

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



**STUDY & EVALUATION SCHEME WITH SYLLABUS**

**FOR**

**B. TECH. 4<sup>th</sup> YEAR**

**AUTOMOBILE ENGINEERING**

**[Effective from Session: 2021-22]**

**B. Tech Automobile Engineering  
Evaluation Scheme  
Effective from Session 2021-22**

<b>SEMESTER- VII</b>													
Sl. No.	Code	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1		HSMC-1/HSMC-2	3	0	0	30	20	50		100		150	3
2	KAU 071 - 072	Departmental Elective-IV	3	0	0	30	20	50		100		150	3
3	KAU 073 - 074	Departmental Elective-V	3	0	0	30	20	50		100		150	3
4		Open Elective-II	3	0	0	30	20	50		100		150	3
5	KME 751	Measurement & Metrology Lab	0	0	2				25		25	50	1
6	KAU 751	Mini Project or Internship Assessment*	0	0	2				50			50	1
7	KAU 752	Project	0	0	8				150			150	4
8		MOOCs (Essential for Hons. Degree)											
		<b>Total</b>	<b>9</b>	<b>0</b>	<b>12</b>	<b>21</b>						<b>850</b>	<b>18</b>

\*The Mini Project or internship (5 - 6 weeks) conducted during summer break after VI semester and will be assessed during VII semester.

<b>SEMESTER- VIII</b>													
Sl. No.	Code	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1		HSMC-2/HSMC-1	3	0	0	30	20	50		100		150	3
2		Open Elective-III	3	0	0	30	20	50		100		150	3
3		Open Elective-IV	3	0	0	30	20	50		100		150	3
4	KAU 851	Project	0	0	18				100		300	400	9
5		MOOCs (Essential for Hons. Degree)											
		<b>Total</b>	<b>9</b>	<b>0</b>	<b>18</b>							<b>850</b>	<b>18</b>

Students can choose any elective horizontally from the pool of electives.

<b>Departmental Elective-IV</b>	KAU 071	Automotive Pollution and Control	KAU 072	Hybrid Vehicle Propulsion
<b>Departmental Elective-V</b>	KAU 073	Vehicle Body Engineering & safety	KAU 074	Trouble Shooting, Service & Maintenance Repair

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<b>Subject Code: KME 751</b>	<b>Measurement &amp; Metrology Lab</b>	<b>L T P : 0 0 2</b>	<b>Credits: 1</b>
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<b>Course Outcome (CO):</b> The Students will be able to		<b>Bloom Taxonomy</b>
<b>CO-1</b>	Understand the basic principles of instrumentation for measurement of surface finish, strain, temperature, pressure and flow.	K2
<b>CO-2</b>	Understand the principle and operation of Coordinate Measuring Machine (CMM).	K2
<b>CO-3</b>	Apply Sine Bar, Slip Gauges, Bevel Protractor, Stroboscope, Dial Indicator etc. for measurement of different attributes.	K3
<b>CO-4</b>	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.

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**Semester – VII: Departmental Elective – IV: Specialization – Automobile Engineering**

<b>Subject Code: KAU 071</b>	<b>Automotive Pollution and Control</b>	<b>L T P : 3 0 0</b>	<b>Credits: 3</b>
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<b>The students will be able to</b>		<b>Blooms Taxonomy</b>
<b>CO-1</b>	Understand formation of various type engine emissions, their effect on human health & environment and protocols for controlling carbon emissions.	K2
<b>CO-2</b>	Understand the types of emissions from spark and compression ignition engines.	K2
<b>CO-3</b>	Understand the different technologies used in SI and CI engines for reducing engine emissions.	K2
<b>CO-4</b>	Understand various after-treatment devices used for reducing tail pipe emissions according to Bharat Stage norms for various categories of vehicles.	K2
<b>CO-5</b>	Understand various emission standard procedures used for testing the emissions from various categories of vehicles.	K2
<b>CO-6</b>	Understand the various equipments used for measurement of exhaust emissions.	K2

**Unit I****(8 Hours)****Engine emissions and air pollution**

Constituents of engine exhaust responsible for air pollution and their effect on human health, ozone layer depletion and global warming, Photochemical smog, greenhouse gases, Kyoto protocol and carbon trading.

