

# **COURSE STRUCTURE**

**B.TECH.**

**MECHANICAL ENGINEERING**

**(SPECIALIZATION IN AUTOMOBILE  
ENGINEERING)**

**Under**

**Choice Based Credit System (CBCS)**

**B. Tech. Mechanical Engineering (Specialization in Automobile Engineering)**

| S.No. | Department | Program Offered   | Credits |     | Total Credits |
|-------|------------|---|---------|-----|---------------|
|       |            |   |         |     |               |
| 1     | ME         | B.Tech. Mechanical Engineering<br>(Specialization in Automobile<br>Engineering) | HSS     | 25  | 184           |
|       |            |   | BS      | 24  |               |
|       |            |   | ES      | 28  |               |
|       |            |   | PC      | 48  |               |
|       |            |   | PE      | 26  |               |
|       |            |   | OE      | 16  |               |
|       |            |   | Proj    | 17  |               |
|       |            |   | MNG     | 8 U |               |

## Program Core

| S. NO.            | CODE      | SUBJECT  | TEACHING SCHEME |   |   |   | CREDITS | CONTACTS HR/WK | PRE- REQUISITES  |
|-------------------|-----------|--|-----------------|---|---|---|---------|----------------|--|
|                   |           |  | L               | T | P | J |         |                |  |
| <b>THEORY</b>     |           |  |                 |   |   |   |         |                |  |
| 1                 | BME C0002 | Applied Thermodynamics                           | 3               | 1 | 0 | 0 | 4       | 4              | Basic Mechanical   |
| 2                 | BME C0005 | Fluid Mechanics                                  | 3               | 0 | 0 | 0 | 3       | 3              | Engineering  |
| 3                 | BME C0007 | Strength of Material                             | 3               | 0 | 0 | 0 | 3       | 3              | Applied Mechanics  |
| 4                 | BMEC 0008 | Kinematics of Machines                           | 3               | 0 | 0 | 0 | 3       | 3              | Applied Mechanics  |
| 5                 | BMEC 0009 | Dynamics of Machine                              | 3               | 0 | 0 | 0 | 3       | 3              | Kinematics of Machines                                     |
| 6                 | BME C0010 | Machine Design I                                 | 3               | 0 | 0 | 0 | 3       | 3              | Strength of Material                                       |
| 7                 | BME C0014 | Modern Vehicle Technology                        | 3               | 0 | 0 | 0 | 3       | 3              |  |
| 8                 | BMEC 0016 | Fuels and Lubricants                             | 3               | 0 | 0 | 0 | 3       | 3              |  |
| 9                 | BMEC 0017 | Automotive Petrol and Diesel Engines             | 3               | 0 | 0 | 0 | 3       | 3              | Thermodynamics   |
| 10                | BMEC 0018 | Automotive Electrical and Electronics System     | 3               | 0 | 0 | 0 | 3       | 3              | Kinematics of Machines, Elements of Electronic Engineering |
| 11                | BMEC 0019 | Vehicle Body and Dynamics                        | 3               | 0 | 0 | 0 | 3       | 3              |  |
| 12                | BMEC 0020 | Automotive Chassis and Transmission System       | 3               | 0 | 0 | 0 | 3       | 3              |  |
| 13                | BMEC 0021 | Automotive Engg.                                 | 3               | 0 | 0 | 0 | 3       | 3              | Kinematics of Machines, Dynamics of Machines               |
| 14                | BMEC 0022 | Two and Three Wheeler                            | 3               | 0 | 0 | 0 | 3       | 3              | Automobile System  |
| <b>PRACTICALS</b> |           |  |                 |   |   |   |         |                |  |
| 15                | BME C0803 | Fluid Mechanics Lab                              | 0               | 0 | 2 | 0 | 1       | 2              | BME C0005  |
| 16                | BMEC 0805 | Theory of Machine Lab                            | 0               | 0 | 2 | 0 | 1       | 2              | BMEC 0009  |
| 17                | BME C0806 | Machine Design I Lab                             | 0               | 0 | 2 | 0 | 1       | 2              | BME C0010  |
| 18                | BMEC 0810 | Automotive Electrical and Electronics System Lab | 0               | 0 | 2 | 0 | 1       | 2              | BMEC 0018  |

|              |           |                      |           |          |           |          |           |           |           |
|--------------|-----------|----------------------|-----------|----------|-----------|----------|-----------|-----------|-----------|
| 19           | BMEC 0811 | Automotive Engg. Lab | 0         | 0        | 2         | 0        | 1         | 2         | BMEC 0021 |
| <b>Total</b> |           |                      | <b>42</b> | <b>1</b> | <b>10</b> | <b>0</b> | <b>48</b> | <b>53</b> |           |

## Program Elective

| S. NO.                             | CODE      | SUBJECT  | TEACHING SCHEME |   |   |   | CREDITS | CONTACTS HR/WK | PRE- REQUISITES        |
|------------------------------------|-----------|--|-----------------|---|---|---|---------|----------------|------------------------|
|                                    |           |  | L               | T | P | J |         |                |                        |
| <b>Bouquet: Thermal Automotive</b> |           |  |                 |   |   |   |         |                |                        |
| <b>THEORY</b>                      |           |  |                 |   |   |   |         |                |                        |
| 1.                                 | BME E0601 | Vehicle Performance & Testing                              | 3               | 0 | 0 | 0 | 3       | 3              |                        |
| 2.                                 | BME E0602 | New Generation and Hybrid Vehicles                         | 3               | 0 | 0 | 0 | 3       | 3              |                        |
| 3.                                 | BME E0603 | Trouble Shooting, Servicing And Maintenance Of Automobiles | 3               | 0 | 0 | 0 | 3       | 3              |                        |
| 4.                                 | BME E0604 | Automobile Air Conditioning                                | 3               | 0 | 0 | 0 | 3       | 3              | Thermodynamics         |
| 5.                                 | BMEE0006  | Gas Turbine and Jet Propulsion                             | 3               | 1 | 0 | 0 | 4       | 4              | Applied Thermodynamics |
| 6.                                 | BMEE 0008 | Solar Energy   | 3               | 0 | 0 | 0 | 3       | 3              | Applied Thermodynamics |
| <b>PRACTICALS</b>                  |           |  |                 |   |   |   |         |                |                        |
| 7.                                 | BMEE 0172 | Solar Energy Lab   | 0               | 0 | 2 | 0 | 1       | 2              | BMEE 0008              |
| 8.                                 | BMEE 0186 | Project based Solar Energy Lab                             | 0               | 0 | 0 | 8 | 2       | 8              | BMEE 0008              |

## Program Elective

| S. NO.                            | CODE       | SUBJECT                                 | TEACHING SCHEME |   |   |   | CRE DITS | CON TACTS | PRE- REQUISITES                    |
|-----------------------------------|------------|---|-----------------|---|---|---|----------|-----------|------------------------------------|
|                                   |            |   | L               | T | P | J |          |           |                                    |
| <b>Bouquet: Fluids Automotive</b> |            |   |                 |   |   |   |          |           |                                    |
| <b>THEORY</b>                     |            |   |                 |   |   |   |          |           |                                    |
| 9.                                | BME E 0605 | Alternative Fuels And Pollution control | 3               | 0 | 0 | 0 | 3        | 3         | Chemistry                          |
| 10.                               | BMEE0101   | Advanced Fluid Mechanics                | 3               | 1 | 0 | 0 | 4        | 4         | Fluid Mechanics                    |
| 11.                               | BME E 0606 | Automotive Aerodynamics                 | 3               | 0 | 0 | 0 | 3        | 3         |                                    |
| 12.                               | BMEE0105   | Computational Fluid Dynamics            | 3               | 0 | 0 | 0 | 4        | 4         | Numerical Methods & Turbulent Flow |
| <b>PRACTICALS</b>                 |            |   |                 |   |   |   |          |           |                                    |
| 13.                               | BMEE0175   | CFD Lab                                 | 0               | 0 | 2 | 0 | 1        | 2         | BMEE0105                           |

## Program Elective

| S. NO.  | CODE      | SUBJECT                        | TEACHING SCHEME |   |   |   | CREDITS | CONTACTS HR/WK | PRE- REQUISITES     |
|---|-----------|--------------------------------|-----------------|---|---|---|---------|----------------|---------------------|
|   |           |                                | L               | T | P | J |         |                |                     |
| <b>Bouquet: Design &amp; Safety of Automotive</b> |           |                                |                 |   |   |   |         |                |                     |
| <b>THEORY</b>                                     |           |                                |                 |   |   |   |         |                |                     |
| 14.   | BMEE0203  | Finite Element Methods         | 3               | 1 | 0 | 0 | 4       | 4              | Continuum Mechanics |
| 15.   | BMEE0204  | Vibration and Noise            | 3               | 1 | 0 | 0 | 4       | 4              | Dynamics of Machine |
| 16.   | BME E0607 | Off-road Vehicles              | 3               | 0 | 0 | 0 | 3       | 3              | Machine Design      |
| 17.   | BME E0608 | Design of Transmission Systems | 3               | 0 | 0 | 0 | 3       | 3              |                     |

**B. Tech. Mechanical Engineering (Specialization in Automobile Engineering)**

|     |           |                   |   |   |   |   |   |   |  |
|-----|-----------|-------------------|---|---|---|---|---|---|--|
| 18. | BME E0609 | Automotive Safety | 3 | 0 | 0 | 0 | 3 | 3 |  |
|-----|-----------|-------------------|---|---|---|---|---|---|--|

**BME C0014: MODERN VEHICLE TECHNOLOGY**

**Objective:** The course content should be taught and curriculum should be implemented with the aim to develop different types of skills leading to the achievement of the following competency:

