

**DR. A. P. J. ABDUL KALAM TECHNICAL
UNIVERSITY
LUCKNOW, UTTAR PRADESH**



COURSE STRUCTURE/EVALUATION SCHEME

FOR

B.TECH. 4th YEAR

AUTOMOBILE ENGINEERING

[Effective from Session: 2025-26]

B. Tech.
Automobile Engineering
Evaluation Scheme
[Effective from Session: 2025-26]

SEMESTER- VII														
S. No.	Code	Subject	Learning Mode	LTP			Evaluation Scheme						Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BME701	Measurement & Metrology	Offline	3	-	-	20	10	30	-	70	-	100	3
2	BME070	Departmental Elective-IV	Offline	3	-	-	20	10	30	-	70	-	100	3
4	BOEM**	Open Elective-II	Offline/MOOCs	3	0	0	20	10	30	-	70	-	100	3
5	BME751	Measurement & Metrology Lab	Offline	0	0	2	-	-	-	50	-	50	100	1
6	BME752	Mini Project or Internship Assessment*		0	0	4	-	-	-	100	-	-	100	2
7	BME753	Project-1		0	0	10	-	-	-	150	-	-	150	5
8	BME754	Startup and Entrepreneurial Activity Assessment#		0	0	4	-	-	-	100	-	-	100	2
		Total		9	0	20							750	19
		*The Mini Project or internship (5-6 weeks) conducted during summer break after VI semester and will be assessed during VII semester. # The Startup and Entrepreneurial Activity Assessment will be done in 7 th semester under which a student will have to undergo a startup/entrepreneurship activity of at least 60 hours till 6 th semester.												

SEMESTER- VIII														
S. No	Code	Subject	Learning Mode	Periods			Evaluation Scheme				End Semester		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BOEM**	Open Elective-III	MOOCs	3	0	0	20	10	30	-	70	-	100	3
2	BOEM**	Open Elective-IV	MOOCs	3	0	0	20	10	30	-	70	-	100	3
3	BME851	Project-II		0	0	18				100		350	450	10
		Total		6	0	18	24						650	16

The Internal Assessment of MOOCs will be done by the respective institute and the external Assessment (End Semester Examination) will be done by the University)

Departmental Electives

		Specialization-1	Specialization-2	Specialization-3	Specialization-4
Semester	Specialization	Manufacturing & Automation	Thermal Engineering	Design Engineering	Automotive Systems
VII	Departmental Elective-IV	BAU072	BAU073	BAU074	BAU075
		Manufacturing Process of Automotive Components	Combustion Thermodynamics and Heat Transfer	Vehicle Architecture and Packaging	Vehicle Dynamics, Emission and Control

Subject Code: BME701	Measurement & Metrology	L T P : 3 0 0	Credits: 3
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Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Explain the basics knowledge of measurements. and also develop competence in sensors, transducers	K2
CO 2	Understand and able to use various devices for measuring, strain, Pressure and time related equipment.	K2
CO 3	Understand and able to use various devices for measuring, Flow, Temperature, Force & Torque.	K2
CO 4	Explain the basics knowledge of metrology & Inspection.	K2
CO 5	Understand the fundamentals of various methods for the measurements of surface roughness parameters and working of optical measuring instruments.	K2

UNIT I

Mechanical Measurements: Introduction to measurement and measuring instruments. General concept– Generalized measurement system and its elements-Unit sand standards- measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response- repeatability-systematic, Source of error, statistical analysis of error and random errors- correction, calibration. Dimensional and geometric tolerance

Sensors and Transducers: Types of sensors, types of transducers and their characteristics.

UNIT II

Time Related Measurements: Stroboscope, frequency measurement by direct comparison. Measurement of displacement

Measurement of Pressure: Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures (high vacuum).

Strain Measurement: Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration.

UNIT III

Flow Measurement: Hot Wire Anemometry, Laser Doppler Velocimetry, Rotameter.

Temperature Measurement: Thermometers, bimetallic thermocouples, thermistors and pyrometers.

Measurements of Force & Torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems. Seismic instruments.

UNIT IV

Metrology and Inspection: Standards of linear measurement, line and end standards. Interchange ability and standardization. Linear and angular measurements devices and systems

Comparators: Sigma, Johansson's Microkrator, Limit gauges classification, Taylor's Principle of Gauge Design.

