

**Visvesvaraya Technological University, Belagavi.**

**PhD Coursework Courses – 2018 (Automobile) As per 2017 Regulation**

Sl. No.	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
1	16MAU12, Automotive Engine and Systems	16MAU13, Noise, Vibrations and Harshness	16MAU151, Automotive Materials	16MAU421, Vehicle Performance	16MAU153, Vehicle Maintenance and Fleet Management	16MAU23, Automotive Electrical and Electronic systems
2	16 MAU254, Simulation of I. C. Engine Processes	16MAU14, Advanced Machine Design	16MAU21, Automotive Power Trains	16MAU24, Vehicle Dynamics	16MAU252, Automotive Chassis	16MAU253, Manufacturing techniques in Automotive Engg.
3	16MAU41, Alternative fuels and pollution control	16MAU251, Multi body Dynamics	16MAU22, Automotive Body Engineering and safety	16MAU154, Automotive Embedded Systems	16MAU424, Two and three wheeler Technology	16MAU422, Hybrid Vehicle Technologies

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<b>01</b>	<b>16MAU12</b>	<b>Group-1</b>	<b>AUTOMOBILE ENGINE AND SYSTEMS</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1: Introduction:</b>                  Definition of a heat engine; external and internal combustion engine; basic engine components and nomenclature; the working principles of engines; classification of IC engines; application of IC engines.</p> <p><b>Fuel Supply Systems:</b>  <b>SI Engine:</b> Principle of elementary carburettor, Mixture requirements for steady state and transient operation, Gasoline Fuel Injection.</p> <p><b>C.I. Engines:</b>                  Fuel injection pump systems- Types, constructional features and operation, Factors influencing fuel spray atomization, penetration and dispersion of diesel, Fuel Injection Pumps (inline, rotary), Filters, Governors – Types of Governors - fuel feed pumps and Types, injectors and nozzles – types, functions and necessities, injection lag, pressure waves in fuel lines.</p>			
<p><b>Module2: Combustion in SI engines:</b>                  Essential features of ignition timing and ignition voltage, MBT timing, knock detection and control strategies, thermodynamic analysis of SI engine combustion, analysis of cylinder pressure data.</p> <p><b>Combustion in CI engines:</b>                  Essential features of injection timing and delay period, correlations for ignition delay in engines, effect of fuel properties, types of combustion chambers and merits of the different types, analysis of cylinder pressure data, fuel spray behavior.</p>			
<p><b>Module3: Cooling and Lubrication System :</b></p> <p><b>Cooling System:</b>                  Necessity, variation of gas temperature, Areas of heat flow, heat transfer, piston and cylinder temperature., Heat rejected to coolant, quantity of water required, cooling system, air cooling, water cooling, thermodynamics of forced circulation, thermostats, pressurized water cooling, regenerative cooling, comparison of air and water cooling, radiators types, cooling fan – power requirement, antifreeze solution</p> <p><b>Lubrication System:</b>                  Lubricants, lubricating systems, Lubrication of piston rings, bearings, oil consumption, Oil cooling. Heat transfer coefficients, liquid and air cooled engines, coolants, additives and lubricity improvers, oil filters, pumps, and crankcase ventilation – types.</p>			
<p><b>Module4: Engine Management System:</b> Combined ignition and fuel management systems. Digital control techniques. Complete vehicle control systems, Artificial intelligence and engine management, Exhaust emission control in SI and CI engines, Techniques</p> <p><b>Recent Developments in Automotive Engines:</b> Supercharger, Working Principle, Effect of Super charging, Types and Methods of Super charging, Turbo Charger, Working Principle , Turbo-lag, VVT, V-TEC i-VTEC and IDTEC. ATFT, CRDI system – working Principle, Advantages and Effect of CRDI on emission reductions, Hybrid vehicles and fuel cells.</p>			
<p><b>Module5: Engine Performance Testing:</b>                  Engine performance parameters; Methods of determination of BP, IP, FP, volumetric, thermal, mechanical, scavenging efficiencies, etc., types of dynamometers, Morse Test, Numerical Problems in Engine Testing , Engine Performance and heat balance sheet.</p>			
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Internal Combustion Engine Fundamentals-John B.Heywood, McGraw-Hill Book Company(1988)</li> <li>2. Introduction to Internal Combustion Engines-Dr. K. K. Ramalingam, Scitech Publication, 2004.</li> <li>3. Internal Combustion Engines- V. Ganesan, Tata McGraw Hill Publications.</li> <li>4. Automotive Electrical and Electronics- Tom Denton , SAE, 2000</li> </ol>			

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5. Advanced Engine Technology- Heinz Heisler, SAE Publications, 1995.

<b>02</b>	<b>16 MAU254</b>	<b>Group-1</b>	<b>SIMULATION OF I. C. ENGINE PROCESSES</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1: Principle of Computer Modeling and Simulation:</b>                  Monte Carlo simulation, Nature of computer modeling and simulation, advantages of simulation, limitations of simulation, and areas of application.</p> <p><b>System and Environment:</b>                  Components of a system-iscrete and continuous systems. Models of a system-a variety of modeling approaches</p>			
<p><b>Module 2: Design and Evaluation of Simulation Experiments:</b>                  Variance reduction techniques-antithetic variables- variables verification and validation of simulation models.</p>			
<p><b>Module 3: S. I. Engine Simulation and Two Stroke Engine:</b>                  Simulation of Otto cycle at full throttle, part throttle and supercharged conditions. Progressive combustion, Exhaust and intake process analysis. Two Stroke Engine Simulation – Engine and Porting Geometry, Gas Flow, Scavenging.</p>			
<p><b>Module 4: C.I. Engine Simulation:</b>                  Simulation of ideal Diesel cycle and Diesel cycle at full throttle, part throttle and supercharged conditions. Zero dimensional combustion model, Progressive combustion, Exhaust and intake process analysis.</p>			
<p><b>Module 5: Simulation Exercises:</b>                  Case studies of Simulation for 2 stoke and 4 stroke engine. Simulation exercises using computers – MATLAB/SimuLink, Pro-E / ICEM, CFD Analysis, FE Analysis procedures, Advantages of FEA, Simple Exercise using MSC Nastran.</p> <p><b>Multi-body Simulation Exercises:</b>                  Simple Multi-body Suspension, Four Bar mechanisms, Handling Analysis of simple Bogie using MSC Adams.</p>			
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Computer Simulation of Spark Ignition Engine Processes - V. Ganesan, Universities Press, 1995.</li> <li>2. Computer Simulation of Compression Ignition Engine Processes - V. Ganesan, Universities Press, 1995.</li> <li>3. Combustion Modeling in Reciprocating Engines - J. N. Mattavi and C. A. Amann, Plenum Press, 1980.</li> <li>4. The Thermodynamics and Gas Dynamics of Internal Combustion Engines, Vol. I &amp; II - Horlock and Winterbone, Clarendon Press, 1986.</li> <li>5. The Basic Design of two-stroke engines - Gordon P. Blair, SAE Publication, 1990.</li> </ol>			