- **Improve efficiency, security, safety & performance of automobile using electronics and technology.**

**Credits: 04**

**Semester III**

**L-T-P: 3-1-0**

| Module No. | Content  | Teaching Hours |
|------------|--|----------------|
| I          | <p><b>Applications of Transducers &amp; Sensors:</b> Concept of general measurement system &amp; difference between Mechanical and electrical/ electronic instruments; Measurement of Temperature: Working of Thermocouple and Thermistor; Measurement of Speed: Contact less electrical tachometer, Inductive, Capacitive type tachometer, Stroboscope; Measurement of Force: Strain gauge load cell; Basic requirement of Sensors, Functions, Applications and Circuitry arrangement of various Sensors such as Mass Air flow rate sensor, Exhaust gas Oxygen concentration, Throttle plate angular position, Crankshaft angular position, Coolant temperature, Intake air temperature, Manifold absolute pressure (MAP), Vehicle speed Sensor, Rain Sensor &amp; Rain sensing wiper.</p> <p><b>Advance Ignition system:</b> Electrical &amp; electronics ignition system. Modern Spark Ignition system (e.g. D.T.S.I , T.D.S.I., Multi electrode etc. System) Insulated coils. Concept of Non-Battery Energy Storage: Ultra capacitors and Flywheels.</p> <p><b>Advancement in Engine and related components:</b> Introduction &amp; types of hybrid vehicle. Hybrid drives systems. Compressed air car. Solar Cars. Hydrogen operated Engine. Basic concepts of Blue Motion Technologies like DSG, TSI, TDI, GDI variable valve timing system.</p> | 28             |
| II         | <p><b>Modernization in Peripheral systems:</b> Security Systems. Remote keyless entry, Anti-theft system, Alarm system. Entertainment and peripheral systems. Integrated communications, Proximity sensors, Global positioning satellites (GPS).</p> <p><b>Advance Safety Equipments:</b> Seat Belts, Seat Belts pre-tensioners, Smart seatbelt Reminder, Concepts of Crash test, Crash sensors. Air bags Introduction of air bags, Dual stage air bags, Side Airbags. Tire pressure monitoring system Pedestrian Protection &amp; Night vision with pedestrian detection.</p> <p><b>Modern Features in Automobile:</b> Power Sliding doors. Electronic stability / Skid-control system, Traction control system. Telescopic steering wheel / adjustable pedals. Rear mounted Radar &amp; Cameras. Electromagnetic suspension and levitation. Automatic Lift Axle. Regenerative Braking Systems. Continuous Variable Transmission. Intelligent Parking Assist System, Self-Parking.</p>  | 21             |

**Text Books:**

- Tom Denton, 'Automobile Electrical and electronic systems', Arnold ISBN-0750662190, third edition, 2004.
- Thareja BL, 'Fundamentals of Electrical and Electronics Engineering', Nirja Construction & Development Co Ltd, New Delhi, 1984.
- P L Kohli , 'Automotive Electrical Equipment's', Tata Mc- Graw Hill, New Delhi, 1983.
- A. K. Sawhney and Puneet Sawhney, 'A Course in Electrical and Electronic Measurements and Instrumentation', Dhanpat Rai and sons, New Delhi, 1973.

**Reference Books:**

- John Turner, 'Automotive Sensors', Momentum press, LLC NEW YORK ISBN- 9781606500095 ,ISBN- 1606500090, 2009.
- Barbara J. Peters, George A. Peters, 'Automotive Vehicle Safety', SAE International and Taylor & Francis ISBN - 978-0-7680-1096-1, London, 2002.
- J. Marek, H.-P. Trah Sensors, 'Automotive Technology', Y.Suzuki, I. Yokomor / ISBN - 3527295534 Wiley-vch, weinheim, 2003.
- Jeff Daniels, 'Modern Car Technology', J Haynes & Co. Ltd., 2009

**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2

**Outcome:** Upon successful completion of this course, the student will be able to:

| CO | CO Statement  | PO/PSO                         | CL   | KC  | Duration |
|----|---|--------------------------------|------|-----|----------|
| 1  | Describe construction, functions and applications of various sensors and actuators used in modern vehicle         | PO1, PO3, PO6, PO12/PSO1       | U&Ap | F   | 8        |
| 2  | Explain modern Ignition systems of S.I. and C.I. Engines.   | PO1, PO3, PO4, PO6, PO10/ PSO1 | U    | C   | 7        |
| 3  | Describe latest advancement in Engine technology.   | PO2, PO3, PO4, PO6/PSO1        | R&U  | C   | 8        |
| 4  | Identify and describe various advanced peripheral system used in automobile.                                      | PO2, PO3, PO4, PO6/PSO1        | R&U  | P   | 8        |
| 5  | Demonstrate various safety features and equipment used in modern vehicle.   | PO3, PO6, PO9/ PSO1            | Ap   | C&S | 10       |
| 6  | Describe various modern features like EBD, ABS, Regenerative Braking System etc for better functioning of vehicle | PO1, PO3, PO6, PO9/PSO1        | U    | C   | 8        |

**BMEC 0016 FUEL AND LUBRICANTS**

**Credits: 03**

**Semester IV**

**L-T-P: 3-0-0**

| Module No. | Content   | Teaching Hours |
|------------|---|----------------|
| I          | <p><b>Fuels:</b> Fuels and its types Chemical structure of petroleum, petroleum refining process, products of refining process, Important qualities of S.I and CI engine fuels, Rating of SI and CI engine fuels.</p> <p><b>Properties &amp; Testing of Fuels:</b> Calorific value of fuels and its determination, bomb calorimeter, properties and testing of fuels &amp; Lubricants, viscosity and viscosity index, flash and fire point, cloud and pour point, oiliness steam emulsion number volatility, corrosion stability, carbon residue, aniline point, decomposition stability, precipitation number, ash content, neutralization number, specific gravity and API gravity, saponification number, iodine value, mechanical stability. Consistency and drop point test for grease. B.I.S specification for diesel, petrol, biodiesel and C.N.G.</p> <p><b>Combustion:</b> Combustion in Spark Ignition Engines, stages of combustion in SI Engines flame front propagation, factors influencing the flame speed, rate of pressure rise, abnormal combustion, the phenomenon of knock in SI Engines, effect of engine variables on knock, Combustion in Compression Ignition Engines, stages of combustion in CI Engines, Factors affecting the delay period, The phenomenon of knock in CI Engines.</p> | 26             |
| II         | <p><b>Alternate Fuels:</b> Introduction, possible alternatives Solid fuels, Liquid Fuels, surface Ignition alcohol CI Engine, Spark assisted Diesel, Gaseous Fuels (Hydrogen, CNG, LPG) Dual fuel operation. Other possible fuels (Biogas, producer gas, Blast furnace gas, Coke oven gas, Benzol, Acetone, Diethyl ether, vegetable oil, biodiesel). Introduction to alternate energy source vehicles like, electric vehicle, hybrid, fuel cell &amp; solar cars.</p> <p><b>Lubricants:</b> Introduction, Friction, Specific requirements for automotive lubricants, functions of lubrication, Classification of lubricants (lubricating oils, semi solid lubricants or greases, solid lubricants, lubricating Emulsions). Synthetic lubricants.</p> <p><b>Theory of Lubrication:</b> Mechanism of lubrication (Boundary lubrication, Elasto hydrodynamic lubrication, Hydrodynamic lubrication hydrostatic lubrication Extreme Pressure Lubrication). Lubrication of Engine and Machine Components.</p>   | 23             |

**Text Book:**

- *Internal Combustion Engines* by Ganesan V, Tata McGraw Hill Education Private Limited New Delhi.
- *Lubrication*, Raymond G. Gunther, Chipton Book Co.- 1971.
- *Surface Engineering and Engineering Tribology* by Dr R.B. Choudhary and M.K. Sharma R. Chand and Company
- *Fuels – Solids, Liquids, Gaseous* by Brame, J.S.S. and King, J.G.
- *Fuels and Fuel Technology* by Francis, W, Vol. I & II
- *Modern Petroleum Technology* by Hobson, G.D. & Pohl. W
- *Lubrication–A practical guide to lubricant selection* by A.R. Lansdown, Pergamon press – 1982.
- *Energy today & tomorrow* by Maheswar Dayal, I & B Horishr India.
- *Internal Combustion Engineering and Air Pollution* by Obert. E.F., International Book Co., 1988.