UNIT-V

Limits, Fits &Tolerance and Surface roughness: Introduction to Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness. Measurement of geometric forms like straightness, flatness, roundness. Tool makers microscope, profile projector, autocollimator.

Interferometry: principle and use of interferometry, optical flat. Measurement of screw threads and gears. Surface texture: quantitative evaluation of surface roughness and its measurement.

Books and References:

1. Experimental Methods for Engineers by Holman, MCGRAW HILL INDIA
2. Mechanical Measurements by Beckwith, Pearson
3. Principles of Measurement Systems by Bentley, Pearson
4. Metrology of Measurements by Bewoor and Kulkarni, MCGRAW HILL INDIA
5. Measurement Systems, Application Design by Doeblein, MCGRAW HILL INDIA
6. Hume KJ, "Engineering Metrology", MacDonald and Co
7. Jain, RK, "Engineering Metrology" Khanna Publishers
8. Jain, R.K., "Mechanical Measurement" Khanna Publishers
9. Gupta SC, Engineering Metrology, Dhanpat Rai Publications

Departmental Elective – IV

Subject Code: BAU072	Manufacturing Process of Automotive Components	L T P: 3 0 0	Credits: 3
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Course Outcome: Student will be able to		Bloom Taxonomy
CO1	Understand powder metallurgy processes and applications in manufacturing clutch and brake components.	K2
CO2	Apply forging, extrusion, and hydroforming techniques in producing automotive components.	K3
CO3	Analyze casting and machining processes for key engine and drive train components.	K3
CO4	Understand gear production methods and perform gear finishing and inspection processes.	K2
CO5	Understand advanced manufacturing techniques and materials used in modern automotive components.	K2

UNIT I

Powder Metallurgy

Process flow chart - Production of metal powders and their raw materials - Manufacture of friction lining materials for clutches and brakes - Testing and inspection of PM parts.

UNIT II

Forming Process

Forging - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, foot brake linkage, steering knuckles. Extrusions: Basic Process steps, extrusion of transmission shaft, steering worm blanks, brake anchor pins, rear axle drive shaft, axle housing spindles, piston pin and valve tappets. Hydro forming: Process, hydro forming of manifold and comparison with conventional methods - Hydro forming of tail Lamp housing. Stretch forming - Process, stretch forming of auto body panels - Super plastic alloys for auto body panels.

UNIT III

Casting and Machining

Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes and liners, permanent mould casting of piston, pressure die casting of carburetor and other small auto parts. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins - piston rings - valves - front and rear axle housings - flywheel - Honing of cylinder bores - copy turning and profile grinding machines.

UNIT IV

Gear Manufacturing

Gear milling, Hobbing and shaping - Gear finishing and inspection.

UNIT V

Recent Trends in Manufacturing of Auto Components

Powder injection molding - Shot peen hardening of gears - Production of aluminum MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming - Squeeze casting of pistons - aluminum composite brake rotors. Friction welding of Dissimilar

metal components.

Books and References:

1. Heldt.P.M., High Speed Combustion Engines, Oxford publishing co., New York, 2010.
2. Haslehurst.S.E., Manufacturing Technology, ELBS, London, 2010.
3. Rusinoff., Forging and forming of metals, D.B, Taraporevla Son & co Pvt ltd, Mumbai, 2005
4. Sabroff.A.M. & Others, Forging Materials & Processes, Reinhold Book Corporation, NewYork, 2008
5. Upton, Pressure Die Casting, Pergamon Press, 1985.
6. High Velocity Forming of metals, ASTM, Prentice Hall of India (P) Ltd., New Delhi, 2010.

Departmental Elective – IV

Subject Code: BAU073	Combustion Thermodynamics and Heat Transfer	L T P: 3 0 0	Credits: 3
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Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Understand thermodynamic principles to analyze combustion and spray processes in IC engines.	K2
CO 2	Understand chemical kinetics and reaction mechanisms governing combustion in engines.	K2
CO 3	Analyze flame types, propagation characteristics, and ignition phenomena in combustion systems.	K3
CO 4	Examine heat transfer processes and temperature distribution in engine components.	K3
CO 5	Apply advanced sensors and diagnostic tools for in-cylinder combustion and flow analysis.	K3

UNIT I

Thermodynamics of Combustion

Combustion process in IC engines-Premixed -diffusion. First and Second Law of Thermodynamics applied to combustion – combustion Stoichiometry- chemical equilibrium- spray formation -droplet combustion.