**Formation of Pollutants**

Combustion generated and other pollutants, general mechanisms and kinetics of formation of carbon-monoxide, unburnt hydrocarbon, oxides of nitrogen and particulate matter due to combustion, effect of air-fuel ratio on emissions, Zeldovitch mechanism for formation of NO<sub>x</sub>, soot and smoke formation. NO<sub>x</sub> particulate trade-off.

**Unit II****(7 Hours)****Emissions from Spark ignition engines**

Types of emission form spark ignition engines, importance of mixture formation, lean and rich mixture, study of various mechanism of formation of unburnt hydrocarbon, effect of various design and operating variables on formation of CO, UBHC and NO<sub>x</sub>.

Discussion on different technologies used for reducing engine out emissions from a spark ignition engine, gasoline port injection and gasoline direct injection, Evaporative emissions and their control, HCCI operation of Gasoline engines.

**Unit III****(7 Hours)****Emissions from Compression Ignition engines**

Types of emissions from compression ignition engine, effect of various design and operating variables on formation of NO<sub>x</sub>, smoke and particulate matter.

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Discussion of various technologies for reducing engine out emissions from a compression ignition engine such as turbo charging, inter-cooling, fuel injection pressure, injection timing retard, exhaust gas recirculation, HCCI operation of Diesel engines.

#### **Unit IV**

**(9 Hours)**

##### **Exhaust After treatment**

Need for exhaust after treatment, fundamentals of catalytic converters, three-way catalyst, diesel oxidation catalyst, catalyst deactivation (contamination and poisoning, thermal deactivation), diesel particulate filter, effect of fuel sulphur on after treatment devices, Selective Catalyst Reduction.

##### **Emission Test Procedures**

Test cycles (USEPA Emission Test Cycle, European Emission Test Procedure, Japan Cycle) for emission testing of two three wheelers, passenger cars, utility vehicles, light and heavy duty commercial vehicles. Test procedures (USEPA, European and Evaporative Emission Standards) for various types of evaporative emissions.

#### **Unit V**

**(8 Hours)**

**Study of Emission Stages:** Bharat Stage I, II, III, IV and VI for two-three wheelers, passenger cars, utility vehicles, light and heavy duty commercial vehicles used in India and Europe.

##### **Equipment for Emission Measurements**

NDIR analyzers, Flame ionization detector, chemiluminescence analyzer, constant volume sampling, measurement of smoke and particulate matter.

##### **Text Book:**

1. Pundir. B.P., "IC Engines Combustion and Emissions" Narosa Publishers, 2010.

##### **Reference Books:**

1. Ramalingam. K.K., "Internal Combustion Engines", Scitech Publications, 2003.
2. SAE Transactions, "Vehicle Emission", 3 Volumes, 1982. 4. Obert, E.F., "Internal Combustion Engines", 1982.
3. Taylor, C.F., "Internal Combustion Engines", MIT Press, 1972.
4. Heywood, J.B., "Internal Combustion Engine Fundamentals", McGraw Hill Book Co., 1995.
5. Automobiles and Pollution SAE Transaction, 1995.
6. Springer and Patterson, "Engine Emission", Plenum Press, 1990.

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**Semester – VII: Departmental Elective – IV: Specialization – Automobile Engineering**

<b>Subject Code: KAU 072</b>	<b>Hybrid Vehicle Propulsion</b>	<b>L T P : 3 0 0</b>	<b>Credits: 3</b>
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<b>The students will be able to</b>		<b>Blooms Taxonomy</b>
<b>CO-1</b>	Understand the basics of the hybrid electric vehicles and it's types.	K2
<b>CO-2</b>	Understand the types of drive trains used in hybrid vehicles	K2
<b>CO-3</b>	Understand the propulsion units used in Hybrid Vehicles and their efficiency.	K2
<b>CO-4</b>	Understand the requirements and devices of energy storage used in hybrid vehicles.	K2
<b>CO-5</b>	Understand the concept of downsizing of IC engines in case of hybrid vehicles.	K2
<b>CO-6</b>	Understand the principles of energy management and issues related to these strategies.	K2