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<b>03</b>	<b>16MAU41</b>	<b>Group-1</b>	<b>ALTERNATIVE FUELS AND POLLUTION CONTROL</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1: Introduction:</b> Types of energy sources, their availability, need of alternative energy sources, Non-conventional energy sources, Classification of alternative fuels, Scenario of conventional auto fuels, fuel quality aspects related to emissions. Technological up gradation required, business driving factors for alternative fuels. Implementation barriers for alternative fuels.</p> <p><b>Gaseous alternative fuels &amp; Bio-Diesel</b> <b>Hydrogen:</b> Introduction, properties and production of hydrogen. Storage, Advantages and disadvantages of hydrogen as fuel for S. I. and C. I. engines. Hazards and safety systems for hydrogen, hydrogen combustion. Performance and emission of from hydrogen.</p> <p><b>Other Gaseous fuels:</b> Properties, production, advantages and disadvantages of LPG, CNG, Methanol and Ethanol and their blends as Fuel for SI and CI engine.</p>			
<p><b>Module 2: Bio-Diesel:</b> Straight vegetable oil, Biodiesel-Production of Bio-Diesel, Bio-Diesel as Fuel for CI engine, Performance and emission of bio diesel.</p> <p><b>Biogas or Biomethane:</b> History, properties and production of Biogas, classification of biogas plants, biogas storage and dispensing system. Advantages of biogas, hazards and emissions of biogas.</p> <p><b>Reformulated conventional fuels:</b> Introduction. Production of coal water slurry. Properties, as an engine fuel, emissions of CWS. RFG, Emulsified fuels. Hydrogen-enriched gasoline. Future Alternative Fuels, PMF, Ammonia, Liquid-Nitrogen.</p>			
<p><b>Module 3: Emission from Automotive Engines:</b> <b>Source of Emission from Automobiles:</b> Sources of Air Pollution. Various emissions from Automobiles – Formation- Effects of pollutants on environment and human beings.</p> <p><b>S.I. Engine Emissions and its Control:</b> Emission formation in SI Engines- Carbon monoxide &amp; Carbon dioxide - Unburned hydrocarbon, NOx, Smoke-Effects of design and operating variables on emission formation- controlling of pollutants - Catalytic converters, Charcoal Canister, CCS, Positive Crank case ventilation system, Secondary air injection, thermal reactor, Laser Assisted Combustion, etc.</p>			
<p><b>Module 4:</b> <b>C.I. Engine Emission and its Control:</b> Formation of White, Blue, and Black Smoke, NOx, soot, sulphur particulate and Intermediate Compounds – Physical and Chemical delay — Significance Effect of operating variables on Emission formation- Fumigation, Split injection, Add Blue, Catalytic Coating, EGR, HCCI, Particulate Traps, SCR.</p> <p><b>Influence of Fuel Properties on Emission and Effect of Air Pollution:</b> Effect of petrol, Diesel Fuel, Alternative Fuels and lubricants on emissions, Effect of air pollution on Human Health, Effect of air pollution on animals, Effect of air pollution on plants</p>			
<p><b>Module 5:</b> <b>Test Procedures and Emission Measurements:</b> Constant Volume Sampling I and 3 (CVS-1&amp;CVS-3) Systems, Sampling Procedures- Chassis dyno- Seven mode and thirteen mode cycles for Emission Sampling-Sampling problems-Emission analysers-NDIR, FID, Chemiluminescent, Smoke meters.</p>			
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- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. Engine Emissions, Pollutant formation- G. P. Springer and D. J. Patterson, Plenum Press, New York, 1986.
2. Alternative Fuels- S .S. Thipse. JAICO Publishing House.
3. Non-Conventional Energy Sources- G. D. Rai, Khanna Publishing New Delhi.
4. D. J. Patterson and N. A. Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication, 1985.

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<b>01</b>	<b>16MAU13</b>	<b>Group-2</b>	<b>NOISE, VIBRATIONS AND HARSHNESS</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1: Fundamentals of sound:</b>                  Definition of NVH, Vehicle noise - Direct sound generation mechanism: airborne sound; Indirect sound generation mechanism: structure borne sound; Subjective response sound, Acoustic variables, basic attributes of sound such as wavelength, period, frequency; speed of sound, Decibel scale, Wave equation, types of sound fields, Measures of sound: Sound pressure, sound intensity and sound power, Combining sources: dB arithmetic, Standing wave, Beating, Impedance, Human hearing: frequency Versus sound pressure level, Loudness: phons and sones as noise descriptors; Weighting networks, Leq and various noise metrics for road noises.</p>			
<p><b>Module 2: Noise measurements and instrumentation:</b>                  Measuring microphones, Sound level meter, time and frequency weighting, Sound spectra – Octave band analysis, Order analysis and waterfall plot, Various types of acoustic testing chambers, Sound power measurement from Sound pressure: Free field method, Reverberant field method, Semi- Reverberant field method and Comparison method (using calibrated Sources) Two- microphone probe for measuring; Sound power measurement from Sound Intensity</p>			
<p><b>Module 3: Sound fields and Room Acoustics:</b>                  Characterizing sound sources; Directivity; Sound Fields; Various approaches to modeling sound sources; Transmission loss (TL) and Insertion loss (IL); Reverberation time and Acoustic Absorption Coefficient; Effects of leaks on barrier and TL of composite barriers; measurement Absorption Coefficient and Transmission loss (TL).</p> <p><b>Vehicle Interior and Exterior noise:</b>                  Internal noise sources in vehicles such as engine noise; road noise; aerodynamic (wind) noise; brake noise; squeak, rattle and tizz noises; sound package solution to reduce the interior noise: acoustic isolation, acoustic absorption and damping material solutions; Exterior noise sources in vehicles such as air intake systems and exhaust systems; Tyre noise.</p>			
<p><b>Module4: Sources of Vehicle vibration:</b>                  Power train and Engine vibrations; driveline vibrations; chassis and suspension vibrations; Control strategies; Human response to vehicle vibrations, concept of harshness; subjective and objective evaluation of vehicle harshness.</p> <p><b>Vibration Isolation and Control:</b>                  Introduction; damping of vibrations; vibration isolation and absorption; design of a Vibration Absorbers, unconstrained and constrained layer damping treatment, add on dampers and stiffeners, Introduction to Active Vibration Control.</p>			
<p><b>Module 5: Vibration Measurement and Instrumentation:</b>                  Definition of Modal Properties, Modal analysis theory, FE &amp; Experimental modal analysis, Transducers and accelerometers Excitation sources Impact Excitation, Shaker excitation, Excitation signals, applications of Modal Analysis, laser based vibration measurements; analysis and presentation of vibration data.</p>			
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			