**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2

**Outcome:** Upon successful completion of this course, the student will be able to:

| CO | CO Statement   | PO/PSO                         | CL   | KC  | Duration |
|----|--|--------------------------------|------|-----|----------|
| 1  | Understand the manufacturing process of fuel and lubricants.   | PO1, PO3, PO6, PO12/ PS01      | U    | F   | 8        |
| 2  | Explain various B.I.S specifications of diesel, biodiesel, Bio-gas & CNG fuels.  | PO1, PO3, PO4, PO6, PO10/ PS01 | U    | C   | 7        |
| 3  | Understand fuel rating, additives to be used for grading the fuel, it's quality to increase or decrease for increasing the efficiency of the engine, according to climatic conditions. | PO2, PO3, PO4, PO6/ PS01       | U    | C   | 8        |
| 4  | Identify and distinguish clearly the properties of various alternate fuels & their application for clean environment & pollution control.  | PO2, PO3, PO4, PO6/ PS01       | U&Ap | C&S | 8        |
| 5  | Explain various properties of Lubricants & their applications.   | PO1, PO3, PO6, PO10/ PS01      | U&Ap | C   | 10       |
| 6  | Describe the mechanism of lubricants like Boundary Lubrication, Hydrodynamic lubrication etc   | PO1, PO3, PO6, PO9/ PS01       | U    | U&P | 8        |

**BMEC 0017: AUTOMOTIVE PETROL& DIESEL ENGINE**

**Prerequisites:** Thermodynamics, Basic Mechanical engineering

**Objectives:** The purpose of this course is to impart adequate knowledge on SI Engines.

**Credits: 03**

**Semester: V**

**L-T-P: 3-0-0**

| Module No. | Contents   | Teaching Hours (Approx.) |
|------------|--|--------------------------|
| I          | <p><b>Engine Construction and Operation:</b> Constructional details of 4 stroke petrol engine. Working principle, Otto cycle, and actual indicator diagram. Two stroke engine construction and operation. Comparison of four stroke and two-stroke engine operation. Firing order and its significance.</p> <p><b>SI Engine Fuel System:</b> Carburettor working principle. Requirements of an automotive carburettor; Starting, idling, acceleration and normal circuits of carburettors, compensation, Maximum power devices, constant choke and constant vacuum carburettors. Fuel feed systems, Mechanical and electrical pumps, Petrol injection.</p> <p><b>Diesel cycle:</b> Fuel- air and actual cycle analysis. Diesel fuel, Ignition quality. Cetane number, Fuel Injection System: Requirements, Air and solid injection, function of components, Jerk and distributor type Pumps. Pressure waves, Injection lag, Unit injector, Mechanical and Pneumatic governors. Fuel injector-types of injection nozzle, Spray characteristics, injection timing, pump calibration.</p> | 22                       |
| II         | <p><b>Cooling and Lubrication System:</b> Need for cooling system. Types of cooling system, Liquid cooled system, Thermo-syphon system, and Pressure cooling system. Lubrication system, Mist lubrication system, Wet sump and dry sump lubrication. Properties of lubricants. Properties of coolants.</p> <p><b>Combustion and Combustion Chambers:</b> Combustion in SI &amp; CI engines, stages of combustion, flame propagation, rate of pressurise, abnormal combustion, knocks. Effect of engine variables and knock. Combustion chambers, Different types, Factor controlling combustion chamber design.</p> <p><b>Diesel Engine Testing and Performance:</b> Methods to improve engine performance. Heat balance. Performance maps. Supercharging and Turbocharging: Necessity and limitation, Charge cooling, Types of supercharging and turbo charging, relative merits, matching of turbocharger</p>  | 23                       |

**Text Books :**

- V. Ganeshan, “Internal Combustion Engines”: Tata McGraw-Hill, 2015.
- V. Ganeshan, “Gas Turbines”: Tata McGraw-Hill, 2013.
- W. W. Pulkrabek, “Engineering fundamental of the I.C.Engine”: PHI, India, 2012.

**Reference Books:**

- E. F. Obert, “Internal Combustion Engines & Air pollution”: Hopper & Row Publication New York, 2011.
- John B. Heywood, “Internal Combustion Engines Fundamentals”: McGraw Hill, New York, 2013.
- E. F. Obert, “International Combustion Engines Analysis and Practice”: International Text Book Co.,Scranton,Pennsylvania,1988.
- Wiliam. H. Crouse, “Automotive Engines”: McGraw HillPublishers,1985.
- H. E. Ellinger, “Automotive Engines”: Prentice Hall Publishers,1992.

***Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

| CO | CO Statement   | PO/PSO                | CL  | KC  | Duration |
|----|--|-----------------------|-----|-----|----------|
| 1  | Understand the construction and operation of 2 Stroke and 4 Stroke Petrol Engine           | PO1,PO2/PSO1          | U   | C   | 8        |
| 2  | Know the fuels and Combustion in SI Engines  | PO2,PO3/PSO1          | U&R | C&F | 9        |
| 3  | Understand and evaluate physical parameters of engine design and operating characteristics | PO1,PO3/PSO1          | U   | C   | 9        |
| 4  | Knowledge of Lubrication and Cooling systems   | PO1,PO3,PO3/PSO1,PSO2 | U&R | C   | 9        |
| 5  | Apply the fundamental knowledge of solvingir-standard and real air-fuel engine cycles.     | PO1,PO2,PO3/PSO1,PSO3 | Ap  | C&F | 10       |

## BMEC 0020: Automotive Chassis and Transmission System

**Objectives:** To familiarize the students with the fundamentals of Automobile Chassis and automotive transmissions system.

**Credits: 03**

**Semester: V**

**L-T-P: 3-0-0**

| Module No. | Contents  | Teaching Hours (Approx.) |
|------------|---|--------------------------|
| I          | <p><b>Introduction:</b> Types of chassis layout with reference to power plant locations and drive. Vehicle frames. Various type of frames. Constructional details. Materials Testing of vehicles frames. Unitised frame body construction, Loads acting on vehicle frame.</p> <p><b>Front axle and Steering System:</b> Types of front axle. Construction details Materials. Front wheel geometry viz. Castor, Camber, Kingpin inclination, Toe-in. Conditions for true rolling motion of wheels during steering. Steering geometry. Ackerman and Davis steering system. Constructional details of steering linkages. Different types of steering gear boxes. Steering link age sand layouts. Power and Power assisted steering. Steering of crawler tractors.</p> <p><b>Drive Line:</b> Effect of driving thrust and torque reactions. Hotch-Kiss drive, torque tube drive and radius rods. Propeller shaft. Universal joints. Constants velocity universal joints. Front wheel drive. Final Drive Differential: Different types of final drive. Worm and worm wheel, Straight bevel gear, Spiral bevel gear and hypoid gear final drives. Double reduction and twin speed final drives. Differential principles. Construction details of differential unit. Non-slip differential. Differential locks, Differential housings. Rear Axles: Construction of rear axles. Types of loads acting on rear axles. Full floating. Three quarter floating and semi floating rear axles. Rear axle housing. Construction of different types of axle housings. Multi-axles vehicles.</p> | 23                       |
| II         | <p><b>Suspension System:</b> Need of suspension system, types of suspension, suspension springs, constructional details and characteristics of leaf, coil and torsion bar springs. Independent suspension, Rubber suspension, Pneumatic suspension, Shock absorbers.</p> <p><b>Braking System:</b> Classification of brakes, drum brake &amp; disc brakes. Constructional Details-Theory of braking. Mechanical, hydraulic and Pneumatic brakes. Servo brake. Power and power assisted brakes- different types of retarders like eddy current and hydraulic retarder. Antilock braking systems.</p> <p><b>Automotive Transmission:</b> Ford—T-model gearbox, Wilson gearbox, Electro-magnetic transmission, Automatic over drive, Hydraulic control system for automatic transmission. Hydrostatic Drive and Electric Drive: Hydrostatic drive; various types of hydrostatic drive Systems-Principles of hydrostatic drive system, Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive.</p>   | 22                       |

### Text Books :

- Newton. Steeds & Garrot, “Motor Vehicles”: Butter worths, London, 1983.
- W. Judge, “Mechanism of the car”: Chapman and Halls Ltd., London, 1986.
- P. M. Heldt, “Automotive Chassis”: Chilton Co., New York, 1990.

**Reference Books:**

- W. H. Crouse and Anglin, “Automotive Transmission and Power Trains Construction”: McGraw-Hill,2003.
- W. H. Crouse, “Automotive Chassis and Body”: McGrawHillNewYork,1971.

**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2

**Outcome:** Upon successful completion of this course, the student will be able to:

| CO | CO Statement  | PO/PSO                | CL  | KC  | Duration |
|----|---|-----------------------|-----|-----|----------|
| 1  | Know the basics of Automobile Chassis Components.   | PO1,PO2/PS01, PS03    | R&U | F&C | 8        |
| 2  | Understand construction and Working principle of Front Axle, Rear Axle.                           | PO2,PO3/PS01          | U   | C   | 9        |
| 3  | Understand Construction and Working principle of Final Drive, Steering System.                    | PO1,PO3/PS01          | U   | C   | 9        |
| 4  | Understand Construction and Working principle of Brakes and Suspension System.                    | PO1,PO3,PO4/PS01,PS02 | U   | C   | 9        |
| 5  | Know about the hydrostatic drive and electric drive in automobiles, their principle of operation. | PO1,PO2/PS01, PS03    | U&R | F&C | 10       |

**BMEC 0018: AUTOMOTIVE ELECTRICAL & ELECTRONIC SYSTEM**

*Prerequisites: Kinematics of Machines*

*Objectives: To provide knowledge about application of electrical and electronics in automobile engineering.*

**Credits: 03**

**Semester: VI**

**L-T-P: 3-0-0**

| Module No. | Contents   | Teaching Hours (Approx.) |
|------------|--|--------------------------|
| I          | <p><b>Batteries:</b> Principles and construction of lead-acid battery. Characteristics of battery, rating capacity and efficiency of batteries. Various tests on battery condition, charging methods. Constructional aspect of alkaline battery. Starting System: Condition at starting. Behaviour of starter during starting. Series motor and its characteristics. Principle &amp; construction of starter motor. Working of different starter drive units, care and maintenance of starter motor. Starter Switches.</p> <p><b>Charging System:</b> Generation of direct current. Shunt generator characteristics. Armature reaction. Third brush regulation. Cut-out. Voltage &amp; current regulators. Compensated voltage regulator alternators principle &amp; constructional aspects and bridge benefits. Ignition Systems: Types, Construction &amp; working of battery coil and magneto ignition systems. Relative merits, Centrifugal and vacuum advance mechanisms, types and construction of spark plugs, electronic ignition systems.</p> <p><b>System &amp; Accessories:</b> Insulated &amp; earth return systems. Positive &amp; negative earth systems. Details of head light &amp; side light. Headlight dazzling &amp; preventive methods. Electrical fuel-pump, Speedometer, Fuel, oil &amp; temperature gauges, Horn, Wiper system, Trafficator.</p> | 23                       |
| II         | <p><b>Automotive Electronics:</b> Current trends in modern automobiles, Open and close loop Systems-Components for electronic engine management. Electronic management of chassis system. Vehicle motion control. Sensors and Actuators: Basic sensor arrangement, Types of sensors such as-Oxygen sensors, Crank angle position sensors-Fuel metering/vehicle speed sensor and detonation sensor-Altitude sensor, flow sensor. Throttle position sensors. Solenoids, stepper motors, and relays.</p> <p><b>Electronic Fuel Injection and Ignition Systems:</b> Introduction, feedback carburettor systems. Throttle body injection and multi-port or point fuel injection. Fuel injection systems, Injection system controls. Advantages of electronic ignition systems: Types of solid-state ignition systems and their principle of operation, Contact less electronic ignition system, and electronic spark timing control.</p> <p><b>Digital Engine Control System:</b> Open loop and closed loop control systems - Engine cranking and warm up Control-Acceleration Enrichment-Deceleration leaning and idle speed control. Distributor less Ignition-Integrated engine control systems, Exhaust emission control engineering. Electronic dashboard Instruments-On-board diagnosis system, security and warning system.</p>  | 23                       |

