



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Shri Rawatpura Sarkar University, Raipur



Examination Scheme & Syllabus for M.Tech.(Automobile Engineering) Semester-II

(Effective from the session: 2022-23)



**SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING**

**Faculty of Engineering
Shri Rawatpura Sarkar University, Raipur
M.Tech. (Automobile Engineering)
Semester-II
Examination Scheme
(Effective from the session: 2022-23)**

S.N	Course Code	Th/ Pr	Subject	Type of Course	Teaching hours per week				Examination Scheme				Total Marks
					L	T	P	TC	Theory		Practical		
									EX	IN	EX	IN	
1	MENAE201T	Th	Automotive System Component Design	Core	3	1	-	4	70	30	-	-	100
2	MENAE202T	Th	Vibration & Noise Control	Core	3	1	-	4	70	30	-	-	100
3	MENAE203T	Th	Vehicle Body Engineering	Core	3	1	-	4	70	30	-	-	100
4	MENAE204A	Th	Elective-II	Core	3	1	-	4	70	30	-	-	100
5	MENAE205T	Th	Automotive Instrumentation and Embedded Systems	Core	3	1	-	4	70	30	-	-	100
6	MENAE206P	Pr	Vehicle Dynamics-Lab	Core	-	-	4	2	-	-	50	25	75
7	MENAE207P	Pr	Modeling and Simulation-Lab	Core	-	-	4	2	-	-	50	25	75
Total Contact hr per week: 28				Total Credit:	24				Grand Total Marks:				650

L- LECTURE T- TUTORIAL P- PRACTICAL

ELECTIVE-II

I	Alternative Fuel & Energy System	MENAE204A
II	Automotive Maintenance & Management	MENAE204B
III	Tribology	MENAE204C



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Course Title	AUTOMOTIVE SYSTEM COMPONENT DESIGN				
Course Code	MENAE201T				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Internal Combustion Engine, Thermodynamics				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • Know about various types of materials, properties of materials and various applications of the materials, and computer aided application. • Know about the fits, clearance and tolerances concepts, also the design of the helical springs. • To know about design procedure to design piston and its parts, cylinder and cylinder block, lubrication of piston assembly. • Understand the designing the parts of connecting rod and crankshaft, • Understand the design aspects of Inlet and exhaust valves, valve mechanism, and also the materials for the valves. • Learn design calculation of various types of clutches. • Understand the performance of vehicles and design of gear box. 				
Course Contents	<p>UNIT – I</p> <p>Introduction Determination of engine power, Engine selection, swept volume, stroke, bore & no. of cylinders, Arrangement of cylinders stroke to bore ratio. Design procedure of theoretical analysis, Design considerations.</p> <p>UNIT – II</p> <p>Design of components Material selection & actual design of components - cylinder block design, cylinder head design, piston & piston pin design, piston ring design, connecting rod design, crankshaft design, flywheel design, design of valve mechanism.</p> <p>UNIT – III</p> <p>Engine balancing Firing order, longitudinal forces, and transverse forces, pitching moments, yawing moments, Engine layout, major critical speed & minor critical speed, design of engine mounting.</p> <p>UNIT – IV</p> <p>Design of cooling system design principles of exhaust & inlet systems, Primary design calculation of major dimensions of fuel injection system. Fins design considerations.</p>				



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	<p>UNIT - V</p> <p>Design of internal system</p> <p>gear & gear box principle and analysis, clutch system design consideration & theoretical & numerical analysis, brake system mechanism, bearing load calculations design of full floating & semi floating quarter floating rear shaft & axle housing, brakes types etc.</p>
Course outcomes	<p>After the completion of course:</p> <ol style="list-style-type: none">1. Design the cylinder block and cylinder parts based on the engine specification of and also based on the engine application.2. Design the piston and its parts based on the engine specification of and also based on the engine application.3. Design the connecting rod and its parts based on the engine specification of and also based on the engine application.4. Design the crankshaft and its parts based on the engine specification of and also based on the engine application also with the balancing weight of the crankshaft.5. Design the valves and its mechanism for both the inlet and exhaust valve based on the engine specification of and also based on the engine application.6. Apply the knowledge gained through various design of clutches for modifications.
Text Books	<ol style="list-style-type: none">1. I. C. Engine & Air Pollution – E. F. Obert, Harper & Row Publishers, New York.2. Engine Design – Giles J. G., Liffle Book Ltd.3. Engine Design – Crouse, Tata McGraw Publication, Delhi.4. R.K. Jain, "Machine Design", Khanna Publishers, New Delhi, 1997.5. "Design Data Book", PSG College of Technology, Coimbatore, 2000.
Reference Books	<ol style="list-style-type: none">1. P.M.Heldt "High Speed Combustion Engines", Oxford-IBH Publishing Co., Calcutta, 1965.2. Giri.N.K- "Automobile Mechanics"- Khanna Publisher, New Delhi-2002.