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**Text Books:**

1. Engineering Noise Control: Theory and Practice- Bies D A and Hansen C H, Spon Press, Taylor &Francis, NYUSA, 2003.
2. Vehicle Noise & Vibration Refinement -Xu Wang, Elsevier Publishing Limited, 2010.
3. Mathew Harrison Vehicle Refinement- Controlling Noise & Vibration in Road Vehicles, Elsevier Publication (2004).
4. Theory and Problems of Mechanical Vibrations - William W. Seto, McGraw Hill International BookCo., Singapore (Schaum's outline series)
5. Mechanical Vibrations - S. S. Rao, Pearson Education Inc.,

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<b>02</b>	<b>16MAU14</b>	<b>Group-2</b>	<b>ADVANCED MACHINE DESIGN</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1: Introduction:</b>                  Role of failure prevention analysis in mechanical design, Modes of mechanical failure, Review of failure theories for ductile and brittle materials including Mohr's theory and modified Mohr's theory, Numerical examples.</p> <p><b>Fatigue of Materials:</b>                  Introductory concepts, High cycle and low cycle fatigue, Fatigue design models, Fatigue design methods ,Fatigue design criteria, Fatigue testing, Test methods and standard test specimens, Fatigue fracture surfaces and macroscopic features, Fatigue mechanisms and microscopic features.</p>			
<p><b>Module 2: Stess-Life (S-N) Approach:</b>                  S-N curves, Statistical nature of fatigue test data, General S-N behavior, Mean stress effects, Different factors influencing S-N behaviour, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using SN approach.</p> <p><b>Strain-Life(<math>\epsilon</math>-N)approach:</b>                  Monotonic stress-strain behavior ,Strain controlled test methods ,Cyclic stress strain behavior ,Strain based approach to life estimation, Determination of strain life fatigue properties, Mean stress effects, Effect of surface finish, Life estimation by <math>\epsilon</math>-N approach.</p>			
<p><b>Module 3: LEFM Approach:</b>                  LEFM concepts, Crack tip plastic zone, Fracture toughness, Fatigue crack growth, Mean stress effects, Crack growth life estimation. Notches and their effects: Concentrations and gradients in stress and strain, S-N approach for notched membranes, mean stress effects and Haigh diagrams, Notch strain analysis and the strain – life approach, Neuber's rule, Glinka's rule, applications of fracture mechanics to crack growth at notches.</p>			
<p><b>Module 4: Fatigue from Variable Amplitude Loading:</b>                  Spectrum loads and cumulative damage, Damage quantification and the concepts of damage fraction and accumulation, Cumulative damage theories, Load interaction and sequence effects, Cycle counting methods, Life estimation using stress life approach.</p>			
<p><b>Module 5: Surface Failure:</b>                  Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue spherical contact, Cylindrical contact, General contact, Dynamic contact stresses, Surface fatigue strength.</p>			
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Metal Fatigue in engineering- Ralph I. Stephens, Ali Fatemi, Robert, Henry o. Fuchs, Johnwiley Newyork, Second edition. 2001.</li> <li>2. Failure of Materials in Mechanical Design- Jack. A. Collins, John Wiley, Newyork 1992.</li> <li>3. Machine Design- Robert L. Norton , Pearson Education India, 2000.</li> <li>4. Fatigue of Materials- S .Suresh , Cambridge University Press, -1998</li> <li>5. Fundamentals of Metal Fatigue Analysis - Julie. A. Benantine, Prentice Hall,1990.</li> </ol>			



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<b>03</b>	<b>16MAU251</b>	<b>Group-2</b>	<b>MULTI BODY DYNAMICS</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<b>Module 1:</b> Introduction to MBD, Notation. Kinematics of free bodies: point mass and rigid body. Position, velocity, acceleration. Angular orientation descriptions: transformation matrices, Euler angles, cardan angles, quaternion (Euler parameters). Kinematic equations of rotation.			
<b>Module 2:</b> Conservative and non-conservative force and torque elements. Spring, damper, bushing, force elements with inner dynamics. Constraint forces. Impacts. The problem with play and dry friction.			
<b>Module 3:</b> Rigid Body and Kinematic Constraints: Rigid body kinetics. Newton- Euler equations. Inertia tensor. Inertial and body- fixed description. State space description of multi- body systems. Kinematic constraints. Constraints functions. Degrees of freedom. Jacobian. Basic types of joints and linkages.			
<b>Module 4:</b> Structure and functionality of multi- body codes. Kinematics equilibrium points (static), dynamics, Inverse dynamics.			
<b>Module 5:</b> Linearization, modal analysis, and optimization. Usage of Software such as MSC ADAMS for multi body dynamics simulation for automotive system.			
<b>Question paper pattern:</b>			
<ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<b>Text Books:</b>			
<ol style="list-style-type: none"> <li>1. Multibody Dynamics, Huston- R.L., Butterworth- Heinemann, (1990).</li> <li>2. Dynamics of Multibody Systems- Shabana, A.A., Wiley, (1989).</li> <li>3. Computational Methods for Multibody Dynamics -Amirouche, F.M.L, Prentice-Hall, (1992).</li> <li>4. Computer-Aided Kinematics and Dynamics of Mechanical Systems-Haug, E.J., Volume I: Basic Methods, Allyn and Bacon, (1989).</li> <li>5. Dynamics of Multibody Systems - Roberson, R.E. and Schwertassek, R., Springer-Verlag, (1988).</li> <li>6. Multibody System Handbook - Schiehlen, W.O., Springer- Verlag, (1990).</li> <li>7. MSC ADAMS user Manual.</li> </ol>			