**Reference Books:**

- A. W. Judge, “Modern Electrical Equipment of Automobiles”: Chapman & Hall, London, 1992.
- A. P. Young. & L. Griffiths, “Automobile Electrical Equipment”: English Language Book Society & New Press, 1990.
- W. H. Crouse, “Automobile Electrical Equipment”: McGraw Hill Book Co Inc., New York, 1980.

**Text Books:**

- P. L. Kholi, “Automotive Electrical Equipment”: Tata McGraw-Hill Co. Ltd. New Delhi, 1975.
- W. B. Ribbens, “Understanding Automotive Electronics”: 5th Edition, Butterworth, Heinemann Woburn, 1998.
- R. N. Brady, “Automotive Computers and digital Instrumentation”: Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.
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**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2

**Outcome:** Upon successful completion of this course, the student will be able to:

| CO | CO Statement   | PO/PSO            | CL  | KC    | Duration |
|----|--|-------------------|-----|-------|----------|
| 1  | Understand importance of electrical systems in Automobile and number of subsystems like starting system, charging system etc | PO1,PO2/PSO1      | U   | C     | 9        |
| 2  | Know about conversion of mechanical to electronics systems.  | PO2,PO3/PSO1,PSO2 | R&U | C&P   | 9        |
| 3  | Understand function and construction of various electrical, electronic components and system.                                | PO1,PO3/PSO1,PSO2 | U   | C     | 9        |
| 4  | Understand of various types of sensors.  | PO1,PO3,PO4/PSO1  | U   | C     | 9        |
| 5  | Analyse injection and ignition systems with new technologies.  | PO1,PO2,PO3/PSO1  | An  | C&FDP | 10       |

**BMEC 0810: AUTOMOTIVE ELECTRICAL & ELECTRONIC SYSTEM LAB**

**Objectives:** To provide knowledge about application of electrical and electronics in automobile.

**Credits: 01**

**Semester: VI**

**L-T-P: 0-0-2**

| Module No. | LIST OF EXPERIMENTS  | Teaching Hours (Approx.) |
|------------|--|--------------------------|
|            | 1. To study of rectifier and filters<br>2. Testing of starting motors and generators<br>3. Diagnosis of ignition system faults<br>4. Study of Automobile electrical wiring.<br>5. Study of logic-gates, adder and flip-flops<br>6. Study of SCR and IC timer<br>7. Interfacing A/D converter and simple data acquisition<br>8. Microcontroller programming and interfacing |                          |

**Outcomes:** After studying these topics, the student will be able to

**CO1:** Explain different kinds of automotive wiring.

**CO2:** Describe the action of basic electric circuits.

**CO3:** To understand the basics of instrumentation, measurement, data acquisition, interpretation and analysis.

**CO4:** To learn rectifiers, filters, A/D and D/A convertors.

**Mapping of Course Outcomes (COs) with Program outcomes (POs) and Program Specific Outcomes (PSOs):**

| COs | POs/PSOs              |
|-----|-----------------------|
| CO1 | PO1,PO2/PSO1          |
| CO2 | PO2,PO3/PSO1          |
| CO3 | PO1,PO3/PSO1,PSO2     |
| CO4 | PO1,PO3,PO4/PSO1,PSO2 |

**BMEC 0019: VEHICLE BODY AND DYNAMICS**

**Objectives:** This course provides the basic knowledge about construction & various types of automotive bodies. On completion of this course, the students are exposed to understand the concept of body construction techniques under the light of aerodynamics.

**Credits: 03**

**Semester: VI**

**L-T-P: 3-0-0**

| Module No. | Contents  | Teaching Hours (Approx.) |
|------------|---|--------------------------|
| I          | <p><b>Car Body Details:</b> Types: Saloon, Convertibles, Limousine, Estevan, racing and sports car. Visibility: regulations, driver's visibility, test for visibility, Methods of improving visibility and space in cars. Safety: safety design, safety equipment's for car. Car body construction.</p> <p><b>Vehicle Aerodynamics:</b> 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.</p> <p><b>Wind tunnel testing:</b> Flow visualization techniques, scale model testing. Component balance to measure force and moments.</p>  | 20                       |
| II         | <p><b>Bus Body Details:</b> Types, minibus, single decker, double decker, two level, split level and articulated bus. Bus Body Lay-Out: Floor height, engine location, entrance and exit location, seating dimensions.</p> <p><b>Constructional details:</b> Frame construction, Double skin Construction- Types of metal section Used-Regulations-Conventional and Integral type construction.</p> <p><b>Commercial Vehicle Details:</b> Types of body, Flat platform, drop side, fixed side, tipper body, tanker body. Light commercial vehicle body types, Dimensions of driver's seating relation to controls, driver's cabin design. Body Materials, Trim and Mechanisms: Steel sheet, timber, plastics, GRP, properties of Materials-Corrosion anti-corrosion methods, scapulation of paint and painting process, body trim items. Body mechanisms.</p> | 23                       |

**Text Books:**

- J. B. Braithwaite, "Vehicle Body building and drawing": Heinemann Educational Books Ltd., London, 1977.
- J. Fenton, "Vehicle Body layout and analysis": Mechanical Engg Publication Ltd., London, 1982.

**Reference Books:**

- J. Powloski, "Vehicle Body Engineering": Business Books Ltd., 1989.
- J. C. Giles, "Body construction and design": Iiffe Books Butterworth & Co., 1971.

**B. Tech. Mechanical Engineering (Specialization in Automobile Engineering)**

*Focus: This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

| CO | CO Statement  | PO/PSO                | CL  | KC  | Duration |
|----|---|-----------------------|-----|-----|----------|
| 1  | To expose the fundamentals in various automotive body construction techniques.                  | P01,P02/PS01          | R&U | F&C | 8        |
| 2  | To integrate the concepts of aerodynamics in body engineering for better style and low drag.    | P01,P02,P03/PS01,PS02 | Ap  | C&P | 9        |
| 3  | Understand the various types of bus body construction, seating layout, regulations and comfort. | P01,P03/PS01          | U   | C   | 9        |
| 4  | Understand the various heavy vehicle bodies, driver's visibility and cabin design.              | P01,P03/PS01          | U   | C   | 8        |
| 5  | Know the different types of materials and painting techniques for vehicle body.                 | P01,P02,P03/PS01,PS02 | R&U | F&C | 9        |

**BMEC 0021: AUTOMOTIVE ENGINEERING**

**Objective:** To study function of various components in automotive vehicles and safety consideration in vehicles. To study clutches, power suspension, brakes, drive lines, universal joints, steering system, construction and working of hybrid vehicles.

**Credits: 04**

**Semester VII/VIII**

**L-T-P: 4-0-0**

| Module No. | Content   | Teaching Hours |
|------------|---|----------------|
| I          | <p><b>Introduction to Automobiles:</b> Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body &amp; Frame, Unitized Body, Car Body Styles, Bus Body &amp; Commercial Vehicle Body Types; Front Engine Rear Drive &amp; Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety considerations; Safety features of latest vehicle; Future trends in automobiles.</p> <p><b>Clutches: Requirement of Clutches</b> – Principle of Friction Clutch – Wet Type &amp; Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages.</p> <p><b>Suspension Systems:</b> Need of Suspension System, Types of Suspension; factors influencing ride comfort, Suspension Spring; Constructional details and characteristics of leaf springs.</p>  | 26             |
| II         | <p><b>Steering System: Front</b> Wheel geometry &amp; Wheel alignment viz. Caster, Camber, King pin Inclination, Toe-in/Toe-out; Conditions for true rolling motions of Wheels during steering; Different types of Steering Gear Boxes; Steering linkages and layout; Power steering – Rack &amp; Pinion Power Steering Gear, Electronics steering.</p> <p><b>Automotive Brakes, Tyres &amp; Wheels:</b> Classification of Brakes; Principle and constructional details of Drum Brakes, Disc Brakes; Brake actuating systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors affecting Brake performance, Power &amp; Power Assisted Brakes; Tyres of Wheels; Types of Tyre &amp; their constructional details, Wheel Balancing, Tyre Rotation; Types of Tyre wear &amp; their causes.</p> <p><b>Hybrid Automotive Vehicles:</b> Introduction to Hybrid Vehicle, Construction and working of hybrid vehicles, working of fuel cell vehicle, vehicular fuel cell system: fuel cell stack, fuel cell engine auxiliaries, electric drive system; benefits of hybrid vehicles, fuel supply, storage and processing in fuel cells.</p> | 24             |

**Text Books:**

- Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.
- Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.
- Automobile Engineering by D.S. Kumar, S.K. Kataria and Sons, New Delhi.