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Course Title	VIBRATION & NOISE CONTROL				
Course Code	MENAE202T				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Internal Combustion Engine & Theory Of Machine				
Course objectives	<p>This course will enable students:-</p> <ul style="list-style-type: none"> • Understand the various types of vibration with damping and without damping. • Understand the Various types of noise and it's measurement and analysis techniques. • Understand the various sources of noise from automobiles. • Understand the various noise controlling techniques. • Understand the various noise from mechanical components and it's suppressing techniques. 				
Course Contents	<p>UNIT I Introduction</p> <p>Single degree of freedom, two degree of freedom, free, forced and damped vibrations modeling and simulation studies, model of an automobile, magnification factor, transmissibility, vibration absorber. Two degree of freedom system. modal analysis.</p> <p>UNIT II Numerical methods</p> <p>Approximate methods for determining fundamental frequency, Dunkerleys lower bound, Rayleighs upper bound, Holzer method for closed coupled system and branched system.</p> <p>UNIT III Control techniques</p> <p>Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.</p> <p>UNIT IV Automotive noise sources</p> <p>Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise,</p>				



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	<p>aerodynamic noise, tyre noise, brake noise.</p> <p>UNIT V</p> <p>Source of noise and control</p> <p>Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers</p>
Course outcomes	<p>At the end of this course students will be able to:-</p> <ol style="list-style-type: none">1. Classification of vibration of free, forced, undamped , damped, linear , nonlinear vibration Response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, Determination of natural frequencies.2. Introduction to amplitude, frequency, wavelength and sound pressure level, Addition, subtraction and averaging decibel levels, Noise dose level, legislation, measurement and analysis of noise, Measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.3. Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise engine radiated noise, intake and exhaust noise, Assessment of mechanical noise, accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.4. Vibration isolation by tuned absorbers, untuned viscous dampers. Damping treatments, application dynamic forces generated by IC engines, engine isolation, Crank shaft damping, Modal analysis of the mass elastic model shock absorbers.
Text Books	<ol style="list-style-type: none">1. Singiresu S.Rao - "Mechanical Vibrations" - Pearson Education, ISBN -81-297-0179-0 - 2004.2. Kewal Pujara "Vibrations and Noise for Engineers, Dhanpat Rai & Sons, 1992.
Reference Books	<ol style="list-style-type: none">1. Heisler, Advanced Engine Technology SAE Publication.2. Edward F. Obert Internal Combustion Engines.3. H.N. Gupta Fundamentals of Internal Combustion Engines by, PHI.4. Mathur and Sharma Internal Combustion Engines Dhanpat Rai and Sons 2002.



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Course Title	VEHICLE BODY ENGINEERING				
Course Code	MENAE203T				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Automobile Engineering & Internal Combustion Engine				
Course objectives	<p>This course will enable students:-</p> <ol style="list-style-type: none"> 1. Study different types of car and its constructions. 2. Understand the aerodynamics involved in vehicles. 3. Gain knowledge regarding various types of bus and its construction details. 4. Learn the details available in various commercial vehicles. 5. Study the properties of body materials and its corresponding mechanism. 6. Study the design of external body of the vehicles and aerodynamics concepts. 				
Course Contents	<p>UNIT I Car body details</p> <p>Types: saloon, convertibles, limousine, estate car, racing and sports car. Visibility: regulations, driver's visibility, tests for visibility, methods of improving visibility and space in cars.</p> <p>Safety: safety design, safety equipment's for cars. Car body construction; design criteria, prototype making, initial tests, crash tests on full scale model, Dummies and Instrumentation.</p> <p>UNIT II Vehicle aerodynamics</p> <p>Objectives. Vehicle drag and types; various types of forces and moments, effects of forces and moments, side wind effects on forces and moments, Various body optimization techniques for minimum drag, wind tunnel testing: flow visualization techniques, scale model testing, component balance to measure forces and moments.</p> <p>Effects of rounding sharp front body edges. Effects of different cab to trailer body Forebody pressure distribution. Effects of a cab to trailer body roof height. Commercial vehicle drag reducing devices.</p> <p>UNIT III Bus body details</p> <p>Types: mini bus, single Decker, double-decker, two level and articulated bus.</p>				



