1993.
7	Stephen P. Timoshenko and D. H. Young, *Engineering Mechanics*, 4th ed. New York, USA: McGraw-Hill, 1956.
8	Ferdinand P. Beer and E. Russell Johnston Jr., *Mechanics for Engineers*, 4th ed. New York,

	USA: McGraw-Hill, 1987.
9	Isaac M. Daniel and Ori Ishai, *Engineering Mechanics of Composite Materials*, 2nd ed., Oxford University Press, 2005.
10.	Robert M. Jones, *Mechanics of Composite Materials*, 2nd ed., USA: CRC Press, 1998.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Engineering Mechanics	Prof. K. Ramesh, Prof. Tarkes Dora Pallicity	IIT Madras
	Course Link: https://nptel.ac.in/courses/112106286		
2	Engineering Mechanics - Statics and Dynamics	Prof. Anubhab Roy	IIT Madras
	Course Link: https://nptel.ac.in/courses/112106180		
3	Engineering Mechanics	Prof. U.S. Dixit, Dr. G. Saravana Kumar	IIT Guwahati
	Course Link: https://nptel.ac.in/courses/112103108		
4	Engineering Mechanics	Prof. Manoj K Harbola	IIT Kanpur
	Course Link: https://nptel.ac.in/courses/122104014 https://nptel.ac.in/courses/122104015		

Course Name:	**Materials Engineering**		
Course Code:	ES-AUE302	**Category:**	Engineering Science Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	No-prerequisite
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	Understanding of the correlation between the internal structure of materials, their mechanical properties, and various methods to quantify their mechanical integrity and failure criteria.
2	To provide a detailed interpretation of equilibrium phase diagrams.
3	Learning about different phases and heat treatment methods to tailor the properties of materials.
4	Learning about different materials for engineering applications.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction:** Atomic bonding, Classification of materials	2L
2	**Crystal geometry and imperfections:** Space lattices, Unit cells, Crystal structure, Crystal directions and planes, Crystal imperfections- Point defects, Line defects, Surface defects, Volume defects.	6L
3	**Constitution of alloys:** Types of solid solutions- substitutional and interstitial; Hume-Rothery rules for solid solutions; Solidification and microstructural evolution in metals and alloys; Construction and interpretation of binary equilibrium diagrams-isomorphous, eutectic, and peritectic-type phase diagrams, Intermediate phases, Gibbs' phase rule, lever rule.	8L
4	**Mechanical properties:** Elasticity and plasticity in materials, Stress-strain curve, tensile properties, hardness and hardness measurement, impact properties, fatigue, and creep.	5L
5	**Steels and Cast Irons:** Iron-carbon phase diagram, Types of steels- low, medium, and high carbon steels, stainless steels, alloy steels, and their applications; Heat treatment- annealing, normalizing, hardening, tempering, surface hardening; Cast irons properties, types and application.	8L
6	**Non-ferrous Metals and Alloys:** Properties and applications of - Cu and its alloys, Al and its alloys, Age hardening, Ti and its alloys, Ni-based alloys.	3L
7	**Ceramics, Polymers and Composites:** Structure and unique properties of important ceramics, polymers, and composites; rule of mixtures.	2L
8	**Material Degradation and Prevention:** Fundamentals of material degradation; corrosion – definition and basic mechanism; types of corrosion – galvanic, pitting, crevice; environmental effects on degradation (humidity, salts, temperature). Basic corrosion prevention methods – protective coatings (painting, galvanization)	2L
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify crystal structures and crystal defects of materials
2	Construct, interpret, and apply binary alloy phase diagrams, including phase rules and microstructural evolution, to predict material behavior in alloys.
3	Correlate the microstructure and mechanical properties of materials.
4	Describe the types, properties and applications of steels and cast iron, non-ferrous alloys, ceramics and polymers
5	Identify corrosion types and explain degradation and prevention methods in materials

Learning Resources:	
1	William D. Callister Jr., *Materials Science and Engineering: An Introduction*, 6th ed. New Delhi, India: Wiley India, 2006.
2	V. Raghavan, *Materials Science and Engineering*, 5th ed. New Delhi, India: Prentice Hall of India Pvt. Ltd., 2004.