**Reference Books:**

- John Turner, 'Automotive Sensors', Momentum press, LLC NEW YORK ISBN- 9781606500095, ISBN- 1606500090, 2009.
- Barbara J. Peters, George A. Peters, 'Automotive Vehicle Safety', SAE International and Taylor & Francis ISBN - 978-0-7680-1096-1, London, 2002.
- J. Marek, H.-P. Trah Sensors, 'Automotive Technology', Y.Suzuki, I. Yokomor / ISBN – 3527295534 Wiley-vch, weinheim, 2003.
- Jeff Daniels, 'Modern Car Technology', J Haynes & Co. Ltd., 2009

**B. Tech. Mechanical Engineering (Specialization in Automobile Engineering)**

**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2

**Course Outcome:** At the end of the course, a student will be able to

| CO | CO Statement   | PO/PSO                         | CL | KC  | Duration |
|----|--|--------------------------------|----|-----|----------|
| 1  | Understand the principle of automobiles drive and advances in automobiles. | PO1, PO3, PO6, PO12/ PS01      | U  | C   | 8        |
| 2  | Explain the concept of various types of clutch.                            | PO1, PO3, PO4, PO6, PO10/ PS01 | U  | C   | 8        |
| 3  | Describe various types of steering system along with merits and demerits.  | PO2, PO3, PO4, PO6/ PS01       | U  | R&U | 8        |
| 4  | Identify and describe various types of hybrid vehicles.                    | PO2, PO3, PO4, PO6/ PS01       | An | C&S | 8        |
| 5  | Demonstrate about various types of Suspension system                       | PO3, PO6, PO9/ PS01            | U  | R&C | 8        |

**BMEC 0811: AUTOMOTIVE ENGINEERING LAB**

**Objective:** To study function of various components in automotive vehicles and safety consideration in vehicles. To study clutches, power suspension, brakes, drive lines, universal joints, steering system.

**Credits: 01**

**L-T-P: 0-0-2**

| Module No. | Content  | Teaching Hours |
|------------|--|----------------|
|            | <p><b>List of Experiments:</b></p> <ul style="list-style-type: none"> <li>• To study and prepare report on the constructional details, working principles and operation of the following Automotive Engine Systems &amp; Sub Systems. (a) Multi-cylinder: Diesel and Petrol Engines. (b) Engine cooling &amp; lubricating Systems. (c) Engine starting Systems. (d) Contact Point &amp; Electronic Ignition Systems.</li> <li>• To study and prepare report on the constructional details, working principles and operation of the following Fuels supply systems: (a) Carburetors (b) Diesel Fuel Injection Systems (c) Gasoline Fuel Injection Systems.</li> <li>• To study and prepare report on the constructional details, working principles and operation of the following Automotive Clutches. (a) Coil-Spring Clutch (b) Diaphragm – Spring Clutch. (c) Double Disk Clutch.</li> <li>• To study and prepare report on the constructional details, working principles and operation of the following Automotive Transmission systems. (a) Synchromesh – Four speed Range. (b) Transaxle with Dual Speed Range. (c) Four Wheel Drive and Transfer Case. (d) Steering Column and Floor – Shift levers.</li> <li>• To study and prepare report on the constructional details, working principles and operation of the following Automotive Drive Lines &amp; Differentials. (a) Rear Wheel Drive Line. (b) Front Wheel Drive Line. (c) Differentials, Drive Axles and Four Wheel Drive Line.</li> <li>• To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems. (a) Front Suspension System. (b) Rear Suspension System.</li> <li>• To study and prepare report on the constructional details, working principles and operation of the following Automotive Steering Systems. (a) Manual Steering Systems, e.g. Pitman –arm steering, Rack &amp; Pinion steering. (b) Power steering Systems, e.g. Rack and Pinion Power Steering System. (c) Steering Wheels and Columns e.g. Tilt &amp; Telescopic steering Wheels, Collapsible Steering Columns.</li> <li>• To study and prepare report on the constructional details, working principles and operation of the following Automotive Tyres &amp; wheels. (a) Various Types of Bias &amp; Radial Tyres. (b) Various Types of wheels.</li> <li>• To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems. (a) Hydraulic &amp; Pneumatic Brake systems. (b) Drum Brake System. (c) Disk Brake System. (d) Antilock Brake System. (e) System Packing &amp; Other Brakes.</li> <li>• To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.</li> <li>• 11. Diagnosis of ignition system faults</li> <li>• 12. Study of Automobile electrical wiring.</li> </ul> |                |

**B. Tech. Mechanical Engineering (Specialization in Automobile Engineering)**

**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2

**Course Outcome:** At the end of the course, a student will be able to

CO1. Understand about different types of automotive transmission system. **(Understand)**

CO2. Understand different types of automotive suspension system. **(Understand)**

CO3. Learn about different types of steering system **(Understand)**.

CO4. Understand different types of automotive brake system **(Understand)**

**Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs):**

| <i>COs</i> | <i>POs/PSOs</i>                     |
|------------|-------------------------------------|
| <b>CO1</b> | PO1, PO2, PO3, PO4, PO6, PO12/ PSO1 |
| <b>CO2</b> | PO1, PO2/PSO1                       |
| <b>CO3</b> | PO2, PO3/PSO1                       |
| <b>CO4</b> | PO1, PO3, PO4/PSO1, PSO2            |

**BMEC 0022: TWO AND THREE WHEELERS**

**Pre- Requisite:** - Automobile System

**Objective:** The course is designed to understand different types of two and three wheelers types, construction and working. Students will also be able to learn about different functions of two and three wheelers.

**Credits: 03**

**Semester: VII/ VIII**

**L-T-P: 3-0-0**

| Module No. | Content   | Teaching Hours |
|------------|---|----------------|
| I          | <p><b>UNIT I</b><br/><b>Power Unit:</b> Two stroke and four stroke SI engine, merits and demerits. Symmetrical and unsymmetrical port timing diagrams. Types of scavenging process merits and demerits, scavenging efficiency. Scavenging pumps. Rotary valve engine, Fuel system. Lubrication system.</p> <p><b>UNIT II</b><br/>Magneto coil and battery coil spark ignition system, electronic Ignition system. Starting system. Kick starter system.</p> <p><b>UNIT III</b><br/><b>Chassis and Sub-Systems:</b> Main frame, its types. Chassis and shaft drive. Single, multiple plates and centrifugal clutches. Gearbox and gear controls. Front and rear suspension-systems, Shock absorbers Panel meters and controls on handle bar.</p> | 20             |
| II         | <p><b>UNIT IV</b><br/><b>Brake and Wheels:</b> Drum brakes, Disc brakes, front and rear brake links layout, Spoked wheel, Cast wheel. Disc wheel. Disc types. Tyres &amp; tubes.</p> <p><b>UNIT V</b><br/><b>Two Wheelers:</b> Case study of major Indian models of motorcycles, SCOOTERS AND MOPEDS. Bajaj, Vespa, Lambretta scooters. Enfield, TVS-Suzuki, Hero-Honda, Yamaha RX100, Kawasaki Bajaj Motorcycle. Kinetic Spark, Hero Majestic, TVS mopeds. Servicing and maintenance.</p> <p><b>UNIT VI</b><br/><b>Three Wheelers:</b> Case study of Indian Models. Front engine and rear engine. Auto rickshaws. Pick-up van. Delivery Van and Trailer.</p>   | 24             |

**Text Book:**

- Irving P.E., Motorcycle Engineering, Temple Press Book, London,1992.
- The Cycle Motor Manual, Temple Press Ltd., London, 1990.
- Encyclopedia of Motorcycling, 20 volumes, Marshall Cavensih, New York and London, 1989.
- Bryaut. R.V., Vespa Maintenance and Repair series.
- Raymond Broad, Lambretta-A practical guide to maintenance and repair,1987

**B. Tech. Mechanical Engineering (Specialization in Automobile Engineering)**

***Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2*

***Course Outcome:** At the end of the course, a student will be able to*

| CO | CO Statement  | PO/PSO                          | CL | KC  | Duration |
|----|---|---------------------------------|----|-----|----------|
| 1  | Understanding & learning different types of two and three wheelers  | PO1, PO3, PO6, PO12/ PSO1       | U  | C   | 8        |
| 2  | Explain & analyze special parts and their importance and working in two and three wheelers                                      | PO1, PO3, PO6, PO10/ PSO1       | An | F&C | 9        |
| 3  | Identify & understand maintenance of two and three wheelers   | PO2, PO3, PO4, PO6/ PSO1, PSO2  | U  | C   | 9        |
| 4  | Understand the various subsystem of two wheelers and also know how it is different from light motors and heavymotor vehicles.   | PO2, PO3, PO4, PO6/ PSO1        | U  | C   | 9        |
| 5  | Understand the various subsystem of three wheelers and also know how it is different from light motors andheavy motor vehicles. | PO1, PO3, PO6, PO10/ PSO1, PSO2 | U  | C   | 9        |