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	<p>Bus body layout; floor height, engine location, entrance and exit location, seating dimensions. Constructional details: frame construction, double skin construction, types of metal sections used, Regulations, Conventional and integral type construction.</p> <p>UNIT IV Commercial vehicle details</p> <p>Types of body; flat platform, drop side, fixed side, tipper body, tanker body, Light commercial vehicle body types. Dimensions of driver's seat relation to controls. Drivers cab design.</p> <p>UNIT V Body materials, trim and mechanisms</p> <p>Steel sheet, timber, plastic, GRP, properties of materials; Corrosion, anticorrosion methods. Selection of paint and painting process. Body trim items. Body mechanisms.</p>
Course outcomes	<p>At the end of this course students will be able to:-</p> <ol style="list-style-type: none">1. Be acquainted with knowledge of different types of cars.2. Analyse the aerodynamics involved in vehicles.3. Be familiar with various types of bus and construction details.4. Be familiar with various types of commercial vehicles..5. Analyse the properties of body materials and its mechanisms.6. Design and optimize the external body shapes to have aero dynamic shape.
Text Books	<ol style="list-style-type: none">1. J.Powloski - "Vehicle Body Engineering" - Business Books Ltd, London -1989.2. Steed W - "Mechanics of road vehicles"- Iliffe books Ltd., london- 1960.
Reference Books	<ol style="list-style-type: none">1. Giles.J.C. - "Body construction and design" - Liiffe Books Butterworth & Co. - 1971.2. John Fenton - "Vehicle Body layout and analysis" - Mechanical Engg. Publication Ltd., London - 1982.3. Braithwaite.J.B. - "Vehicle Body building and drawing" - Heinemann Educational Books Ltd., London - 1977.



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Course Title	AUTOMOTIVE INSTRUMENTATION AND EMBEDDED SYSTEMS				
Course Code	MENAE205T				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Automobile Engineering, Internal combustion engine, basic electronics etc.				
Course objectives	<p>This course will enable students:-</p> <ol style="list-style-type: none"> 1. Understand measurement characteristics. 2. Understand the working of automotive instruments. 3. Know about the measurement analysis. 4. Understand the working of embedded systems. 5. Understand the working of real time operating system(RTOS) 				
Course Contents	<p>UNIT I Measurement characteristics Instrument Classification, Characteristics of Instruments - Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments.</p> <p>UNIT II Automotive instrumentation Modern automotive instrumentation - Computerized instrumentation system, multiplexing, sampling and advantages - Measurements - Fuel quality, coolant temperature, oil pressure vehicles speed. Display devices - LED, LCD, VFD, CRT and types, CAN network, the glass cockpit and information system. Onboard diagnostics - Fault code displays. Off board diagnostics - Engine data display, expert system occupant protection system - Airbag deployment system security and warning systems.</p> <p>UNIT III Measurement analysis Chemical, thermal, magnetic and optical gas analyzers, measurement of smoke, dust and moisture, gas chromatography, spectrometry, measurement of pH, Review of basic measurement techniques.</p> <p>UNIT IV Introduction to embedded system Introduction to functional building blocks of embedded systems - Register, memory devices, ports, timer, interrupt controllers using circuit block diagram</p>				