**UNIT I****Introduction to Hybrid Electric Vehicles:****(4 Hours)**

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

**Conventional Vehicles:****(4 Hours)**

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

**UNIT II****Hybrid Electric Drive-trains:****(4 Hours)**

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

**Electric Drive-trains:****(4 Hours)**

Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

**UNIT III****Electric Propulsion unit:****(10 Hours)**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

**UNIT IV****Energy Storage:****(5 Hours)**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy

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storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

**Sizing the drive system:**

**(4 Hours)**

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

**UNIT V**

**Energy Management Strategies:**

**(8 Hours)**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

**Text Books:**

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press , 2003.
2. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press , 2004.

**Reference Books:**

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley , 2003.
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd., 2011.

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**Semester – VII: Departmental Elective – V: Specialization – Automobile Engineering**

<b>Subject Code: KAU 073</b>	<b>Vehicle Body Engineering &amp; safety</b>	<b>L T P : 3 0 0</b>	<b>Credits: 3</b>
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<b>Course Outcome: The students will be able to</b>		<b>Blooms Taxonomy</b>
<b>CO-1</b>	Understand the classification of the vehicles on the basis of body.	K2
<b>CO-2</b>	Understand the importance of material selection in designing automotive bodies.	K2
<b>CO-3</b>	Understand the concepts of aerodynamics used in designing automobiles.	K2
<b>CO-4</b>	Understand the importance of interior and exterior ergonomics while designing the vehicle.	K2
<b>CO-5</b>	Identify various sources of noise and methods of noise separation and various safety aspects in a given vehicle.	K2
<b>CO-6</b>	Calculate various aerodynamic forces and moments acting on vehicle, load distribution in vehicle body and stability of vehicle.	K3

**UNIT-I:****Classification of Coachwork:****[L-9 Hours]**

Styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, types of commercial vehicles, vans and pickups, etc. Terms used in body building construction, angle of approach, Angle of departure, ground clearance, Cross bearers, floor longitudes, posts, seat rail, waist rail, cant rail, Roof stick, Roof longitude, Rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets.

**UNIT-II:****Vehicle Body Materials:****[L-9 Hours]**

Aluminum alloys, Steel, alloy steels, plastics, Metal matrix composites, structural timbers - properties, glass reinforced plastics and high strength composites, thermoplastics, ABS and styrenes, load bearing plastics, semi rigid PUR foams and sandwich panel construction. Paints adhesives and their properties, corrosion and their prevention.

**UNIT-II:****Aerodynamics:****[L-5 Hours]**

Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles.

**Load Distribution:****[L-5 Hours]**

Type of body structures, Vehicle body stress analysis, vehicle weight distribution, Calculation of loading for static loading, symmetrical, longitudinal loads, side loads, stress analysis of bus body structure under bending and torsion.



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**UNIT-IV:****Interior Ergonomics:****[L-4 Hours]**

Introduction, Seating dimensions, Interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms.

**Vehicle Stability:****[L-4 Hours]**

Introduction, Longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding. Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability.

**UNIT-V:****Noise and Vibration:****[L-5 Hours]**

Noise characteristics, Sources of noise, noise level measurement techniques, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression.

**Impact protection:****[L-5 Hours]**

Basics, physics of impact between deformable bodies, design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety.