3	R. K. Rajput, *Fundamentals of Material Science*, 2nd ed. New Delhi, India: S. K. Kataria & Sons, 2010.
4	William F. Smith, *Materials Science and Engineering*, 4th ed. New Delhi, India: Tata McGraw-Hill, 2008.
5	Ever J. Barbero, *Finite Element Analysis of Composite Materials Using Abaqus*, 1st ed., CRC Press, 2013.
6	K. S. Ghosh, *Foundations of Corrosion Science and Engineering*, 1st ed. New Delhi, India: McGraw-Hill Education, 2012.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Introduction to materials science and engineering	Prof. Rajesh Prasad	IIT Delhi
	Course Link: https://nptel.ac.in/courses/113102080		
2	Materials Science	Prof. Satish V Kailas	IISc Bangalore
	Course Link: https://nptel.ac.in/courses/112108150		
3	Basics of Materials Engineering	Prof. Ratna Kumar Annabattula	IIT Madras
	Course Link: https://nptel.ac.in/courses/112106293		

Course Name:	**Mathematics-III**		
Course Code:	BS-M301	**Category:**	Basic Science Course
Semester:	Third	**Credit:**	3
L-T-P:	3–0–0	**Pre-Requisites:**	High School Mathematics, BS-M101, BS-M201
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05
Course Objectives:			
1	To understand probability distributions and their applications.		
2	To apply basic statistical methods and regression analysis for data interpretation.		
3	To use complex differentiation and integration techniques in engineering problems		
4	To study Bessel and Legendre functions and their applications in physical systems.		
5	To solve partial differential equations related to heat, wave, and Laplace equations		

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Probability Distribution:** (i) Introduction to probability theory (ii) Discrete and continuous random variable: Probability mass function (p.m.f.) and probability density function (p.d.f.) of single random variable; Cumulative distribution function (c.d.f.); Applications; (iii) Expectation and variance of random variable; **Some special types of distributions** (i) **Discrete probability distribution:** Binomial and Poisson distributions; Mean and variance; (ii)**Continuous probability distribution:** Uniform, Exponential and Normal distributions; Mean and variance.	8L
2	**Statistics:** **Measure of Central Tendency & Dispersion** (i) Statistical data and frequency distribution; (ii) Mean, Median and Mode; (iii)Variance and standard deviation. **Correlation & Regression** (i) Introduction to bivariate data; Scatter diagram; (ii) Correlation and Correlation Coefficient, Rank Correlation; (iii) Linear Regression and properties; (iv) Introduction to non-linear regression.	6L
3	**Calculus of Complex Variables:** (i) Function of complex variable; Limit, continuity and differentiability; (ii) Analytic function; Cauchy-Riemann equations (Statement only); Sufficient conditions for a function to be analytic; Harmonic function and Conjugate Harmonic function; Milne-Thomson Method; (iii) Zeros and singularities (iv) Cauchy's Theorem (statement only), Cauchy-Goursat Theorem (statement only); Cauchy's Integral Formula; (v) Taylor's and Laurent's series; (vi) Residues of a given function; Cauchy's Residue Theorem (statement only); evaluation of definite integrals involving sine and cosine.	10L
4	**Series Solution of Ordinary Differential Equations:** (i) Introduction to Series solution; Ordinary and Singular points; (ii) Bessel's equation; Bessel's function; Recurrence relations of Bessel's function of first kind; (iii) Legendre's equation; Legendre's Polynomials; Generating function and Orthogonal Properties; Recurrence relations; Rodrigue's Formula (statement only).	6L
5	**Solution of Partial Differential Equations:** (i) Brief introduction to PDEs; Types of PDEs; Solutions of PDE by Lagrange's Method; (ii) Solution of Boundary Value Problems by Method of Separation of Variables; (a) Two-dimensional Laplace equation; (b) One dimensional heat conduction equation; (c) One dimensional wave equation.	6L