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	<p>representation for each categories - Devices & buses for devices network - Serial communication using I2C, CAN, USB buses - parallel communication using ISA, PCI - device drivers in a system - Serial port & parallel port.</p> <p>UNIT V</p> <p>Real time operating system (rtos)</p> <p>Introduction to basic concepts of RTOS, Basics of real time & embedded system operating systems. RTOS - Interrupt handling, task scheduling; embedded system design issues in system development process - Action plan, use of target system, emulator, use of software tools.</p>
<p>Course outcomes</p>	<p>The students should be able to:</p> <ol style="list-style-type: none"> 1. Describe the static and dynamic analysis, experimental error analysis, and statistical analysis. 2. Describe the working of modern automotive instrumentation and computerized instrumentation system. 3. Describe the measurements of fuel quantity, coolant temperature, oil pressure, vehicle speed. 4. Describe the working of display devices and information system 5. Describe the operation of onboard and off board diagnostics, occupant protection system and warning system 6. Describe the working of gas analyzers, smoke tester, gas chromatography and spectrometry 7. Describe the classification of instrument and characteristics of instruments.
<p>Text Books</p>	<ol style="list-style-type: none"> 1. William B.Riddens -Understanding Automotive Electronics, 5th edition- Butter worth Heinemann Woburn- 1998 2. Rajkamal, 'Embedded System - Architecture, Programming, Design', Tata McGraw Hill, 2003. 3. Daniel W. Lewis 'Fundamentals of Embedded Software', Prentice Hall of India, 2004. 4. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 1988. 5. Raman, C.S., Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, Tata McGraw Hill, New Delhi, 1983
<p>Reference Books</p>	<ol style="list-style-type: none"> 1. Bechhold- Understanding Automotive Electronics- SAE- 1998. 2. David E. Simon, 'An Embedded Software Primer', Pearson Education, 2004. 3. Frank Vahid, 'Embedded System Design - A Unified hardware & Software Introduction', John Wiley, 2002. 4. Sriram V. Iyer, Pankaj Gupte, 'Embedded Real Time Systems Programming', Tata McGraw Hill, 2004.



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	<ol style="list-style-type: none">5. Steve Heath, 'Embedded System Design', II edition, Elsevier, 2003.6. Doebelin, Measurement System Application and Design, McGraw Hill, 1978.
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Course Title	VEHICLE DYNAMICS - LAB				
Course Code	MENAE206P				
Course Credits	L	T	P	TC	
	-	-	4	2	
Prerequisites	Vehicle Frames, Axles, Gear Box				
Course objectives	<p>This course will enable students: -</p> <p>The course should enable the students to:</p> <ol style="list-style-type: none"> 1. Testing of natural frequency. 2. Measurement of displacement velocity and acceleration. 3. Whirling of Shafts. 4. Critical Speed Determination. 5. Measurement of Front Wheel Geometry. 6. Introduction to MATLAB- SIMULINK solving simple MCK problems 7. Conversion of Analog to Digital and Digital to Analog <p>Study of LS Dyna / Adams.</p>				
Course Contents	<p>LIST OF EXPERIMENTS</p> <ol style="list-style-type: none"> 1. Testing of natural frequency. 2. Measurement of displacement velocity and acceleration. 3. Whirling of Shafts. 4. Critical Speed Determination. 5. Camber angle measurement. 6. Introduction to MAT Lab - Simulink, solving simple MCK problems. 7. Conversion of Analog to Digital and Digital to Analog. 8. Study of LS Dyna / Adams. 				
Course outcomes	<p>This course will enable students:-</p> <ol style="list-style-type: none"> 1. To find the natural frequency of the given material 2. Using various sensors to find displacement, Velocity and acceleration with the use of Mathematical software. 3. Using circular rod to find its maximum permissible location of bending while it is getting rotated. 4. Using circular rod to find its maximum permissible location of bending while it is getting rotated from its axis shift from original axis. 				