**Books & Reference:**

1. Bosch, "Automotive Handbook", 8th Edition, SAE publication, 2011.
2. Powloski J., "Vehicle Body Engineering", Business books limited, London, 1969.
3. Ronald K. Jurgen, "Automotive Electronics Handbook", Second Edition, McGraw-Hill Inc., 1999.
4. Vehicle body engineering Giles J Pawlowsky Business books limited 1989
5. Vehicle body layout and analysis John Fenton Mechanical Engg. Publication ltd, London. 1990
6. Vehicle Safety 2002 Cornwell press Town bridge, UK ISBN 1356 – 1448
7. Aerodynamics of Road Vehicles W.H. Hucho Butter worth's 1987 4th Edition

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**Semester – VII: Departmental Elective – V: Specialization – Automobile Engineering**

<b>Subject Code: KAU 074</b>	<b>Trouble Shooting, Service &amp; Maintenance Repair</b>	<b>L T P : 3 0 0</b>	<b>Credits: 3</b>
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<b>The students will be able to</b>		<b>Blooms Taxonomy</b>
<b>CO-1</b>	Understand types of maintenance procedures used in automobiles.	K2
<b>CO-2</b>	Understand the common garage practices and factors affecting efficiency of garage.	K2
<b>CO-3</b>	Understand the procedure of engine dismantling, inspection, common problems and remedies.	K2
<b>CO-4</b>	Understand the procedure of chassis and driveline components maintenance, inspection, common problems and remedies.	K2
<b>CO-5</b>	Understand the procedure of electrical system maintenance, inspection, common problems and remedies.	K2
<b>CO-6</b>	Understand basic principles of body work, paint of automobile vehicles and their safety measures.	K2

**UNIT I****Automobile Maintenance****(6 Hours)**

Importance of maintenance, scheduled and unscheduled maintenance, preparation of check lists, analysis of breakdown, preventive measures, unit replacement system, maintenance schedule, chassis lubrication schedule, component retrieval, estimating repair cost, maintenance record, warranty period, servicing. Inspection forms, Log books, Trip sheets, other maintenance record forms.

**Garage Practice****(2 Hours)**

Types of servicestation/garage, layout of garage, Factors affecting layout, tools & equipment's, transport service undertakings, designa layout for different garage.

**UNIT II****Engine Maintenance****(10 Hours)**

Dismantling of engine components, cleaning methods, visual inspection and dimensional check of various engine components, minor and major tune up, reconditioning and repairing methods of engine components, Assembly procedure, special tools used for maintenance, repair and overhauling, Cooling Systems, Anti corrosion and antifreeze solutions, radiator, and thermostat, Lubrication oil topping up, oil change, oil relief valve, fuel feed systems, FIP adjustment and testing, injector testing. Common problems and their remedies.

**UNIT III****Chassis and Drive Line Maintenance****(8 Hours)**

Mechanical type gear box, Automatic type gear box, Final reduction, propeller shaft, front and rear suspension systems, Brake systems: hydraulic, servo, air etc., Air bleeding, steering system, axles, wheel alignment, tires. Common problems and their remedies.

**UNIT IV****Electric System Maintenance****(5 Hours)**

Battery testing method, starter motor, Electric horn, wiper motor, flasher, electric fuel pump, gauges, Lighting system, head lights focusing, wiring harness testing, Common problems and their remedies.

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**Charging system****(4 Hours)**

DC generator, AC alternator, regulator, Ignition system: coil ignition, transistor assisted ignition, capacitor discharge ignition testing method and procedure. Common problems and their remedies.

**UNIT V****Body Repair****(8 Hours)**

Minor body panel beating, tinkering, shouldering, Painting: Introduction of automotive paints, types of paints, corrosion and anticorrosion method, rubbing, polishing, working of paint booth, door lock mechanism, window glass actuation mechanism.

**Books and References**

1. John Doke "Fleet Management", McGraw-Hill Co. 1984.
2. Maleev. V.L., "Diesel Engine operation and Maintenance", Maintenance, McGraw Hill book Co., New York, 1954.
3. Judge. A.N., "Motor vehicle engine servicing, 3rd, Edition", Pitman Paper pack, London, 1969.
4. Judge. A.W., "Maintenance of High speed diesel engines", Chapman Hall Ltd., London, 1956.
5. John. W. Vale. J.R., "Modern Auto Body and Finder repair".
6. Venk. Spicer. "Automotive Maintenance and Troubleshooting".
7. "Vehicle Service Manuals of reputed manufactures".