Total	**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply the concepts of probability distributions to model random variables and solve engineering and scientific problems involving uncertainty.
2	Analyze data using basic statistical measures and regression analysis to interpret relationships between variables and support data-driven decision making.
3	Apply techniques of complex differentiation and integration to solve problems involving analytic functions and engineering applications.
4	Analyze and solve problems involving Bessel and Legendre functions, and apply these special functions in boundary-value and physical system problems.
5	Solve partial differential equations associated with heat, wave, and Laplace equations using appropriate analytical methods for engineering applications

Learning Resources:	
1	Erwin Kreyszig, *Advanced Engineering Mathematics*. New York, USA: John Wiley & Sons.
2	Michael D. Greenberg, *Advanced Engineering Mathematics*. India: Pearson Education.
3	B. S. Grewal, *Higher Engineering Mathematics*. New Delhi, India: Khanna Publishers.
4	N. G. Das, *Statistical Methods (Combined Volume)*. New Delhi, India: Tata McGraw-Hill.
5	Sheldon Ross, *A First Course in Probability*. India: Pearson Education.
6	William Feller, *An Introduction to Probability Theory and Its Applications*, Vol. 1. New York, USA: John Wiley & Sons.
7	N. P. Bali and Manish Goyal, *A Textbook of Engineering Mathematics*. New Delhi, India: Laxmi Publications, 2010.
8	M. D. Raisinghania, *Advanced Differential Equations*. New Delhi, India: S. Chand & Company.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Introduction to Probability Theory and Statistics	Prof. S Dharmaraja	IIT Delhi
	Course Link: https://nptel.ac.in/courses/111102160		
2	Probability and Statistics	Prof. Somesh Kumar	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/111105041		
3	First Course on Partial Differential Equations – I	Prof. A. K. Nandakumaran, Prof. P. S. Datti	IISc Bangalore
	Course Link: https://nptel.ac.in/courses/111108144		

Course Name:	**Thermodynamics and Thermal Engineering**		
Course Code:	PC-AUE301	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	High school Physics, Mathematics-I (BS-M101)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn about work and heat interactions, and the balance of energy between the system and its surroundings.
2	To learn about the application of the first and second laws of thermodynamics for various energy conversion devices.
3	To learn about gas and vapor cycles and their first law and second law efficiencies.
4	To evaluate the changes in the properties of substances in various processes.
5	To understand the refrigeration cycle and the air-conditioning system

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Fundamentals & Zeroth Law:** Concepts: Macroscopic vs. Microscopic; Continuum; Systems (Closed, Open, Isolated); State, Path, and Point functions; Thermodynamic Equilibrium. Zeroth Law: Equality of temperature; Thermometry scales; Ideal gas temperature scale.	3L+1T
2	**First Law of Thermodynamics:** Energy Interactions: Work transfer (displacement and other forms); Heat transfer; First Law for a Cycle and a Process. Closed Systems: Internal Energy (U) and Enthalpy (H); Specific Heats (C_p, C_v). Open Systems: Steady Flow Energy Equation (SFEE); Applications to Nozzles, Turbines, Compressors, and Heat Exchangers. Unsteady Flow: Filling and emptying of tanks	6L+2T
3	**Second Law & Entropy:** Statements: Kelvin-Planck and Clausius statements; Heat Engines, Refrigerators, and Heat Pumps; Carnot Cycle and Corollaries. Entropy: Clausius Inequality; Entropy changes for solids, liquids, and gases; Entropy generation (S_{gen}). Exergy (Availability): Available and Unavailable energy; Exergy of a process/cycle; Second Law Efficiency	8L+2T
4	**Pure Substances & Thermodynamic Relations:** Pure Substances: P–V, P–T, T–s diagrams; Triple point and Critical point; Steam Tables and Mollier Chart. Relations: Maxwell's Equations; Tds equations; Clausius-Clapeyron equation; Joule-Thomson coefficient.	5L+2T
5	**Vapor and Gas Power Cycles:** Vapor Cycles: Rankine Cycle; Reheat and Regenerative cycles; Feedwater heaters (Open/Closed); Binary cycles. Gas Power Cycles: Air-standard Otto, Diesel, and Dual cycles; Brayton Cycle (Gas Turbine) with Intercooling, Reheating, and Regeneration.	6L+2T