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	<ol style="list-style-type: none">5. Using wheel alignment equipments to find a front wheel geometry of Toe in/out, Caster, Camber/King Pin Inclination and Included angle.6. Using MATLAB- SIMULINK software to solve simple mechanical systems.7. Using data card to find D/A to A/D convertor8. Using Multi Body dynamics software to solve simple Car model.
List of Equipment's	<ol style="list-style-type: none">1. Four Wheeler Chassis Dynamometer.2. Shock absorber test rig3. Measuring Devices - Displacement, Velocity and acceleration.4. Piston and Valves5. A/ D Converter6. D / A Converter7. MAT Lab Software8. Adams / L.S. Dyna



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Course Title	MODELING AND SIMULATION- LAB				
Course Code	MENAE206P				
Course Credits	L	T	P	TC	
	-	-	4	2	
Prerequisites	CAD/CAM, Lines, Circles, Ellipses, Parabolas, Hyperbolas etc.				
Course objectives	<p>This course will enable students: - The subject should enable the student to model & analyze various engine components, according to the specifications.</p>				
Course Contents	<p>LIST OF EXPERIMENTS</p> <p>Modeling and Analysis of following IC Engine Parts</p> <ol style="list-style-type: none"> 1. Piston 2. Piston Pin and Piston Rings 3. Connecting Rod 4. Inlet and Exhaust Valves 5. Camshaft 6. Crankshaft 7. Balancing weight of Crankshaft 				
Course outcomes	<p>The students will be able to: model the various engine components, for the given specifications & to analyze the same for various load & temperature conditions, such as:</p> <ol style="list-style-type: none"> 1. Piston. 2. Piston pin & rings. 3. Connecting Rod. 4. Inlet & Exhaust valves. 5. Camshaft. 6. Crankshaft. 7. Balancing weight of Crankshaft. 				
Software required	1.	Computer Notes	-		30 Nos.
	2.	Software like Pro/E, CATIA and ANSYS	-		30 Nos.



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Elective –II

Course Title	ALTERNATIVE FUEL & ENERGY SYSTEM				
Course Code	MENAE204A				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Internal Combustion Engine, Non-Conventional Energy & Automobile Engineering.				
Course Objectives	This course will enable students: - 1. Gain knowledge of various alternate fuels. 2. Understand properties, performance and emission characteristics of Alcohols. 3. Know about Natural gas, LPG, hydrogen and biogas. 4. Study in depth of various vegetable oils used for engines. 5. Know about Electric vehicle.				
Course Contents	UNIT- I Introduction Need for alternate fuel, Availability and properties of alternate fuels, general use of alcohols, LPG, Hydrogen, Ammonia, CNG and LNG, Vegetable oils and biogas, Merits and demerits of various alternate fuels, Introduction to alternate energy sources. Like EV, Hybrid, Fuel cell and solar cars. UNIT-II Alcohols and oxygenates Properties as engine fuel, Alcohols and gasoline blends, Performance in SI engine, Methanol and gasoline blends, Combustion characteristics in CI engines, Emission characteristics, Oxygenates, Performance in SI & CI Engines. UNIT- III Natural gas, lpg, hydrogen and biogas Availability of CNG, properties, Modification required using in engines, Performance and emission characteristics of CNG using LPG in SI & CI engines, Performance and emission of LPG. Hydrogen; Storage and handling, Performance and safety aspects. UNIT IV Vegetable oils Various vegetable oils for engines, Esterification, Performance in engines,				



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	<p>Performance and emission characteristics, Bio diesel and its characteristics</p> <p>UNIT V</p> <p>Electric, hybrid, fuel cell and solar cars</p> <p>Layout of an electric vehicle, Advantage and limitations, Specifications, System components, Electronic control system, High energy and power density batteries, Hybrid vehicle, Fuel cell vehicles, Solar powered vehicles.</p>
Course outcomes	<p>The students should be able to:</p> <ol style="list-style-type: none">1. Apply various alternate fuels appropriately to the needs2. Learn in details about methanol and ethanol usage, storage, chemical structure, pros and cons.3. Be acquainted with the knowledge of natural gas, LPG, hydrogen and biogas.4. Evaluate the performance characteristics of various vegetable oils.5. Be familiar with electric and hybrid vehicles.
Text Books	<p>Richard. L. Bechfold - Alternative Fuels Guide Book - SAE International Warren dale - 1997.</p>
Reference Books	<ol style="list-style-type: none">1. Maheswar Dayal - "Energy today & tomorrow" - I & B Horishr India - 1982.2. Nagpal - "Power Plant Engineering" - Khanna Publishers - 1991.3. " Alcohols as motor fuels progress in technology" - Series No.19 - SAE Publication USE - 1980.4. SAE paper nos. 840367, 841333, 841334, 841156, Transactions, SAE, USA.