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<b>01</b>	<b>16MAU151</b>	<b>Group-3</b>	<b>AUTOMOTIVE MATERIALS</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1: Aluminium Alloys &amp; Lightweight Magnesium for Automotive Applications:</b> Introduction; Wrought Aluminum alloys; Cast aluminum processes Technologies; Cast aluminum metallurgy and properties; New Lightweight alloys; Process technologies; mechanical and physical properties; Case studies of applications.</p> <p><b>Testing Automotive Materials:</b> Evaluation of materials under realistic loading and environmental conditions; different test methods for evaluation of properties for specific applications.</p>			
<p><b>Module 2: Composite Materials for Automotive Applications:</b> Definition, Classification, Types of matrices &amp; reinforcements, characteristics &amp; selection, Fiber composites, laminated composites, particulate composites, prepegs, sandwich construction.</p> <p><b>Manufacturing of Composite Materials:</b> Lay up and curing – open and closed mould processing – Hand lay –up techniques – Bag moulding and filament winding. Pultrusion, pulforming, Thermoforming, Injection moulding, Cutting, Machining and joining, tooling, Quality assurance – Introduction, material qualification, types of defects, NDT methods.</p>			
<p><b>Module 3: Metal matrix composites:</b> Reinforcement materials, types, Characteristics &amp; selection, base metals, selection, applications in automotive engineering.</p>			
<p><b>Module 4: Micro mechanical analysis of a lamina:</b> Introduction, Evaluation of the four elastic modules – Rule of mixture, ultimate strengths of unidirectional lamina.</p> <p><b>Macro mechanics of a lamina:</b> Hooke’s law for different types of materials, number of elastic constants; Two – dimensional relationship of compliance &amp; stiffness matrix. Hooke’s law for two dimensional angle lamina, engineering constants – angle lamina, Invariants, Theories of failure.</p>			
<p><b>Module 5: Macro Mechanics of Laminates:</b> Laminates Coding, ABD Matrices, Classical Laminates Theory, Special cases of Laminates, Strength Theories of Laminates.</p>			
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Developments in Lightweight Alloys for Automotive Applications-James M Boileau, 2001-2005, SAE (Product Code PT-130).</li> <li>2. Lightweight Magnesium Technology-Thomes Ruden, 2001 through 2005, SAE (Product code PT-131)</li> <li>3. Testing Automotive Materials &amp; Components - Donald H Wright, SAE (Product Code R – 124)</li> <li>4. Composite material science and Engineering- Krishan K. Chawla, Springer.</li> <li>5. Fibre reinforced composites- P. C. Mallik , Marcel Decker.</li> </ol>			

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<b>02</b>	<b>16MAU21</b>	<b>Group-3</b>	<b>AUTOMOTIVE POWER TRAINS</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1: Overview of Vehicle Powertrains System:</b>                  Outlines of Power Trains, Power train functions, Power train layout and components, Main and Auxiliary functions, Requirements profile, Interrelations: Direction of rotation, Transmission Ratio and Torque, Road Profiles, Load Profiles, Typical Vehicle uses and Driver types, Performance features of Vehicle Transmissions. Design trends in Transmission, Kinematical relations of powertrains, Numerical problems.</p> <p><b>Matching engine and transmission:</b>                  Road loads and axle loads, Deriving condition diagram, Ideal transmission and engine-transmissions matching, Total ratio and overall gear ratio- Selecting the largest power- train ratio, Selecting the smallest power- train ratio, Selecting the intermediate gears- saw tooth profile, Geometrical gear steps, Progressive gear steps, Numerical problems.</p>			
<p><b>Module 2: Start-up Devices:</b>                  One -way clutch, Band clutch, Multi-disk clutch, Clutch Design and Analysis, Hydrodynamic Clutches and Torque Converters: Principles, Characteristic curves of Hydrodynamic Clutches, Construction and operation of Torque Converter, Input/output characteristics, Design Considerations, Trilok Converter, Torque Converter test diagram, Interaction of engine and Trilok Converter, Numerical problems.</p>			
<p><b>Module 3: Manual Transmissions:</b>                  Manual Transmission Layouts and Components, Basic gear box construction, gear-sets with fixed axles, countershaft transmission and epicyclic gears, schemes for reverse gear. Transmission Power Flows, Numerical problems.</p> <p><b>Gear shifting mechanisms, Layout and design of Synchronizers:</b>                  Internal shifting mechanisms and External shifting mechanisms, Classification of shifting elements, synchronizer functional requirements, synchronizing process, design of synchronizers, alternative transmission synchronizers</p>			
<p><b>Module 4: Automatic Transmissions:</b>                  Level of automation, Gear shift mode, stepped and Continuously Variable Transmissions, synchronizer gear boxes, epicycloidal gear boxes, Car CVT'S: Van Doorne Continuously Variable Transmission (CVT) and Torotrak Continuously Variable Transmission (CVT). Design and analysis of planetary gear trains, Gear ratios and clutch engagement schedule, Clutch torques in steady state condition, Torque analysis in shifting process, Numerical problems.</p>			
<p><b>Module 5: Differential and Final drives:</b>                  Outline of differential theory-friction free differential, Differential with internal friction, Self locking differential, final drives: formats, performance limits, transmission ratios. Differential gears, differential locks and locking differentials, types of self locking differential, Numerical problems.</p> <p><b>Design of other Transmission elements:</b>                  Design of slip joint, universal joint, dead &amp; live axle, constant velocity joints, Bearing Design, Selection of ball and roller bearing, Gear box housing design.</p>			
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Automotive Transmissions: Fundamentals, Selection, Design and Application, GisbertLechner, Harald Naunheimer, Springer-Verlag Berlin Heidelberg, New York, ISBN 3-540-65903.</li> <li>2. Design Practices: Passenger Car Automatic Transmissions, Many authors, Third Edition, AE-18, SAE, Warrendale, 1994.</li> <li>3. Handbook of Automotive Powertrain and Chassis Design- J. Fenton, Professional Engineering Publishing, London 1998.</li> <li>4. Gears and Transmissions, Vol. 4- J.G. Giles, Automotive Technology series, Butterworth, London 1969.</li> </ol>			

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**PhD Coursework Courses – 2018 (Automobile) As per 2017 Regulation**