6	**Refrigeration, air conditioning & Psychrometry:** Refrigeration: Vapor Compression (VCR) and Absorption (VAR) systems; Refrigerants. Basic principles and types of air conditioning. Psychrometry: Properties of moist air; Psychometric chart; Cooling/Heating and Humidification/Dehumidification.	6L+2T
7	**Compressors:** Compressors: Reciprocating compressors; Volumetric efficiency; Multistage compression with intercooling.	2L+1T
Total:		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Resolve complex energy balance problems for steady and unsteady flow systems using SFEE.
2	Evaluate entropy generation and second-law efficiency for engineering devices using thermodynamic tables and charts
3	Evaluate the performance of energy conversion devices
4	Calculate psychometric properties and calculate air-conditioning requirements and compressible flow parameters for high-speed mechanical applications.

Learning Resources:	
1	P. K. Nag, *Engineering Thermodynamics*. New Delhi, India: Tata McGraw-Hill, 2018.
2	Richard E. Sonntag, Claus Borgnakke, and Gordon J. Van Wylen, *Fundamentals of Thermodynamics*. New York, USA: John Wiley & Sons, 2007.
3	Michael J. Moran and Howard N. Shapiro, *Fundamentals of Engineering Thermodynamics*. New York, USA: John Wiley & Sons, 1999.
4	J. B. Jones and R. E. Duggan, *Engineering Thermodynamics*. New Delhi, India: Prentice-Hall of India, 1996.
5	Merle C. Potter and Craig W. Somerton, *Schaum's Outline of Thermodynamics for Engineers*. New York, USA: McGraw-Hill, 2014.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Applied Thermodynamics	Prof. Niranjan Sahoo, Prof. Pranab Kumar Mondal	IIT Guwahati
	Course Link: https://nptel.ac.in/courses/112103307		
2	Basic Thermodynamics	Prof. Suman Chakraborty	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/112105123		
3	Laws of Thermodynamics	Prof. S.K Som, Prof. Suman Chakraborty	IIT Kharagpur

	Course Link: https://nptel.ac.in/courses/112105220		
4	Concepts of Thermodynamics	Prof. Suman Chakraborty, Prof. Aditya Bandopadhyay	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/112105266		

Course Name:	**Manufacturing Technology**		
Course Code:	PC-AUE302	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	4
L-T-P:	4-0-0	**Pre-Requisites:**	No-prerequisite
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To impart knowledge and train students with the basic principles, design aspects, defects, applications in the areas of metal casting, welding, forming, machining and additive manufacturing processes.
2	To enable students to apply their knowledge of metal casting, welding, forming, machining and additive manufacturing processes for solving complex problems

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Casting:** Introduction, Pattern making, Moulding, Melting, Pouring and Solidification; Casting design considerations; Estimation of pouring and solidification time; Casting processes: Sand, Centrifugal, Die, Investment, Shell mould, Lost foam; Casting defects and residual stresses.	10L
2	**Joining/fastening processes**: Physics of welding; Types of welding; Oxyfuel welding techniques; Arc welding processes: Shielded metal arc welding; GMAW (MIG), GTAW (TIG); Resistance welding: Spot, Seam, Butt, Projection, Percussion welding; Solid state welding: Friction welding, Friction-stir welding, Ultrasonic welding; Laser welding; Thermit welding; Estimation of heat input in welding processes; Brazing and soldering; Defects in welding.	12L
3	**Forming Processes:** Introduction to bulk and sheet metal forming; Plastic deformation and yield criteria; Fundamentals of hot and cold working processes; Basic principles, types, and load estimation for bulk forming (Forging, Rolling, Extrusion, Drawing) and sheet forming (Shearing, Deep drawing, Bending).	10L
4	**Conventional Machining processes:** Single and multi-point cutting tools; Orthogonal cutting, Various force components; Chip formation, Tool wear and tool life; Estimation of shear angle, shear stress, shear strain, velocity relationship, cutting force and tool life; cutting tool materials, cutting fluids, Surface finish, and Machinability; General principles of working and commonly performed operations in the following machines: Lathe, Shaper, Milling, Drilling, and Grinding machine; Estimation of machining time and Material removal rate.	12L