**BME E0601: VEHICLE PERFORMANCE AND TESTING**

**Objective:** The course is designed to familiarize the students in vehicle testing and performance.

**Credits: 03**

**L-T-P: 3-0-0**

| Module No. | Content   | Teaching Hours |
|------------|---|----------------|
| I          | <p><b>VEHICLE PERFORMANCE ESTIMATION &amp; PREDICTION:</b> Aerodynamic drag, methods of estimation of resistance to motion, power requirement for propulsion, Power plant characteristics &amp; transmission related requirements, arrangement of power train, vehicle controls, vehicle acceleration, maximum speed, and gradeability drive systems comparison, hill climbing, handling and ride characteristics on different road surfaces. Effect of pressure, temperature and humidity on power output.</p> <p><b>VEHICLE TRANSMISSION PERFORMANCE:</b> Characteristics &amp; features of friction clutches, mechanical gear transmission &amp; epi-cyclic gearboxes.</p> <p><b>OPERATIONAL PERFORMANCE:</b> Engine performance &amp; operating characteristics, Operation at full load and part load conditions, fuel economy, effect of vehicle condition, tyre and road condition, traffic condition and driving habits on fuel economy, vehicle safety.</p>   | 20             |
| II         | <p><b>CONTROL SYSTEMS:</b> Braking arrangements &amp; Characteristics, weight transfer, steering arrangements, rigid &amp; independent suspension, roll center, torsion bar, stabilizer, radius bar.</p> <p><b>VEHICLE PERFORMANCE TESTING:</b> Testing of major components of vehicle like clutch, suspension, braking, steering etc., Engine testing – noise, vibrations, emission, power &amp; fuel consumption, Vehicle testing on chassis dynamometers, Road and Track Testing, Initial inspection, running in and durability, extensive driving, maximum speed &amp; acceleration, Brake testing on the road, Hill climbing, handling &amp; ride characteristics on different road surfaces, ride comfort.</p> <p><b>ACCELERATION AND BRAKING PERFORMANCE:</b> Longitudinal performance - Load transfer due to driveline torque - Transient Behavior - Simple IC engine modeling - Polynomial fits - ODE input-output models - Braking Performance - Transient behavior - Quarter car models - Half car models - 2 and 4 degree of freedom - Dynamic weight shift - Anti-lock brakes - Braking Stability.</p> | 24             |

**Text Book:**

- Martyr A. J, Plint M. A, "Engine Testing Theory and Practice", 3rd edition, Butterworth-Heinemann, 2007.
- Gousha H. M, "Engine Performance Diagnosis & Tune Up Shop Manual".
- Giles J. G, "Vehicle Operation & Performance".
- Crouse. W. H, Anglin. D. L, "Motor Vehicle Inspection", McGraw Hill, 1978.

**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2

**B. Tech. Mechanical Engineering (Specialization in Automobile Engineering)**

**Course Outcome:** At the end of the course, a student will be able to

| CO | CO Statement  | PO/PSO                             | CL  | KC  | Duration |
|----|---|------------------------------------|-----|-----|----------|
| 1  | Know the concept of vehicle performance estimation. | PO1, PO3, PO6, PO12/<br>PSO1       | R&U | F&C | 8        |
| 2  | Know the concept of vehicle performance testing.    | PO1, PO3, PO6, PO10/<br>PSO1       | R&U | C   | 9        |
| 3  | Know about transmission performance.                | PO2, PO3, PO4, PO6/<br>PSO1, PSO2  | R&U | C   | 9        |
| 4  | Know about the Laboratory testing of vehicles.      | PO2, PO3, PO4, PO6/<br>PSO1        | R&U | C   | 9        |
| 5  | About the stability of vehicle.                     | PO1, PO3, PO6, PO10/<br>PSO1, PSO2 | U   | C   | 9        |

**BME E0602: NEW GENERATION AND HYBRID VEHICLES**

**Credits: 03**

**L-T-P: 3-0-0**

| Module No. | Content   | Teaching Hours |
|------------|---|----------------|
| I          | <p><b>INTRODUCTION:</b> Electric and hybrid vehicles, flexible fuel vehicles (FFV), solar powered vehicles, vehicles, fuel cells vehicles.</p> <p><b>POWER SYSTEM AND NEW GENERATION VEHICLES:</b> Hybrid Vehicle engines, Stratified charge engines, lean burn engines, low heat rejection engines, hydrogen engines, HCCI engine, VCR engine, surface ignition engines, VVTI engines. High energy and power density batteries, fuel cells, flexible fuel systems.</p> <p><b>VEHICLE OPERATION AND CONTROL:</b> Computer Control for pollution and noise control and for fuel economy – Transducers and actuators - Information technology for receiving proper information and operation of the vehicle like optimum speed and direction.</p> | 25             |
| II         | <p><b>VEHICLE AUTOMATED TRACKS:</b> Preparation and maintenance of proper road network - National highway network with automated roads and vehicles - Satellite control of vehicle operation for safe and fast travel, GPS.</p> <p><b>SUSPENSION, BRAKES, AERODYNAMICS AND SAFETY:</b> Air suspension – Closed loop suspension, compensated suspension, anti-skid braking system, retarders, regenerative braking, safety gauge air bags- crash resistance. Aerodynamics for modern vehicles, safety systems, materials and standards.</p>  | 20             |

**Text Book:**

- Bosch Hand Book, SAE Publication, 2000
- Heinz, "Modern Vehicle Technology" Second Edition
- Advance hybrid vehicle power transmission, SAE.
- Light weight electric for hybrid vehicle design.
- Noise reduction, Branek L.L., McGraw Hill Book company, New York, 1993

**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2

**Course Outcome:** At the end of the course, a student will be able to

| CO | CO Statement  | PO/PSO                         | CL | KC  | Duration |
|----|---|--------------------------------|----|-----|----------|
| 1  | Understand the recent development pertain to energy system.   | PO1, PO3, PO6, PO12/ PS01      | U  | F&C | 9        |
| 2  | Explain various operation of Hybrid vehicles and new generation vehicles.                               | PO1, PO3, PO4, PO6, PO10/ PS01 | U  | C   | 9        |
| 3  | Understand the working of GPS and satellite control of vehicle operation for safe and fast travel.      | PO2, PO3, PO4, PO6/ PS01       | U  | F&C | 9        |
| 4  | Demonstrate the application of computer for controlling pollution and noise for better fuel efficiency. | PO2, PO3, PO4, PO6/ PS01       | Ap | C&P | 9        |
| 5  | Explain recent technologies in the area of suspension systems, brakes, aerodynamics etc.                | PO1, PO3, PO6, PO10/ PS01      | U  | C   | 9        |

## **BMEE0603: TROUBLE SHOOTING, SERVICING AND MAINTENANCE OF AUTOMOBILES**

**Objective:** To study function of various components in automotive vehicles and safety consideration in vehicles. To input knowledge on Vehicle Trouble shooting and maintenance.

**Credits: 03**

**L-T-P: 3-0-0**

| Module No. | Content  | Teaching Hours |
|------------|--|----------------|
| I          | <p><b>INTRODUCTION AND TROUBLE SHOOTING:</b> Check list on trouble shooting - Engine, clutch, gear box, rear axle, front axle, steering, electrical systems - Trouble shooting on engine management system - On board diagnosis using multi-scanner - Testing of SI engine using computerized engine analyzer.</p> <p><b>MAINTENANCE OF WORKSHOP, ITS SCHEDULE AND RECORDS:</b> Importance of maintenance - schedule and unscheduled maintenance - scope of maintenance - vehicle down time - vehicle inspection, reports, log books, trip sheet.</p> <p><b>ENGINE REPAIR AND OVERHAULING:</b> Dismantling of SI &amp; CI engines 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 - Design trouble shooting chart for MPFI &amp; CRDI Engines.</p> | 21             |
| II         | <p><b>MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS:</b> Maintenance - servicing and repair of clutch, fluid coupling, gear box, torque converter, propeller shaft - Maintenance of front axle, rear axle, brakes, steering systems, tyre.</p> <p><b>MAINTENANCE AND REPAIR OF VEHICLE BODY:</b> Body panel tools for repairing - Tinkering and painting - Use of soldering, metalloid paste.</p> <p><b>MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS AND FLEET MAINTENANCE MANAGEMENT:</b> Service, maintenance, testing and troubleshooting of battery, starter motor, alternator rectifier and transistorized regulator. Fleet maintenance requirement - investment and costs, types of work shop layout, tools and equipment - spare parts and lubricants stocking, manpower, training, workshop management, warranty, replacement policy.</p>   | 24             |

### **Text Book:**

- Martin W. Stockel, Martin T. Stockel, Chris Johanson, "Auto Service & Repair: Servicing, Troubleshooting, and Repairing Modern Automobiles: Applicable to All Makes and Models", Goodheart-Willcox Publisher, 1996.
- Vaughn D. Martin, "Automotive Electrical Systems: Troubleshooting and Repair Basics", Prompt Publications, 1999.
- Crouse W., "Everyday Automobile Repair", Intl. student edition, TMH, New Delhi, 1986.
- James D. Halderman, "Chase D. Mitchell, "Automotive steering, suspension, and alignment", Prentice Hall, 2000.

**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2

**Course Outcome:** At the end of the course, a student will be able to

| CO | CO Statement   | PO/PSO                              | CL  | KC  | Duration |
|----|--|-------------------------------------|-----|-----|----------|
| 1  | Know about vehicle trouble shooting.                           | PO1, PO2, PO3, PO4, PO6, PO12/ PSO1 | R&U | F&C | 11       |
| 2  | Enabling students to operate and manage maintenance workshops. | PO1, PO2/PSO1                       | Ap  | C   | 11       |
| 3  | Maintenance of shop, its schedule and prepare record.          | PO2, PO3/PSO1                       | Ap  | C   | 11       |

**B. Tech. Mechanical Engineering (Specialization in Automobile Engineering)**

12-B Status from UGC

|   |   |                           |    |     |    |
|---|---|---------------------------|----|-----|----|
|   |   |                           |    |     |    |
| 4 | Repair and overhauling of engine, chassis vehicle body. | PO1,PO3,<br>PO4/PS01,PS02 | Ap | C&P | 12 |

**BMEE 0604: AUTOMOBILE AIR CONDITIONING**

**Objective:** This course aims at providing adequate knowledge about air conditioning system in automobiles since it has now become an integral part of a vehicle and the whole of South India and parts of the North witness intense heat during summers.