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Elective-II

Course Title	AUTOMOTIVE MAINTENANCE & MANAGEMENT				
Course Code	MENAE204B				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Sensors, Ignition System, Detonation in automobile.				
Course Objectives	<p>This course will enable students: -</p> <ol style="list-style-type: none"> 1. Understand the complete knowledge of the vehicle maintenance procedures and acquire skills in handling situations where the vehicle is likely to fail. 2. Understand various types of maintenance of vehicles and features and applications. 3. Objective of the preventive maintenance program is to minimize breakdowns, unscheduled repairs, and undue wear and tear. 4. Ensure maximum vehicle availability for customers with minimum interruptions due to unscheduled repairs and breakdowns. 5. Minimize the consumption of petroleum based fuels and assure fuel security and accountability. 6. Minimize the cost of fuel used by the fleet and provide safe, convenient fueling access for fleet customers. 				
Course Contents	<p>UNIT-I Maintenance records and schedule Importance of maintenance with different types, maintenance records, factors considered for design & development of modern service garages / dealers shops, different garage layouts.</p> <p>UNIT-II Engine Maintenance Engine troubles, effects & remedies, different major & minor services for engine, inspection and checking of components visually and dimensionally, reconditioning methods of engine components, engine tune-up, special tools & advanced equipment's.</p> <p>UNIT-III Chassis Dive-line Maintenance Maintenance, repair and servicing of clutches, Fluid flywheel, gear boxes, Automatic transmission, CVT unit, propeller shaft, differential unit, front axle and rear axle, suspension systems, servicing of brake systems- hydraulic, air systems, brake bleeding and brakes adjustments, maintenance and servicing of</p>				



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	<p>steering system-Manual & Power Steering system, wheel balancing, wheel alignment, maintenance of tyres, tyre rotation, frame defects, chassis frame alignment.</p> <p>UNIT-IV Maintenance, servicing of auxiliaries Cooling system service, anti-corrosion additives, ant freezing solutions, dry & wet liners, Petrol fuel and diesel fuel system maintenance, MPFI maintenance, lubrication system services, Chassis lubrication, lubrication chart, maintenance and care of storage batteries, battery testing methods, maintenance of ignition systems, tyre service & reconditioning.</p> <p>UNIT-V Maintenance & repair of vehicle body Passenger comfort parameters, body coach work, window rattling, noise & vibration, body repair tools & equipments, polishing and painting of new and old vehicle body</p>
<p>Course outcomes</p>	<p>The students should be able to:</p> <ol style="list-style-type: none"> 1. Differentiate various layouts, analyze the merits and limitations and apply in real time. 2. Dismantle study, perform corrections and assemble the various parts of the vehicle. 3. Describe the maintenance procedures of various systems like steering systems, braking system, suspension system and engine etc. 4. Dismantle study, rectify and assemble drive line system, final drive and differential, rear axle, wheels and tires, suspension and brake systems. 5. Realize effects of maintenance and minimize the consumption of petroleum based fuels. 6. Describe the maintenance procedures of various electrical systems like battery, starter motor, alternator, D.C motor etc. 7. Be familiar with maintenance procedures of engine, cooling system and lubrication system, checking and servicing of dash board instruments.
<p>Text Books</p>	<ol style="list-style-type: none"> 1 . Mechanics of Road Vehicles – W. Steed, Illefe Books Ltd. London 2 Introduction to Internal Combustion Engines”, Richard Stone, 3 McMillan, London. Automotive Chassis – P. M. Heldt, Chilton Co. NK 4 I. C. Engine – Litchy 5 I. C. Engine – Obert.
<p>Reference Books</p>	<ol style="list-style-type: none"> 1. Vehicle and Engine Technology – Hein Heister 3. Advance Vehicle Technology - Hein Heister 4. S. I. Engine – Fuel Injection Development - Charles A. Fisher Chapman & Hall 5. Automotive Engines - Herbert E. Ellinger 6. Automobile Engg. Volume – I - American Technical Society, Chicago



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	2.Internal Combustion Engines Fundamentals – John B. Heyhood, McGraw Hill
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Elective-II