5	**Additive Manufacturing Processes:** Extrusion; Vat polymerization, Powder bed fusion; Material jetting; Binder jetting; Direct energy deposition and Sheet lamination processes.	4L
Total:		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain basic principles and methods of casting, welding, forming, machining (conventional and nonconventional), and additive manufacturing processes.
2	Interpret different process parameters and relationships among those parameters for casting, welding, forming, and machining (conventional and nonconventional).
3	Solve problems related to casting, welding, forming, and machining processes using standard methods.
4	Analysing different subsystems of casting, welding, forming, and machining processes.

Learning Resources:	
1	Mikell P. Groover, *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*. New Delhi, India: Wiley India, 2018.
2	J. T. Black and Ronald A. Kohser, *DeGarmo's Materials and Processes in Manufacturing*, SI ed. New Delhi, India: Wiley India, 2017.
3	Serope Kalpakjian and Steven R. Schmid, *Manufacturing Processes for Engineering Materials*, 5th ed. India: Pearson India, 2014.
4	P. N. Rao, *Manufacturing Technology: Foundry, Forming and Welding*, vol. 1, 5th ed. New Delhi, India: Tata McGraw-Hill, 2018.
5	P. N. Rao, *Manufacturing Technology: Metal Cutting and Machine Tools*, vol. 2, 5th ed. New Delhi, India: Tata McGraw-Hill, 2018.
6	Amitabha Ghosh and Ashok Kumar Mallick, *Manufacturing Science*, 2nd ed. New Delhi, India: East-West Press Pvt. Ltd., 2010.
7	Sabrie Soloman, *3D Printing and Design*. New Delhi, India: Khanna Publishing House, 2020.
8	A. B. Chattopadhyay, *Machining and Machine Tools*, 2nd ed. New Delhi, India: Wiley, 2017.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Fundamentals of Manufacturing Processes	Prof. D. K. Dwivedi, Prof. Shamik Basak	IIT Roorkee
	Course Link: https://nptel.ac.in/courses/112107219		

Course Name:	**Automotive Engines**		
Course Code:	PC-AUE 303	**Category:**	Professional Core Courses

Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Engineering Thermodynamics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To familiarize with the terminology associated with IC engines
2	To understand the basics of IC engines
3	To understand combustion, and various parameters and variables affecting it in various types of IC engines
4	To learn about various systems used in IC engines and the type of IC engine required for various applications