UNIT II

Chemical Kinetics of Combustion

Combustion kinetics, rate of reaction, equation of Arrhenius, activation energy, Chemical thermodynamic model for Normal Combustion.

UNIT III

Flames

Laminar–premixed-diffusion flames–flame speed correlations–quenching- flammability. Ignition-flame stabilization- turbulent premixed, diffusion flames – Damkohler number.

UNIT IV

Heat Transfer in IC Engines

Engine heat transfer-heat Balance. Measurement of instantaneous heat transfer rate. Heat transfer modelling. Heat transfer coefficients- radiative heat transfer. Temperature measurement in Piston-Cylinder-Cylinder Head-liner-valves.

UNIT V

Instrumentation

Pressure sensors-piezoelectric pickup-crank angle encoder-thermocouples. Hot wire anemometer-laser Doppler anemometry and velocimetry for flow and combustion analysis in IC engines. In- cylinder pressure measurement and Rate of heat release calculation.

Books and References:

1. John. B. Heywood, 'Internal Combustion Engines'', Tata McGraw Hill Co., Newyork, 1988.
2. Ashley Campbel, "Thermodynamic analysis of combustion engine", john book company, New York,

1979.

3. Ganesan. V. "Computer Simulation of Spark Ignition Engine Process", Wiley eastern India ltd, 1996.
4. Irvin Glasman, "Combustion" Academic Press, London, 1987, ISBN 0-12-285851-4.
5. J.I. Ramos, "Modeling of Internal Combustion Engine", McGraw hill book company New York 1990.
6. John. B. Heywood, "Internal Combustion Engines", Tata McGraw Hill Co., New York, 1988.
7. Spalding.D.B., "Some fundamentals of Combustion", Butterworth Science Publications, London, 1985.
8. Taylor.E.F. "The Internal Combustion Engine", International Text Book Co., Pennsylvania, 1982.

Departmental Elective – IV

Subject Code: BAU074	Vehicle Architecture and Packaging	L T P: 3 0 0	Credits: 3
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Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Apply CAM and automation concepts in automotive manufacturing.	K3
CO 2	Understand automotive production using CAPP, MRP, and ERP tools.	K2
CO 3	Apply GT and cellular manufacturing for efficient auto component production.	K3
CO 4	Analyze FMS and AGVS applications in automobile manufacturing.	K4
CO 5	Understand robot systems used in automotive production processes.	K2

UNIT-I

Brief introduction to CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerized elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance– Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

Unit-II

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

Unit-III

Group Technology (GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

Unit-IV

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application Vehicle Guidance technology –Vehicle Management & Safety.

Unit-V

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

Books and References

1. Mikell.P.Groover, “Automation, Production Systems and Computer Integrated Manufacturing,” Prentice Hall of India, 2008.
2. Radhakrishnan P, SubramanyanS.andRaju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.
3. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India,2003.
4. Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach” Chapman & Hall, London, 1995.
5. Rao. P, N Tiwari&T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill, Publishing Company, 2000.

Departmental Elective – IV

Subject Code: BAU075	Vehicle Dynamics, Emission and Control	L T P: 3 0 0	Credits: 3
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Course Outcome: Student will be able to		Bloom Taxonomy
CO1	Analyze vehicle performance under steady and transient conditions considering external forces and dynamic effects.	K3
CO2	Understand cornering behavior and ride dynamics based on suspension and handling characteristics.	K2
CO3	Analyze vehicle vibrations using single and multi-degree-of-freedom systems.	K3
CO4	Understand combustion processes and emission formation in SI and CI engines.	K2
CO5	Apply emission control techniques and measurement methods in compliance with automotive regulations.	K3

UNIT-I

Performance Characteristics of Road Vehicles:

Steady State Operation: Various external forces acting on vehicle, Nature of the forces and factors affecting the forces, Tractive effort & Power available from the engine, Equation of motion, Maximum tractive effort, Weight distribution, Stability of vehicle on slope, Road performance curves, Acceleration, Gradability & Drawbar Pull.

Transient Operation: Inertia effect, Equivalent mass, Equivalent moment of inertia, Equivalent ungeared system, Time to produce synchronizing during gear change, Effect of engine flywheel on acceleration, Dynamics of vehicles on Banked tracks, Gyroscopic Effects, Net driving power.