<b>03</b>	<b>16MAU22</b>	<b>Group-3</b>	<b>AUTOMOTIVE BODY ENGINEERING AND SAFETY</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1: Introduction:</b> Types of car bodies, bus bodies and commercial vehicle bodies.</p> <p><b>Interior Ergonomics:</b> Introduction, Seating dimensions, Interior ergonomics, ergonomics system design, seat comfort, requirements of drivers and passenger seats, 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.</p>			
<p><b>Module2: Aerodynamics:</b> 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.</p> <p><b>Body Materials, Trim, Mechanisms:</b> Steel sheet, timber, plastic, GRP, properties of materials - Corrosion - Anticorrosion methods – Selection of paint and painting process - Body trim items - Body mechanisms.</p>			
<p><b>Module3: Noise and vibration:</b> Noise characteristics, Sources of noise, sound measurement techniques: Sound level meter, time and frequency weighting, Sound spectra – Octave band analysis, Various types of acoustic testing chambers, Sound power measurement from Sound pressure: Free field method, Reverberant field method, Semi-Reverberant field method and Comparison method (using calibrated Sources) Two- microphone probe for measuring; Sound power measurement from Sound Intensity, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression.</p>			
<p><b>Module4: Body Loads and Design of Vehicle Bodies:</b> Idealized structure- structural surface, shear panel method, symmetric and asymmetrical vertical loads in car, longitudinal loads, different loading situations.</p> <p><b>Vehicle Layout design:</b> preliminary design, Load distribution on vehicle structure, stress analysis of bus body structure under bending and torsion, stress analysis in integral bus body, Design of chassis frame, Rules and regulations for body, Recent safety measures, Testing of body.</p>			
<p><b>Module5: Vehicle safety:</b> Active and passive safety, Restraint systems used in automobiles: safety belts, Head restraints, Air bags, Knee bolsters, Importance of Bumpers and their design, Types of safety glass and their requirements, Importance of Ergonomics in Automotive safety- Locations of controls.</p> <p><b>Vehicle structures for crash worthiness:</b> Types of crash / roll over Tests, Regulatory requirements for crash testing, Instrumentation, high speed photography, Image Analysis.</p>			
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Vehicle Body Engineering-Pawloski J., Business Books Ltd.</li> <li>2. The automotive chassis: Engineering principle - Reimpell J, 2nd Edition, 1983.</li> <li>3. Low speed Automobile Accidents -Watts, A. J., et al Lawyers and Judges 1996</li> <li>4. An Introduction to Modern Vehicle Design- JullianHappian-Smith SAE, 2002.</li> </ol>			

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<b>01</b>	<b>16MAU421</b>	<b>Group-4</b>	<b>VEHICLE PERFORMANCE</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<b>Module 1: Introduction to vehicle system:</b> Morphology of vehicles, General layout of passenger cars and commercial vehicle, Type of power units, arrangement of power train, Vehicle controls.			
<b>Module 2: Friction and rolling resistance of pneumatic tyres:</b> Aerodynamics forces and moments, Relationship between tractive effort and longitudinal slip of tyres, cornering properties of tyres, Equation of motion and maximum tractive effort.			
<b>Module 3: Vehicle performance estimation and prediction:</b> Power plant characteristic and transmission related requirements, Vehicle acceleration, and max. Speed, Gradability Drive systems comparison.			
<b>Module 4: Vehicle transmissions:</b> Characteristics and features friction clutches, mechanical geared transmission lay shaft and epicyclic gearbox, Synchronizers, Fluid coupling and torque converters. Drive lines, two wheel drive, four wheel drive, braking arrangement, safety in braking, weight transfer steering, and cornering power of tyres.			
<b>Module 5: Handling characteristics of vehicles:</b> Steering geometry, steady state handling characteristics, steady state response to steering input. Directional stability of vehicle. Effect of shock and vibration on human being, comfort criteria.			
<b>Question paper pattern:</b> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<b>Text Books:</b> <ol style="list-style-type: none"> <li>1. Mechanics of road vehicle- W. Steeds, Illiffe Books Ltd, London3rdEdition, 1992.</li> <li>2. Steering, Suspension tyres- J. G. Giles, Illife Books Lid London1st Edition, 1975.</li> <li>3. Automotive chassis- P. M .Heldt, Chilton Co,New York, 1st Edition,1982.</li> <li>4. Vehicle Dynamics-J. R. Ellis, Business Books, London, 2ndEdition,1969.</li> </ol>			

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<b>02</b>	<b>16MAU24</b>	<b>Group-4</b>	<b>VEHICLE DYNAMICS</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1: Basics of Vibration:</b>                  Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Un-damped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility, Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed. Modal analysis.</p>			
<p><b>Module 2: Tyres:</b>                  Tyre forces and moments, Tyre structure, Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tyre. Performance of tyre on wet surface. Ride property of tyres. Magic formulae tyre model, Estimation of tyre road friction. Test on Various road surfaces. Tyre vibration..</p> <p><b>Braking Performance:</b>                  Basic equations, Braking forces, Brakes, Brake Proportioning, Antilock Brake system, Braking efficiency, Rear wheel lockup, Standards and Legislations, Numerical Examples.</p>			
<p><b>Module 3: Vertical Dynamics:</b>                  Human response to vibration, Sources of Vibration. Design, analysis and computer simulation of Passive, Semi-active and Active suspension using Quarter car, half car and full car model. Influence of suspension stiffness, suspension damping, and tyre stiffness. Control law for LQR, H-Infinite, Skyhook damping. Air suspension system and their properties.</p> <p><b>Vehicle Aerodynamics:</b>                  Aerodynamic, Aerodynamic forces lift and drag components, Pitching, yawing, rolling moments, and Total road loads, Numerical Examples.</p>			
<p><b>Module 4: Steady State Handling Characteristics of Road Vehicles;</b>                  Steering Geometry, Derivation of fundamental equation governing the steady-state handling behavior of a road vehicle, Neutral Steer, Understeer and Oversteer characteristics, characteristic and critical speeds, Neutral Steer Point, Static margin, Steady-State Response to Steering Input-Yaw Velocity Response, Lateral Acceleration Response, Sideslip Response and Curvature Response; Numerical Problems.</p> <p><b>Performance Characteristics of Off-Road Vehicles:</b>                  Drawbar Performance - Drawbar Pull and Drawbar Power, Tractive Efficiency, Coefficient of Traction, Weight-to-Power Ratio for Off-Road Vehicles; Fuel Economy of Cross-country Operations Transport Productivity and Transport Efficiency, Mobility Map and Mobility Profile, Selection of Vehicle Configurations for Off-Road, Numerical Problems.</p>			
<p><b>Module 5: Suspension Mechanisms:</b>                  Solid Axle Suspension, Independent Suspension, Roll Center and Roll Axis, Car Tire Relative Angles, Toe, Caster Angle, Camber, Trust Angle, Suspension Requirements and Coordinate Frames, Kinematics Requirements, Dynamic Requirements, Wheel, wheel body, and tyre Coordinate Frames, Caster Theory, Numerical examples.</p>			
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Vehicle Dynamics: Theory and Applications- Reza N. Jazar, Springer Verlag.</li> <li>2. Theory of Ground Vehicles- J. Y. Wong, John Willey &amp; Sons, NY.</li> <li>3. Fundamentals of Vehicle Dynamics- T. D. Gillespie, SAE.</li> <li>4. Tyres, Suspension, and Handling - John C. Dixon, 2nd Edition, Society of Automotive Engineers Inc, 1996.</li> </ol>			