**Credits: 03**

**L-T-P: 3-0-0**

| Module No. | Content   | Teaching Hours |
|------------|---|----------------|
| I          | <p><b>REFRIGERATION:</b> Introduction; methods of refrigeration; vapor compression refrigeration system; vapor absorption refrigeration system; applications of refrigeration and air conditioning; Automobile air conditioning; air conditioning for passengers; isolated vehicles; transport vehicles; applications related with very low temperatures.</p> <p><b>REFRIGERANT:</b> Classification; properties; selection criteria; commonly used refrigerants; alternative refrigerants; eco-friendly refrigerants; applications of refrigerants; refrigerants used in automobile air conditioning.</p> <p><b>PSYCHOMETRY:</b> Psychometric properties; tables; charts; psychometric process; comfort charts; factors affecting comfort; effective temperature; ventilation requirements.</p>   | 20             |
| II         | <p><b>AIR CONDITIONING SYSTEMS:</b> Classification; layouts; central / unitary air conditioning systems; components like compressors; evaporators; condensers; expansion devices; fan blowers; heating systems etc.</p> <p><b>LOAD ANALYSIS:</b> Outside and inside design consideration; factors forming the load on refrigeration and air conditioning systems; cooling and heating load calculations; load calculations for automobiles; effect of air conditioning load on engine performance. Distribution duct system; sizing supply / return ducts; type of grills; diffusers; ventilation; air noise level; layout of duct systems for automobiles and their impact on load calculations.</p> <p><b>AIR ROUTINE and TEMPERATURE CONTROL:</b> Objectives: evaporator care air flow through the dash re-circulating unit; automatic temperature control; controlling flow; control of air handling systems.</p> | 22             |

**Text Book:**

- Paul Lung,, “Automotive Air Conditioning”, C.B.S Publisher and Distributor
- American Society of Heating, Refrigeration and Air Conditioning, “ASHRAE Handbook – Fundamentals”, 1985.
- "Heating and Air Conditioning Systems", Mitchell Information Services.

**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2

| CO | CO Statement  | PO/PS O            | CL    | KC  | Duration |
|----|---|--------------------|-------|-----|----------|
| 1  | Understand the air refrigeration, vapor compression refrigeration, vapor absorption, steam jet refrigerationsystems and different type of refrigerants. | PO1,PO2/PSO 1,PSO3 | U     | C   | 10       |
| 2  | Expedite the working of single stage, multistage and cascade refrigeration.   | PO2,PO3/PSO 1      | U&Ap  | C&P | 10       |
| 3  | Knowledge of psychometric and different   | PO1,PO3/PSO        | R & U | C   | 10       |

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|   |   |                        |           |       |    |
|---|---|------------------------|-----------|-------|----|
|   | psychometric processes. Understand and evaluate cooling and heating load and design of HVAC system. | 1                      |           |       |    |
| 4 | Develop and design RAC systems and evaluate different expansion and control devices.                | PO1,PO3,PO4 /PS01,PS02 | Ap and An | C&FDP | 12 |

**B. Tech. Mechanical Engineering (Specialization in Automobile Engineering)**

**BMEE 0006: GAS TURBINE AND JET PROPULSION**

**Pre-requisite:** Applied Thermodynamics

**Objective:** Students will be able to understand propulsion systems in aircraft that are essential to graduate engineers who are intended to work in aircraft system/component manufacturing/maintenance environments. Students should be able to describe the key aeronautical engineering features in the context to which the relevant industry operates.

**Credits:04**

**L-T-P:3-1-0**

| Module No. | Content   | Teaching Hours |
|------------|---|----------------|
| I          | <p><b>Introduction to Gas Turbine:</b> Simple gas turbine and review of Brayton cycle. Cycle Arrangements: Open cycle arrangement, closed cycle arrangement. Basic requirements of working medium and its properties.</p> <p><b>Ideal cycles and their analysis:</b> Simple gas turbine cycle, heat exchange cycle, reheat cycle, intercooled cycle, combinations of various cycles, comparison of various cycle.</p> <p><b>Impulse turbine and reaction turbines:</b> Introduction to impulse turbine and reaction turbines, Multi stage machine, compounding of turbines.</p> | 22             |
| II         | <p><b>Elementary turbine design:</b> Velocity triangle of single stage turbine, Expression for work output, blade loading and flow coefficients, blade and stage efficiencies, Blade to gas speed ratio, losses and efficiencies. Aircraft Propulsion: Introduction, types of air craft engines and their analysis (gas turbine engines, turbo jet engines, turbo fan engines, turbo prop engines)</p> <p><b>Air craft propulsion theory:</b> Thrust, thrust power, propulsive efficiency, ram efficiency, thermal efficiency and overall efficiency.</p>                       | 23             |

**Text Books:**

- Cohen and Rogers, 'Gas Turbine Theory', Dorling Kindersley (India) pvt. Ltd. , Noida.
- V. Ganesan, 'Gas Turbines', Tata McGraw Hills, New Delhi.
- S.M. Yahya, 'Turbines, Compressors and fans', McGraw Hills, New Delhi.

**Reference Books:**

- Jack D. Mattingly, 'Elements of Gas Turbine Propulsion', Tata McGraw Hills, New Delhi.
- Mathur and Sharma, 'Gas Turbine and Jet & Rocket Propulsion', Standard publishers, Delhi.
- Ahmed and Sayed, 'Air craft propulsion and Gas Turbine Engines', CRC press, Taylor and Francis.

**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2.

**Course Outcome:** At the end of the course, a student will be able to

| CO | CO Statement  | PO/PSO       | CL | KC   | Duration |
|----|---|--------------|----|------|----------|
| 1  | Outline governing equations of compressible fluid flow.               | PO2,PO4/PSO3 | U  | C    | 8        |
| 2  | Analyze one dimensional compressible flow through variable area duct. | PO2,PO3/PSO3 | An | C&PC | 8        |
| 3  | Analyze compressible flow having normal shock.                        | PO2,PO4/PSO3 | An | C&PC | 8        |

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|   |   |                  |    |     |   |
|---|---|------------------|----|-----|---|
| 4 | Apply governing equations to compressible flow through constant area duct with friction.      | PO2,PO4/PS<br>O3 | Ap | C&P | 7 |
| 5 | Apply governing equations to compressible flow through constant area duct with heat transfer. | PO2,PO3/PS<br>O3 | Ap | C&P | 7 |
| 6 | Interpret propulsive systems for their working and application.                               | PO3,PO4/PS<br>O3 | U  | C   | 9 |

**BMEE 0605: ALTERNATIVE FUELS AND POLLUTION CONTROL**

**Objective:** The purpose of this course is to impart adequate knowledge on Alternative fuels and pollution control in the Automobiles.

**Credits: 03**

**L-T-P: 3-0-0**

| Module No. | Content   | Teaching Hours |
|------------|---|----------------|
| I          | <p><b>INTRODUCTION:</b> Various pollutants from SI and CI engines. Effects of pollutants on environment and human beings. Estimation of petroleum reserves. Need for alternative fuels. Potential alternative fuels (alcohols, oxygenates, hydrogen, LPG, NG, biogas, and vegetable oils), Merits and demerits of various alternative fuels.</p> <p><b>EMISSIONS FROM SI ENGINES AND THEIR CONTROL:</b> Emission formation in SI engines (CO, HC and NO<sub>x</sub>). Effect of design and operating variables on emission formation. Control techniques -Thermal reactor, exhaust gas recirculation, three-way catalytic convertor and Charcoal canister control for evaporative emission-positive crank case ventilation for blow by gas control.</p> <p><b>EMISSIONS FROM CI ENGINES AND THEIR CONTROL:</b> Emission formation in CI engines (HC, CO, NO<sub>x</sub>, aldehydes, smoke and particulates), effect of design and operating variables on emission formation, control techniques, exhaust gas recirculation, NO<sub>x</sub> selective catalytic reduction, diesel oxidation catalytic convertor, diesel particulate filter, NO<sub>x</sub> versus particulates –trade off.</p>                       | 20             |
| II         | <p><b>EMISSION MEASURING INSTRUMENTS AND TEST PROCEDURES:</b> Principle of operation of emission measuring instruments used in SI and CI engines, Measurement of CO<sub>2</sub> and CO by NDIR, hydrocarbon emission by FID, Chemiluminescent analyzer for NO<sub>x</sub>, Liquid and Gas chromatograph, spot sampling and continuous indication type smoke meters.</p> <p><b>ALCOHOL FUELS AND GASEOUS FUELS:</b> Properties of alcohols, engine modifications required to use alcohols in SI engines, performance, combustion and emission characteristics in SI engines, alcohol – gasoline blends, fuel flexible vehicle, methanol reformed gas engine, use of alcohols in CI engines-emulsions, dual fuel system, spark assisted diesel engine, surface ignition engine, ignition accelerators, performance, combustion and emission characteristics in CI engines. Properties of hydrogen, production and storage methods, safety precautions, use in SI and CI engines, biogas production and its properties, use in SI and CI engines, properties of LPG and CNG, use in SI and CI engines. Performance, combustion and emission characteristics of hydrogen, biogas, LPG and CNG in SI and CI engines.</p> | 24             |

**Text Book:**

- Ganesan V, “Internal combustion engines”, 4th edition, Tata McGraw Hill
- Michael F. Hordeski, “Alternative Fuels: The Future of Hydrogen”, The
- Rajput R. K, “A textbook of Internal Combustion Engines”, 2nd edition, Laxmi Publications (P) Ltd, 2007.
- Thipse S. S, “Alternative Fuels: Concepts, Technologies and Developments”, Jaico Publishing House,2010.