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Basic air standard cycle Otto, Diesel & dual fuel cycle, comparison between Otto, Diesel and Dual fuel cycles. Basic Concepts: Air standard cycles and fuel-air cycles. Assumptions, Valve Timing diagram, Actual engine cycle.	3L
2	**Engine Construction:** Construction and working of 4-stroke SI and CI Engine, Comparison between SI and CI engines, SI and CI engine fuel rating, octane number and cetane number, SI and CI Engine fuel properties, Alternative fuels (Alcohol, Biogas, Hydrogen, CNG, LPG).	3L
3	**SI Engine:** Theory of Carburetion, Types of carburetors, electronic fuel injection system, GDI. Combustion in spark Ignition engines, stages of combustion, flame propagation, rate of pressure rise, and abnormal combustion. Phenomenon of Detonation in SI engines, effect of engine variables on Detonation. Combustion Chambers. Rating of fuels in SI engines and additives.	5L
4	**CI Engine:** Fuel supply system, types of fuel pump, injector and distribution system, Combustion in compression ignition engines, stages of combustion, factors affecting combustion, Phenomenon of knocking in CI engine. Effect of knocking, Types of combustion chambers, rating of fuels in CI engines. Additives Comparison of knocking in SI & CI engines, Concepts of Supercharging and Turbocharging.	5L
5	**Engine systems and components:** Ignition system (battery, magneto & electronic); Lubrication system; Engine starting system; Engine cooling system; Governing system (quality and quantity hit & miss governing); Intake and exhaust systems (two valves & four valves); Drive train (cam shaft, valves, etc.). Variable valve timing, HCCI, PCCI engine	5L
6	**Fuels and Emissions:** Chemical structure of the Petroleum, Refining process for petroleum, important qualities of the Engine fuels- (SI & CI engines), Diesel, and Gasoline fuels, Indian specifications. Alternate fuels (SI & CI engines)- Liquid fuels, gaseous fuels (LPG, NG, CNG), hydrogen and emulsified fuel. Air pollution due to IC engine, Engine emissions, Hydrocarbon emissions, (HC) &	7L

	PM & Carbon monoxide emissions (CO), oxides of Nitrogen (NOx) Euro norms, Bharat stage norms, Introduction to EDC and IDC, Introduction to carbon credit, Emission control methods for SI and CI engines, electronic control module, Catalytic converters, EGR Concept of hybrid vehicles.	
7	**Cooling and Lubrication System:** Need for a cooling system. Types of cooling systems: Liquid-cooled system, Thermosyphon system, Pressure-cooling system. Lubrication systems: Mist, Wet sump, and dry sump. Properties of lubricants. Properties of coolants.	4L
8	**Performance characteristics & Testing of I.C. Engines:** Introduction to Indian. Standards for testing of I.C. Engine, mean effective pressure, indicated power, brake power, friction power, Methods to determine power and efficiencies, Variables affecting performance of engine, characteristic curves, heat balance sheet, Methods of improving engine performance; super & turbocharged engines.	4L
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Know the basics of IC engines and the influence of the different parameters on the operational characteristics of IC Engines
2	Understand the fundamentals of various automotive Engine and their construction details.
3	Understand the operation of the automotive engine and the importance of the vehicle.

Learning Resources:	
1	V. Ganesan, *Internal Combustion Engines*, 3rd ed. New Delhi, India: Tata McGraw-Hill, 2007.
2	Edward F. Obert, *Internal Combustion Engines and Air Pollution*. New York, USA: Harper & Row, 1973.
3	Heinz Heisler, *Advanced Engine Technology*. London, UK: Edward Arnold, 1995.
4	John B. Heywood, *Internal Combustion Engine Fundamentals*. New York, USA: McGraw-Hill, 1989.
5	Philip M. Heldt, *High Speed Combustion Engines*. New Delhi, India: Oxford & IBH Publishing Co., 1985.
6	Martin W. Stockel, Thomas S. Stockel, and Chris Johanson, *Auto Fundamentals*. Illinois, USA: The Goodheart-Wilcox Co. Inc., 1996.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	IC Engines and Gas Turbines	Prof. Pranab K. Mondal, Prof. Vinayak N. Kulkarni	IIT Guwahati
	Course Link: https://nptel.ac.in/courses/112103262		

Course Name:	**Machine Drawing**		
Course Code:	PC-AUE391	**Category:**	Professional Core courses