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<b>03</b>	<b>16MAU154</b>	<b>Group-4</b>	<b>AUTOMOTIVE EMBEDDED SYSTEMS</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1: Electronics in Automotive:</b>                  Introduction Body and convenience electronics: vehicle power supply controllers and lighting modules, door control modules, Safety electronics: active safety systems: ABS, ASR, ESP passive safety systems: Restraint systems and their associated sensors in an automobile.                  Powertrain Electronics: Gasoline engine management, Infotainment electronics: Dashboard/instrument cluster, car audio, telematic systems, navigation systems, multimedia systems, cross application technologies. 42V vehicle power supply system.</p>			
<p><b>Module 2: Drive by Wire:</b> Challenges and opportunities of X-by-wire: system &amp; design requirements steer-by-wire, brake-by-wire, suspension-by-wire, gas-by-wire, power-by-wire, shift by-wire. Future of Automotive Electronics.</p>			
<p><b>Module 3: Hardware modules:</b> MC9S12XD family features -Modes of operation-functional block diagram overview-programming model. Memory Map Overview Pulse Width Modulator (PWM) –On-chip ADC Serial Communication Protocol: SCI, SPI,IIC, CAN.</p>			
<p><b>Module 4: Software Development Tools:</b>                  Introduction to HCS12XDT512 Student Learning Kit &amp; PBMCU (Project Board) –Introduction to Code Warrior IDE-Editing-Debugging-Simulating simple programs. Flashing code into HCS12XDT512 SLK board and testing.</p>			
<p><b>Module 5: Integration of Software and Hardware:</b>                  Downloading the Software from Host Machine to Target Machine. Implementing application prototype: Power Window and Automotive Lighting System.</p>			
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Semiconductors-Technical Information, Technologies and characteristic data, Publicis Corporate Publishing 2nd revised and considerably enlarged edition, 2004,</li> <li>2. Freescale MC9S12XDP512 data sheet</li> <li>3. Automotive Electronics Handbook- Ronald K Jurgen , McGraw Hill , 2000.</li> <li>4. Semiconductors: Technical Information, Technologies and Characteristic Data- Werner Klingenstein &amp; Team, Publicis Corporate Publishing, 2nd edition, 2004.</li> <li>5. Intelligent Vehicle Technologies: Theory and Applications- LjuboVlacic, Michel Parent &amp;FurnioHarshima, , Butterworth-Heinemann publications, 2001.</li> </ol>			



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<b>01</b>	<b>16MAU153</b>	<b>Group-5</b>	<b>VEHICLE MAINTENANCE AND FLEET MANAGEMENT</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<b>Module 1: Maintenance Tool, Shop, Schedule, Records:</b> Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re boring\ machine, fuel injection calibration machine.			
<b>Module 2: Importance of maintenance:</b> Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log books. Trip sheet. Lay out and requirements of maintenance shop.			
<b>Module 3: Power Plant Repair and Overhauling:</b> Dismantling of power plant and its components. Cleaning methods. Inspection and checking. Repair and reconditioning methods for all engine components. Maintenance of ignition system, fuel injection system, cooling system- lubrication system. Power plant trouble shooting chart.			
<b>Module 4: The Concept of Transport:</b> The means of transport, classifications, and road transport - advantages of road transport, advantages of motor transport, and motor transport in India - types of road and their features. Transit Operation: Route planning - route location, stop location, route schedules, vehicle and labor scheduling, traffic control - traffic signals, signal timing, freeway control systems. <b>Forms of Ownership:</b> Sole proprietorship, partnership, private limited company, public limited company, statutory company, local authority undertaking / municipal transport company, joint venture. <b>Costs and Fares:</b> Operating costs and types of vehicles - production economics, requirement of buses and frequency, garages and bus stations, garage organisation, construction of bus station.			
<b>Module 5: Legal Aspects:</b> Motor vehicle act- registration, necessity of permits, insurance, test of competence to drive, mistake / offences for which a driver can be punished, adult workers - hours of work, running time, split duty, journey time, round journey time, layover, frequency.			
<b>Question paper pattern:</b> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<b>Text Books:</b> <ol style="list-style-type: none"> <li>1. Motor Vehicle Servicing- A.W. Judge, 3rd Edition, Pitman Paper pack, London, 1969.</li> <li>2. Everyday Automobile repair- W. Crouse, Intl. student edition, TMH, New Delhi, 1986.</li> <li>3. Fleet management- John Dolu, McGraw-Hill Co., 1984.</li> <li>4. Government of India Publication, "The Motor vehicle Act ", 1989.</li> <li>5. Bus operation - Kitchin L D, Illiffe and Sons Ltd., London, III Edition, 1992.</li> <li>6. Spicer,-Automobile collision Work - Frazee, fledell, American technical publications, Chicago,1953.</li> <li>7. Maintenance of high speed diesel engines- A, W. Judge, Chapman Hall Ltd., London, 1956.</li> <li>8. Diesel Engine operation and maintenance- V. L. Maleev, McGraw Hill Book CO., New york, 1995.</li> </ol>			

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<b>02</b>	<b>16MAU252</b>	<b>Group-5</b>	<b>AUTOMOTIVE CHASSIS</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<b>Module 1: Overview of Vehicle chassis System:</b>			
General construction of chassis, Types of chassis layouts with respect to location of Power plant and drive arrangements and their comparison. Stability of vehicle on slope, weight distribution, numerical on above topics.			
<b>Frames:</b>			
Types of frames, loads acting of frame, cross sections and materials for frames, loading points, sub frames, calculation of cross section of frame members, Testing of frames.			
<b>Module 2: Front axle and steering systems:</b>			
Types of front axles and stub axles, Axle parts and materials, loads and stresses, center sections, section near steering head, spring pads, Front wheel geometry- Camber, Castor, toe –in, toe out, King Pin Inclination, under steer and over steer conditions, etc. Condition for correct steering, types of steering gears, power steering, Types of linkages, Ackermann and Davis steering mechanisms, Reversible and Irreversible steering.			
<b>Module3: Suspension system:</b>			
Need, functions and requirements of suspension system, types of suspension system, Constructional details of leaf spring, helper springs, coil springs, torsion bar, rubber springs, plastic springs, air bellows or pneumatic suspension, hydraulic suspension, constructional details of telescopic shock absorbers, independent suspension, front wheel independent suspension, rear wheel independent suspension, types, stabilizer, trouble shooting, Numerical problems.			
<b>Module 4: Brakes:</b>			
Necessity and requirements of brakes, stopping distance and time, brake efficiency, weight transfer, brake shoe theory, determination of braking torque, Classification of brakes, constructional details- Drum Bakes Disc brakes and their comparison, Hydraulic brake system, Pneumatic brakes, Power assisted Braking system, Servo Brakes, Anti-lock Braking system, Retarders, Hill Holders, Requirements of brake fluids, , trouble shooting.			
<b>Module 5: Rear Axles:</b>			
Construction of rear axles, Types of loads acting on rear axle, Full floating, Three Quarter Floating and Semi – floating axles, Hotchkiss and torque tube drive.			
<b>Wheels and Tyres:</b>			
Types of wheels, construction, structure and function, wheel dimensions, structure and function of tyres, static and dynamic properties of pneumatic tyres, types of tyres, materials, tyre section & designation, factors affecting tyre life, special wheels, trouble shooting.			
<b>Question paper pattern:</b>			
<ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<b>Text Books:</b>			
<ol style="list-style-type: none"> <li>1. Automotive Chassis – P.M. Heldt, Chilton &amp; Co.</li> <li>2. Automotive Mechanics – N.K. Giri ,Khanna Publications, New Delhi,2004.</li> <li>1. Automotive mechanics – Joseph I Heintner, Affiliate d East West Press, New Delhi/Madras,1967</li> <li>2. Automobile Engineering Vol. I - Kirpal Singh, Standard publications, New Delhi</li> <li>3. A Text Book of Automobile Engineering- Laxmi Publications Private Ltd, 2007.</li> </ol>			