Course Title	TRIBOLOGY			
Course Code	MENAE204C			
Course Credits	L	T	P	TC
	3	1	-	4
Prerequisites	Automobile Engineering & Environment Engineering, surface engineering			
Course Objectives	<ol style="list-style-type: none"> 1. Design of surfaces in contact is a critical problem for mechanical engineering. 2. Tribology & lubrication is an interdisciplinary course which deals with fundamentals of surface contact, friction, wear and lubrication. 3. Topics include description and modeling of engineering surfaces, popular surface contact theories, and major modes of friction, wear, lubrication and adhesion. 4. The tribology challenges in micro system will be discussed as well. 			
Course Contents	<p>UNIT-I Introduction Engine tribology basics Introduction of Tribology – General tribological considerations in the design of bearings, gears, cams, reciprocating components, etc. tribology / aspects of engine components such as bearings, piston assembly, valve train and drive train components etc.</p> <p>UNIT-II Friction & Wear Natural of metal surfaces – Surface properties – Surface parameters and Measurements. Friction – Sliding friction – Rolling friction characteristics of common metals and non-metals – friction under environments. Engine friction – Losses and engine design parameters. Economic role of wear – type of wear-wear mechanism, factors affecting wear, selection of materials for different wear situations, measurement of wear, tribometers and tribometry. Engine wear, mechanisms, wear resistance material and coatings and failure mode analysis.</p> <p>UNIT-III Bearings and Lubrication Lubricants, type of lubricants, properties and testing, service classification of lubricants, lubrication of tribological components, lubrication system, lubricant monitoring, SOAP, ferrography and other rapid testing methods for lubricants contamination. Hydrodynamic Lubrication: Theory of hydrodynamic lubrication, generalized Reynolds equation, slider bearings, fixed & pivoted shoe bearings, hydrodynamic journals bearings, short and finite bearings, thrust bearings, sintered bearing, non-circular bearings and</p>			



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	<p>multi side surface bearings.</p> <p>UNIT -IV Externally (Externally – pressurized) lubrication Hydrostatic bearing, basic concepts, bearing pads, coefficients, restrictors, capillary, orifice and flow control valve, bearing characteristics number and performance coefficients, flat, conical and spherical pad thrust bearing, multi-recess journal and thrust bearings, air and gas lubricated bearings.</p> <p>UNIT-V lubrication Elasto – hydrodynamic lubrication: Ball and roller element bearings, classification, selection and life estimation, fatigue, monitoring of ball / roller bearings, diagnostics. Rheodynamics (Static) lubrication: Non-Newtonian fluids, characteristics, general recommendations of lubricants, SAE & other cloud numbers, thixotropic, materials and Bingham solids, grease lubrication and care stability, tribology components in extreme environments like vacuum, pressure, temperature, tribology matching and selection, tribology testing and standards.</p>
Course outcomes	<p>The students should be able to:</p> <ul style="list-style-type: none"> • Have a knowledge of surface topography and know how to model a rough engineering surface; • Have a clear overall picture about the basics of tribology and related sciences, theoretical background about processes in tribological system, mechanisms and forms of interaction of friction surfaces; • Understand Hertz contact and rough surface contact; • Be familiar with adhesion theories and the effect of adhesion on friction and wear; • Have a mastery of the friction/lubrication mechanisms and know how to apply them to the practical engineering problem. • Know the methods to reduce the friction for engineering surface.
Text Books	<ol style="list-style-type: none"> 1. Friction and Lubrication, Bowden F.P. & Tabor D., Heinemann Edu. Books Ltd. 1974 2. Friction & Wear of Material, Ernest Rabinowicz 3. Tribology – Handbook, Neal M.J., Butterworth, 1973 4. Standard hand Book of Lubrication Engg., O’Connor J.J. & Boyd J., McGraw Hill, 1968.
Reference Books	<ol style="list-style-type: none"> 1. Theory of Hydro-dynamic Lubrication, Pinkus O, & Sternlicht B., McGraw Hill, 1961. 2. Theory & Practice of Lubrication of Bearing, Fuller D.D., McGraw Hill, 1947. 3. Analysis & Lubrication of Bearings, Shaw M. C., Macks F., McGraw Hill, 1947.



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Semester-II
2022-23