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**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2

**Course Outcome:** At the end of the course, a student will be able to

| CO | CO Statement  | PO/PSO                         | CL  | KC  | Duration |
|----|---|--------------------------------|-----|-----|----------|
| 1  | Different types of Alternative fuels for Automobiles. | PO1, PO3, PO6, /<br>PSO1       | R&U | F&C | 9        |
| 2  | Performance of Alternative Fuels used in Automobiles. | PO1, PO3, PO6 /<br>PSO1        | U   | C   | 9        |
| 3  | Mechanism of pollutant formation in engines.          | PO2, PO3, PO4, /<br>PSO1, PSO2 | U   | C   | 9        |
| 4  | Treatment and control Techniques                      | PO2, PO3, PO4, /<br>PSO1       | Ap  | C&P | 9        |
| 5  | Emission from CI and SI engines.                      | PO1, PO3, PO6, /<br>PSO1, PSO2 | U   | C   | 8        |

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**BMEE0606: AUTOMOTIVE AERODYNAMICS**

**Objective:** At the end of the course, the students will be able to apply basic principles of aerodynamics for the design of vehicle body.

**Credits: 03**

**L-T-P: 3-0-0**

| Module No. | Content   | Teaching Hours |
|------------|---|----------------|
| I          | <p><b>INTRODUCTION:</b> Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics.</p> <p><b>AERODYNAMIC DRAG OF CARS:</b> Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.</p> <p><b>SHAPE OPTIMIZATION OF CARS:</b> Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners. Case studies on modern vehicles.</p> | 22             |
| II         | <p><b>VEHICLE HANDLING:</b> The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles and racing cars.</p> <p><b>WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS:</b> Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods. CFD analysis.</p>  | 20             |

**Text Book:**

- Hucho .W.H., “Aerodynamic of Road Vehicles”, Butter worths Co., Ltd., 1997
- Pope, “Wind Tunnel Testing”, 2nd Edition, John Wiley & Sons New York, 1974.
- “Automotive Aerodynamic”, Update SP-706, Society of Automotive Engineers Inc,1987.
- “Vehicle Aerodynamics”, SP-1145, Society of Automotive Engineers Inc ,1996.

**Focus:** This course focuses on Employability/Skill development and aligned with CO’s 1 and 2

| CO | CO Statement                                       | PO/PSO              | CL   | KC    | Duration |
|----|--|---------------------|------|-------|----------|
| 1  | To understand the fundamentals of aerodynamics.    | PO1, PO2/ PS01      | U    | C     | 10       |
| 2  | To understand vehicle body optimization.           | PO1, PO3/ PS01      | U    | C     | 10       |
| 3  | To acquire skill of measuring aerodynamics forces. | PO1, PO2/ PS01      | R&U  | C     | 11       |
| 4  | To develop skill of design of shape of cars.       | PO1, PO2, PO3/ PS01 | U&Ap | C&FDP | 11       |

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**BME E0607: OFF-ROAD VEHICLES**

**Objective:** The purpose of this course is to impart adequate knowledge on off-road vehicles

**Credits: 03**

**L-T-P: 3-0-0**

| Module No. | Content   | Teaching Hours |
|------------|---|----------------|
| I          | <p><b>INTRODUCTION TO OFF ROAD VEHICLES:</b> Land clearing machines Earth moving machines Scrapers and graders Shovels and ditchers Power plants, chassis and transmission, multi axle vehicles.</p> <p><b>DIFFERENT TYPES OF EQUIPMENT:</b> Transport equipment: Powered equipment, Tractors and Trollies, Trailers, Platform lift trucks, Fork lift trucks, containers and Supports. Hauling equipment: Types of dump trucks, On-high way vehicles, off high way vehicles. Hoisting equipment: Jacks, truck mounted crane, Crawler crane, Outriggers.</p> <p><b>TRACTORS:</b> Tractors and tractors units; Tractors in earth moving, applications of tractors, Rating of Tractors, Wheeled and Crawler tractor, Recent trends in tractor design, power shift transmission and final drive in caterpillar tractor. Motor grader, recent trends, control mechanism of a caterpillar motor grader.</p> | 20             |
| II         | <p><b>EARTH MOVING MACHINES:</b> Bulldozers, cable and hydraulic dozers. Crawler track, running and steering gears, scrapers, drag and self-Powered types - dump trucks and dumpers - loaders, single bucket, multi bucket and rotary types - power and Capacity of earth moving machines.</p> <p><b>SCARPER AND GRADERS:</b> Scrapers, elevating graders, self-powered scrapers and graders. Shovels and Ditchers: Power shovel, revolving and stripper shovels - drag lines - ditchers - capacity of shovels. Land clearing machines: Bush cutter, stampers, tree dozer, rippers.</p> <p><b>SHOVELS AND DITCHERS:</b> Power shovel, revolving and stripper shovels - drag lines - ditchers - Capacity of shovels.</p>   | 22             |

**Text Book:**

- Abrosimov.K. Bran berg. A. and Katayer. K., Road making Machinery, MIR Publishers, Moscow,1971.
- Wang. J.T., Theory of Grand vehicles, John Wiley & Sons, New York, 1987
- Off the road Wheeled and combined traction devices – Ash gate Publishing Co. Ltd. 1988.

**Course Outcome: At the end of the course, a student will be able to**

- CO1. To understand the different off road vehicles and their usage.  
 CO2. To understand the different types of equipment used in off road vehicles.  
 CO3. To understand the complete working of tractors.

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*CO4. To understand the complete working earth moving equipment.*

*CO5. To understand the complete working of scrappers and graders and shovels and ditchers.*

### **Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) :**

| COs | POs/PSOs               |
|-----|------------------------|
| CO1 | PO1, PO3, / PS01       |
| CO2 | PO1, PO3, PO6 / PS01   |
| CO3 | PO2, PO3/ PS01, PS02   |
| CO4 | PO2, PO3, PO4, / PS01  |
| CO5 | PO1, PO3, / PS01, PS02 |

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**BME E0608: DESIGN OF TRANSMISSION SYSTEMS**

**Objective:** To learn about the design procedures for mechanical power transmission components.

**Credits: 03**

**L-T-P: 3-0-0**

| Module No. | Content  | Teaching Hours |
|------------|--|----------------|
| I          | <p><b>Flexible transmission elements-</b> design of flat belts &amp; pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets</p> <p><b>Gear transmission-</b> speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.</p> <p><b>Straight bevel gear-</b> tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits &amp; demerits, terminology, thermal capacity, materials, forces &amp; stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.</p> | 22             |
| II         | <p><b>Gear box-</b> geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-speed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.</p> <p><b>Cam design, types:</b> pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.</p>   | 20             |

**Text Book:**

- Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
- Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
- Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

| CO | CO Statement   | PO/PSO                         | CL | KC    | Duration |
|----|--|--------------------------------|----|-------|----------|
| 1  | To design transmission systems for engines and machines. | PO1, PO3, PO6, PO12/ PS01      | Ap | C&FDP | 10       |
| 2  | To understand Flexible Transmission-speed ratio          | PO1, PO3, PO4, PO6, PO10/ PS01 | U  | C     | 10       |
| 3  | To acquire skill of Gear analysis                        | PO2, PO3, PO4, PO6/ PS01       | An | C     | 11       |
| 4  | To develop skill of design of gearbox and Cam.           | PO2, PO3, PO4, PO6/ PS01       | Ap | C&FDP | 11       |

**B. Tech. Mechanical Engineering (Specialization in Automobile Engineering)**

**BMEE 0609: AUTOMOTIVE SAFETY**

**Credits: 03**

**Semester: VIII**

**L-T-P: 3-0-0**

| <b>Module No.</b> | <b>Content</b>   | <b>Teaching Hours</b> |
|-------------------|--|-----------------------|
| <b>I</b>          | <p><b>INTRODUCTION:</b> Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.</p> <p><b>SAFETY CONCEPTS:</b> Active safety: driving safety, conditional safety, perceptibility safety, operating safety, passive safety: exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact.</p>  | 20                    |
| <b>II</b>         | <p><b>SAFETY EQUIPMENTS:</b> Seat belt, regulations, automatic seat belt tightened system, collapsible steering column, tilt able steering wheel, air bags, electronic system for activating air bags, bumper design for safety</p> <p><b>COLLISION WARNING AND AVOIDANCE:</b> Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.</p> <p><b>COMFORT AND CONVENIENCE SYSTEM:</b> Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system.</p> | 25                    |

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**Text Book:**

- Bosch, “Automotive Handbook”, 8th Edition, SAE publication, 2011.
- Powloski. J., “Vehicle Body Engineering”, Business books limited, London, 1969.
- Ronald.K.Jurgen, “Automotive Electronics Handbook”, Second Edition, McGraw-Hill Inc., 1999.

**Focus:** This course focuses on Employability/Skill development and aligned with CO's 1 and 2

**Course Outcome:** At the end of the course, a student will be able to

| CO | CO Statement   | PO/PSO                         | CL | KC | Duration |
|----|--|--------------------------------|----|----|----------|
| 1  | Understand the functioning of various systems that enhances vehicle safety, passenger comfort.                                     | PO1, PO3, PO6, PO12/ PSO1      | U  | C  | 10       |
| 2  | Explain various collision warning and avoidance system for an automobile.  | PO1, PO3, PO4, PO6, PO10/ PSO1 | U  | C  | 11       |
| 3  | Explain various safety concepts required for a vehicle.  | PO2, PO3, PO4, PO6/ PSO1       | U  | C  | 12       |
| 4  | Describe the mechanism for various comfort and convenience system like central locking system, rain sensorsystem etc. of a vehicle | PO2, PO3, PO4, PO6/ PSO1       | U  | C  | 12       |