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<b>03</b>	<b>16MAU424</b>	<b>Group-5</b>	<b>TWO AND THREE WHEELER TECHNOLOGY</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1: The Power Unit:</b> Types of engines for two wheelers, advantages and disadvantages of two stroke and four stroke engines, engine components, constructional details, materials, symmetrical and unsymmetrical port timing diagrams, valve actuating mechanisms, valve timing diagrams. Rotary valve engine, Advantages and disadvantages of diesel engines for two wheelers, power plant for electric bikes, exhaust systems.</p>			
<p><b>Module2:</b>  <b>Fuel, Lubrication and Cooling system:</b> Layout of fuel supply system, fuel tank construction, carburetor types, construction, working and adjustments. Types of cooling systems, advantages of air cooling system. Lubrication types, Lubrication of parts, grades of lubricating oils.  <b>Electrical system:</b> Types of ignition system, their working principles, wiring diagram for Indian vehicles, spark plug construction, indicators and gauges used in two wheelers, lighting systems.</p>			
<p><b>Module3: Transmission system:</b>  <b>Primary drive and Clutch:</b> Motor cycle power train, Primary drives, Types of primary drives, Chain drive, Gear drive, Construction and operation of motorcycle clutches, Clutch release mechanism. Gear boxes.  <b>Transmission:</b> Introduction to motorcycle transmission, Sprockets and chain, Gears and Dogs in motor cycle transmission, Gear and Gear ratios, Sliding gear transmissions, Shifting fork mechanisms, Constant mesh transmissions and lubrication.  <b>Final drive:</b> Introduction to motorcycle final drives, Fundamentals of chain drive, Chain lubrication and lubricators, Shaft drives, Drive shaft couplings, Final drive gear case.</p>			
<p><b>Module 4: Frames and suspension:</b> Types and constructional details of frames, advantages and limitations, frame materials, frame stresses, frame building problems, frame components, Front and Rear suspension systems, shock absorber construction and working, Panel meters and controls on handle bar, body manufacture and painting.  <b>Brakes and Wheels:</b> Front and rear braking systems, disc and drum brakes, merits and demerits, Types of wheels, loads on wheels, construction and materials for wheels, wheels designation, tyre designation, inflation, types of tyres, construction details.</p>			
<p><b>Module 5: Two wheelers and Three wheelers:</b> Case study of major Indian models of major motor cycles, scooters, scooteretts and mopeds. Case study of Indian models of three wheelers, Front mounted engine and rear mounted engine types, Auto rickshaws, pick up van, delivery van and trailer.  <b>Maintenance:</b> Importance of maintenance, Decarburizing procedure for engine and silencer, periodic inspection, maintenance schedules, trouble diagnosis charts, safety precautions, Lubrication charts.</p>			
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> </ul> <p>The students will have to answer 5 full questions, selecting one full question from each module.</p>			
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Motor cycle engines - P. E. Irving, Temple Press Book, London, 1992</li> <li>2. Motor cycles -Michel M. Griffin</li> <li>3. Motor cycle Mechanics - William H. Crouse and Donald L. Anglin, TMH</li> <li>4. The cycle Motor manual - Temple Press Ltd, 1990</li> <li>5. Vespa maintenance and repair series - Bryaut R. V.</li> </ol>			

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. Encyclopedia of Motor Cycling 20 volumes - Marshall Cavendish, New York., 1989

<b>01</b>	<b>16MAU23</b>	<b>Group-6</b>	<b>AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEMS</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<b>Module 1:</b>			
<b>Storage Battery:</b>			
Principle of lead acid cells, plates and their characteristics containers and separators, electrolyte and their preparation, effect of temperature on electrolyte, its specific gravity, capacity and efficiency, methods of charging from D.C. mains, defects and remedies of batteries, care of idle and new batteries. Recycling Process - Recent development in batteries			
<b>Charging :D.C. Generators and Alternators their Characteristics. Control cutout, Electrical, Electro-mechanical and electronic regulators. Regulations for charging.</b>			
<b>Module2:</b>			
<b>Lighting System</b>			
Wiring Requirements, Insulated and earth return system, details of head light and side light, LED lighting system, wiring colour code, Sealed beam head lamp construction, head light dazzling and preventive methods. Static and Dynamic Beaming of lights.			
<b>Starter Motor &amp; Drives:</b>			
Battery motor starting system, condition at starting, behavior of starter during starting, series motor and its characteristics, consideration affecting size of motor, types of drives, starting circuit.			
<b>Module3:</b>			
<b>Ignition systems and Engine Management Systems:</b>			
Ignition fundamentals, Types of solid state ignition systems, components, construction and operating parameters, high energy ignition distributors, Electronic spark timing, Ignition Advance, Types DIS, MBT and control.			
Combined ignition and fuel management systems. Exhaust emission control, Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation. Complete vehicle control systems, Artificial intelligence and engine management			
<b>Module 4:</b>			
<b>Chassis systems:</b>			
Antilock brakes (ABS), Types , Active suspension, Traction control, Electronic control of automatic transmission, other chassis electrical systems, Central locking, Air bags and seat belt tensioners.			
Microprocessor And Microcomputer controlled devices in automobiles such as instrument cluster, Voice warning system, Travel information system, GPS, AUTOCOP , Keyless entry system.			
<b>Module 5:</b>			
<b>Accessories:</b> Warning and alarm instruments: Brake actuation warning system, traficators, flash system, oil pressure warning system, engine over heat warning system, air pressure warning system, speed warning system, door lock indicators, neutral gear indicator, horn design, permanent magnet horn, air & music horns. Wind shield wiper. window washer, instrument wiring system and electromagnetic interference suppression, wiring circuits for instruments, electronic instruments, dash board illumination and MIL.			
<b>Question paper pattern:</b>			
<ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> </ul>			
The students will have to answer 5 full questions, selecting one full question from each module.			
<b>Text Books:</b>			
<ol style="list-style-type: none"> <li>1. Automotive Hand Book -Bosch, SAE, 8th Edn.</li> <li>2. Storage Batteries - Vinal. G.W., John Wiley &amp; Sons inc., New York, 1985.</li> <li>3. Automobile Electrical Equipment – Crouse W. H., McGraw Hill Book Co Inc., New York, 1980.</li> <li>4. Electrical Ignition Equipment – Spread bury F. G., Constable &amp; Co Ltd., London, 1962.</li> </ol>			