UNIT II

Handling Characteristics:

Low speed cornering, High speed cornering, Cornering equations, Understeer gradient, Static margin, Suspension effects on cornering, Experimental measurements of understeer gradient.

Ride Characteristics:

Ride dynamic system, Excitation sources, Vehicle suspension properties, Suspension isolation, Suspension stiffness, Suspension damping, Suspension non linearities, Active control, Wheel hop resonances, Rigid body bounce/pitch motions, bounce/pitch frequencies, Olley criterion, dynamic index.

UNIT III

Concept of Vibration:

Definitions, Modelling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility, Vibration absorber, Vibration measuring instruments.

UNIT IV

SI engine Combustion and Pollutant Formation:

Chemistry of SI engine Combustion, HC and CO formation in 4 stroke and 2 stroke SI engines, NO formation in SI Engines, Effect of operating variables on emission formation.

CI engine Combustion and Emissions:

Basic of diesel combustion-Smoke emission in diesel engines-Particulate emission in diesel engines, Colour and aldehyde emissions from diesel engines, Effect of operating variables on emission formation.

UNIT V

Control Techniques for SI and CI:

Design changes, optimization of operating factors, exhaust gas re-circulation, fumigation, air injector PCV system-Exhaust treatment in SI engines-Thermal Reactors-Catalytic converters, Catalysts, Use of unleaded petrol.

Emission Measurement, Test procedures & regulations:

Test cycles for light & medium duty vehicles, test procedure for evaporative emissions, Emission standards for light and heavy-duty vehicles & motor cycle emission standard. NDIR analysers, FID, Chemiluminescence, NO_x analyser, oxygen analyser, smoke measurement, constant volume sampling, and particulate emission measurement.

Text Books:

1. Gillespie T. D. (1992), Fundamentals of Vehicle Dynamics, SAE International.
2. Wong J. Y. (1979), Theory of Ground Vehicles, Willey & Sons.
3. Springer and Patterson, Engine Emission, Plenum Press, 1990.
4. Ganesan V., "Internal Combustion Engines", Tata McGraw Hill Co., 1994.
5. Pacejka H. B. (2012), Tyre and Vehicle Dynamics, Butterworth Hienmann.
6. N. K. Giri (2004), Automotive Mechanics, Khanna Publishers, 9th Edition.
7. Rajamani Rajesh (2011), Vehicle Dynamics and Control, Springer.
8. Obert. E. F., "Internal Combustion Engines", 1982.
9. Taylor C.F., "Internal Combustion Engines", MIT Press, 1972.
10. Heywood. J.B., "Internal Combustion Engine Fundamentals", McGraw Hill Book Co., 1995.
11. E. F. Oberts, "Internal Combustion Engine and Air Pollution", Harper & Row Publisher, NY

Subject Code: BME751	Measurement & Metrology Lab	L T P : 0 0 2	Credits: 1
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Course Outcome : Student will be able to		Bloom Taxonomy
CO1	Understand the basic principles of instrumentation for measurement of surface finish, strain, temperature, pressure and flow.	K2
CO2	Understand the principle and operation of Coordinate Measuring Machine (CMM).	K2
CO3	Apply Sine Bar, Slip Gauges, Bevel Protractor, Stroboscope, Dial Indicator etc. for measurement of different attributes.	K3
CO4	Apply the basic concepts of limits, fits & tolerances for selective assembly.	K3

List of Experiments

Minimum 08 experiments out of following (or such experiment) are to be performed:

1. Measurement of effective diameter of a screw thread using 3 wire method.
2. Measurement of angle using sine bar & slip gauges.
3. Study of limit gauges.
4. Study & angular measurement using Bevel protector.
5. Study of different types of Comparators.
6. Study of important parameters of surface finish.
7. Study of principle and operation of coordinate-measuring machine (CMM).
8. Use of dial indicator and V Block to check the circularity and plot the polar Graph.
9. Study and understanding of limits, fits & tolerances in assembly of machine components.
10. Study and understanding of different methods of measurement of pressure.
11. Study and understanding of different methods of measurement of temperature.
12. Study and understanding of measurement of strain using strain gauges.
13. Study and understanding of different methods of measurement of flow.
14. Study and understanding of different methods of measurement of vibration/power.
15. Study and understanding of measurement of displacement using LVDT.