Semester:	Third	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	No prerequisite
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Assembly and detailed drawings of a mechanical assembly, such as a simple gearbox, flange coupling, welded bracket joined by a stud bolt onto a structure, etc.
2	Practicing AutoCAD or similar graphics software and making orthographic and isometric projections of different components.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Schematic product symbols for standard components in mechanical, electrical, and electronic systems, welding symbols, and pipe joints;	6P
2	Orthographic projections of machine elements, different sectional views, full, auxiliary sections; Isometric projection of components;	6P
3	Assembly and detailed drawings of a mechanical assembly, such as a Plummer block, tool head of a shaping machine, tail stock of a lathe, simple gearbox,	6P
4	Flange coupling, welded bracket joined by a stud bolt onto a structure, welded pipe joints indicating work parts before welding, etc.	6P
5	Practicing AutoCAD or similar graphics software and making orthographic and isometric projections of different components.	12P
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe schematic product symbols for standard components in mechanical, electrical, and electronic systems, welding symbols, and pipe joints
2	Explain orthographic projections of machine elements, different sectional views, and the isometric projection of components.
3	Assemble different machine elements such as a Plummer block, the tool head of a shaping machine, the tailstock of a lathe, and welded pipe joints, indicating work parts before welding.

Learning Resources:

1. K. L. Narayana and K. Kannaiah, *Textbook of Engineering Drawing*. New Delhi, India: Scitech Publications.
2. S. Pal and M. Bhattacharyya, *Mechanical Engineering Drawing and Design*.
3. N. D. Bhatt, *Machine Drawing*. New Delhi, India: Charotar Publishing House.

4	P. S. Gill, *Machine Drawing*. New Delhi, India: S. K. Kataria & Sons.
5	K. Venugopal, *Engineering Drawing and Graphics with AutoCAD*. New Delhi, India: New Age International.
6	D. A. Jolhe, *Engineering Drawing with an Introduction to AutoCAD*. New Delhi, India: Tata McGraw-Hill.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Engineering drawing and computer graphics	Prof. Rajaram Lakka Raju	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/112105294		
2	Computer-Aided Design and Manufacturing	Prof. Anoop Chawla, Prof. P.V. Madhusudan Rao	IIT Delhi
	Course Link: https://nptel.ac.in/courses/112102101		

Course Name:	**Manufacturing and Testing Laboratory**		
Course Code:	PC-AUE392	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	No prerequisite
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To study the characteristics of material.
2	Interpret different engineering material properties.
3	Identify different manufacturing technique
4	Translate suitable testing for proper application.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Impact tests: Charpy or Izod tests.	3P
2	Fatigue test of a steel sample.	3P
3	Experiments on friction: determination of coefficient of friction.	3P
4	Determination of yield strength, ultimate strength, modulus of elasticity, percentage elongation and percentage reduction in areas.	3P
5	Macro hardness test (Rockwell and Brinell).	3P

6	Test for drawability of sheet metals through cupping test.	3P
7	Heat treatment and microstructure characterization of steel.	3P
8	Sand preparation and testing: specimen preparation for testing permeability, clay content, grain fineness number, moisture content, green compression strength, green shear strength, splitting strength, hardness, etc.	3P
9	Casting of metals after preparation of a suitable type mould; Experiments on properties of post casting, fettling, cleaning, deburring, and polishing operations	3P
10	Practicing smithy or forging of carbon steels and testing for its property changes;	3P
11	Laboratory experiments in Fabrication processes to observe effects of varying process parameters in GMAW	3P
12	Machining of Gear using milling machine.	3P
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	fulfill team roles assigned & communicate effectively.
2	compute stress, strains and deformation of engineering materials.
3	examine properties of mould material in casting.
4	attain basic knowledge on pattern, Gear making.

Learning Resources:	
1	Debabrata Nag and Abhijit Chanda, *Fundamentals of Strength of Materials*. New Delhi, India: Wiley India, 2010.
2	William D. Callister Jr., *Materials Science and Engineering: An Introduction*, 6th ed. New Delhi, India: Wiley India, 2006.
3	Serope Kalpakjian and Steven R. Schmid, *Manufacturing Processes for Engineering Materials*, 7th ed. India: Pearson India, 2014.
4	William F. Smith, *Materials Science and Engineering*, 4th ed. New Delhi, India: Tata McGraw-Hill, 2008.
5	Mikell P. Groover, *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*, 4th ed. New Delhi, India: Wiley, 2010.