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|---|
| 5. Automotive Computers and Digital Instrumentation - Robert N Brady, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988. |
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<b>02</b>	<b>16MAU253</b>	<b>Group-6</b>	<b>MANUFACTURING TECHNIQUES IN AUTOMOTIVE ENGG.</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1:</b>  <b>Sheet Metal Forming:</b>                  Introduction, Forming methods, shearing and Blanking, Bending, stretch forming, Deep drawing, redrawing operations, Defects in formed products.  <b>High Energy Rate Forming:</b>                  Explosive forming, Electro-hydraulic forming, Electro-magnetic forming, Super Plastic Forming – Process principles, Equipment, Process variables, Merits and Limitations</p>			
<p><b>Module 2:</b>  <b>Forging:</b>                  Classification, various stages during forging, Forging equipment, brief description, deformation in compression, forging defects. Residual stresses in forging.  <b>Special Casting processes:</b>                  Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Slush casting, Thixo-casting and Continuous Casting Processes. Different casting techniques for manufacturing of automotive components like cylinder block, piston, flywheel, bearing liners, etc.</p>			
<p><b>Module 3:</b>  <b>Powder Metallurgy Processing:</b>                  Process details and special characteristics of Powder Metallurgy process, Powder making methods, Characteristics of Powders, Process flow chart, Process steps and Process variables.                  Compaction techniques like CIP &amp; HIP (Cold Iso-static and Hot Iso-static pressing), Product design considerations, Applications of Powder metallurgy.</p>			
<p><b>Module4:</b>  <b>Joining methods- Fusion:</b>                  MIG-CO2 welding, Flux Cored Arc Welding, Resistance Seam, Spot and Projection Welding-Process principles, Equipment, Process variables, Merits and Limitations.  <b>Solid State Welding:</b>                  Friction Welding, Friction Stir Welding - Process principles, Equipment, Process variables, Merits and Limitations.</p>			
<p><b>Module 5:</b>  <b>Joining of Plastics:</b>                  Heated tool welding or hot bar welding, Hot gas welding or pendulum welding, High frequency welding, Ultrasonic welding, Friction welding, Induction welding.</p>			
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Fundamentals of Working of Metals- Sach G., Pergamon Press.</li> <li>2. Engineering Materials &amp; their applications, R. A. Flinn&amp; P. K. Trojan, 4th edition, Jaico Publishing House.</li> <li>3. ASM Handbook on Powder Metallurgy, Volume 17, ASM publications</li> <li>4. High speed combustion engines- P.M. Heldt, Oxford and IBH Publishing Co, New York, 1990.</li> <li>5. AWS Hand Book on welding</li> <li>6. Welding Technology- O.P. Khanna.</li> <li>7. Welding for Engineers-Udin, funk &amp;Wulf.</li> <li>8. Welding and Welding Technology- R.L. Little.</li> </ol>			

**Visvesvaraya Technological University, Belagavi.**

**PhD Coursework Courses – 2018 (Automobile) As per 2017 Regulation**

<b>03</b>	<b>16MAU422</b>	<b>Group-6</b>	<b>HYBRID VEHICLE TECHNOLOGIES</b>
<b>Exam Hours:03</b>		<b>Exam Marks:100</b>	
<p><b>Module 1:</b>  <b>Hybrid Vehicles:</b>                  Introduction to HVs, Performance characteristics of road vehicles; calculation of road load, predicting fuel economy, grid -connected hybrids.</p> <p><b>Hybrid architecture:</b>                  Series configuration- locomotive drives, series parallel switching, load tracking architecture. Pre transmission parallel and combined configurations-Mild hybrid, power assist, dual mode, power split, power split with shift, Continuously Variable transmission (CVT), wheel motors</p>			
<p><b>Module 2:</b>  <b>Propulsion methods:</b>                  DC motors-series wound, shunt wound, compound wound and separately excited motors AC motors- Induction, synchronous, brushless DC motor, switched reluctance motors.</p>			
<p><b>Module 3:</b>  <b>Hybrid power plant specifications:</b>                  Grade and cruise targets, launching and boosting, braking and energy recuperation, drive cycle implications, engine fraction-engine downsizing and range and performance, usage requirements.</p> <p><b>Sizing the drive system:</b>                  Matching electric drive and ICE, sizing the propulsion motor; sizing power electronics.</p>			
<p><b>Module4:</b>  <b>Energy storage technology:</b>                  Battery basics; lead-acid battery; different types of batteries; battery parameters, Battery Recycling</p> <p><b>Fuel cells:</b>                  Fuel cell characteristics, fuel cell types – alkaline fuel cell, proton exchange Membrane; direct methanol fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, hydrogen storage systems, reformers, fuel cell EV, super and ultra capacitors</p>			
<p><b>Module 5:</b>  <b>Non-electric Hybrid Propulsion Systems:</b>                  Short-Term Storage Systems- Flywheel Accumulators. Continuously Variable Transmissions Hydraulic Accumulators Hydraulic Pumps/Motors, Pneumatic Hybrid Engine Systems- Operation Modes.</p>			
<p><b>Question paper pattern:</b></p> <ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 20 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul>			
<p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. The Electric Car: Development &amp; Future of Battery, Hybrid &amp; Fuel-Cell Cars - Mike Westbrook, M H Westbrook, British library Cataloguing in Publication Data.</li> <li>2. Electric and Hybrid Vehicles- Robin Hardy, Iqbal Husain, CRC Press.</li> <li>3. Propulsion Systems for Hybrid Vehicles- John M. Miller, Institute of Electrical Engineers, London.</li> <li>4. Energy Technology Analysis Prospects for Hydrogen and Fuel Cells, International Energy Agency, France.</li> <li>5. Handbook of Electric Motors- Hamid A Toliyat, Gerald B Kliman, Marcel Decker Inc</li> </ol>			