Experiments that may be performed through Virtual Labs:

Sl. No.	Experiment Name	Experiment Link(s)
1	Impact tests: Izod tests	https://sm-nitk.vlabs.ac.in/exp/izod-impact-test/
2	Impact tests: Charpy tests.	https://sm-nitk.vlabs.ac.in/exp/charpy-impact-test/
3	Brinell Hardness Test	https://sm-nitk.vlabs.ac.in/exp/brinell-hardness-test/

4	Rockwell Hardness Test	https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test/
5	Determination of yield strength, ultimate strength, modulus of elasticity, percentage elongation and percentage reduction in areas.	https://sm-nitk.vlabs.ac.in/exp/tensile-test-mild-steel/ https://sm-nitk.vlabs.ac.in/exp/tensile-test-cast-iron/

Course Name:	**Environmental Science**		
Course Code:	AU-BS371	**Category:**	Basic Science Courses
Semester:	Third	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	10 + 2
Full Marks:	100		
Examination Scheme:	Teacher Assessment: 70 (30 + 40)	Participation in Events: 15	Attendance: 15

Course Objectives:

1	To solve various engineering problems applying ecosystem to produce eco-friendly products.
2	To use relevant air, noise, water and soil control method to solve domestic and industrial problems.
3	To recognize relevant energy sources required for domestic and industrial applications.
4	To solve local solid and e-waste problems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Ecosystem:** Structure of ecosystem, Food chain and food web, Aquatic and terrestrial ecosystem, Carbon, Nitrogen, Sulphur and Phosphorous cycle, Depletion of ozone.	2L
2	**Environmental Degradation:** Air Pollution: Natural and manmade sources of air pollution, Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator) Noise Pollution: Sources and effects of pollution, measurement of pollution level, Noise pollution Rules-2000 Water Pollution: Types of water pollutants, BOD and COD, Waste Water Treatment (Primary, Secondary and Tertiary methods). Soil Pollution: Causes, Effects and Preventive measures of soil pollution, E- waste, Plastic waste	7L
3	**Renewable sources of Energy:** Solar Energy: Basics of Solar energy, Solar Pond, Solar water heater, solar dryer, Solar stills. Biomass: Biogas production mechanism, Utilization and storage of biogas. Wind Energy: Current status and future prospects of wind energy. New Energy sources: Hydrogen energy, Ocean energy resources, Tidal energy conversion.	7L

4	**Solid Waste Management, ISO 14000 & Environmental Management:** Solid waste: Municipal solid waste, Biomedical waste, Metallic and Non-metallic wastes, Hazardous waste, Collection and disposal of municipal solid waste, Waste to wealth Concept of carbon footprint Environmental management in fabrication industry ISO14000: Implementation in industries, Benefits.	8L
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco-friendly products.
2	Analyse the air, water, soil and noise pollution, and control measures and acts.
3	Understand different renewable energy resources and efficient process of harvesting.
4	Understand solid waste management, ISO 14000 & Environmental Management.

Learning Resources:	
1	D. De & D. De, *Fundamentals of Environment and Ecology,* S Chand Publication
2	E. Bharucha, *Text Book of Environmental Studies,* Byju's
3	S. C. Sharma and M. P. Poonia, *Environmental Studies*, Khanna Book Publishing
4	M. Basu, *Environmental Studies,* Cambridge University Press
5	A. Vieira & D. Rosa, *Fundamentals of renewable energy processes*, Academic Press Inc
6	F. Kreith and J. F. Kreider, *Principles Solar Engineering,* CRC Press.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Environmental Science	Prof. Shamik Chowdhury, Prof. Sudha Goel	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/109105203		
2	Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts	Prof. Brajesh K Dubey	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/127105018		

Detailed Curriculum for Minor Degree under Department of Automobile Engineering (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus of 3rd semester for Minor Degree

No Minor paper in 3rd Semester