

**AUTOMOBILE ENGINEERING**  
**(MECH 4144)**

**Time Allotted : 3 hrs**

**Full Marks : 70**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and  
any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

**Group – A**  
**(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The most accurate petrol injection system is the  
(a) direct injection (b) port injection  
(c) manifold injection (d) throttle body injection.
- (ii) 'Self energisation' can happen in  
(a) Disc Brake (b) Regenerative Brake  
(c) Drum Brake (d) All three brakes mentioned earlier.
- (iii) In a four stroke cycle S.I. engine the exhaust valve usually opens  
(a) at BDC (b) at TDC  
(c) before BDC (d) after BDC.
- (iv) Auto restoration of the steering wheel to its neutral position after a turn happens due to  
(a) Caster angle (b) Camber angle  
(c) Steering axis inclination angle (d) Toe-in angle.
- (v) The fuel is injected into the cylinder in diesel engine when the piston is  
(a) exactly at TDC after compression stroke  
(b) exactly at BDC before compression stroke  
(c) approaching TDC during compression stroke  
(d) approaching TDC during exhaust stroke.
- (vi) The joints used for transmission of power from gearbox to driven wheels in a front Wheel drive vehicle are called  
(a) universal joint (b) flange joint  
(c) flexible joint (d) constant velocity joint.
- (vii) The following provides a smooth means of disengagement and engagement between the engine and the remainder of transmission system  
(a) clutch (b) gearbox (c) propeller shaft (d) differential.
- (viii) Which of the following resistances to a car's motion increases as square of its speed  
(a) Rolling (b) Gradient (c) Friction (d) Air.

- (ix) Fuel efficiency of a Hybrid car is better than that of an IC engine car because of
- (a) presence of an electric drive motor
  - (b) presence of an electric drive motor & IC Engine
  - (c) IC Engine runs at optimum condition
  - (d) both electric motor & IC engine can drive the car simultaneously.
- (x) Compared to a Hybrid vehicle, efficiency of an Electric vehicle is
- (a) more
  - (b) less
  - (c) same
  - (d) can be any of the above three.

### **Group – B**

2. (a) Draw a schematic layout of the MPFI system in a SI engine and describe its operation. Why is it preferable to a carburetor? [(CO1)(Remember/LOCQ)]
- (b) Describe the working of battery ignition system in a SI engine with a diagram. What are the differences between battery ignition and magneto ignition system? [(CO2)(Remember/LOCQ)]
- 6 + 6 = 12**
3. (a) Explain with schematic diagram how does a vacuum assisted “Power Brake” work? [(CO2)(Analyze/IOCQ)]
- (b) To experimentally calculate the coefficient of friction between the road and the wheels, a car weighing 15 kN and having a wheelbase of 2.5 metres is used. The centre of gravity of the car is 1.2 m in front of the rear axle and 800 mm above ground level. The car is moving up an incline (sine of the angle of inclination is 0.1) at a speed of 50 km/hr. When brakes are applied simultaneously on all wheels, it stops over a distance of 19.76 m. Calculate
- (i) the coefficient of friction between the road and the wheels.
  - (ii) load distribution between front and rear axles. [(CO2)(Evaluate/HOCQ)]
- 4 + (4 + 4) = 12**

### **Group – C**

4. (a) Derive the equation for perfect steering for front wheel steered 4 wheel vehicle. [(CO3)(Analyse/IOCQ)]
- (b) Through suitable sketch indicate the following angles in the front wheels and explain its necessity (i) Camber angle (ii) Steering Angle Inclination (iii) Caster Angle. [(CO3)(Analyze/IOCQ)]
- 6 + 6 = 12**
5. (a) What would be the problem if a car has a single speed gear box? How is that problem overcome with multispeed gear box? [(CO3)(Analyze/IOCQ)]
- (b) With the help of neat diagram explain the working of a synchromesh system in a gearbox and evaluate its advantage w.r.t. non-synchromesh system. [(CO3)(Evaluate/HOCQ)]
- 6 + 6 = 12**

Group – D

6. (a) List the functions and essential requirements of a rear axle. [(CO4)(Remember/LOCQ)]  
(b) What is meant by independent suspension system? How it is achieved in front and rear wheel suspension? [(CO4)(Remember/LOCQ)]  
**6 + 6 = 12**
7. (a) What are advantages of independent suspension over rigid axle suspension? [(CO4)(Analyze/IOCQ)]  
(b) Explain the following with sketch and explain their function and advantages.  
(i) Wishbone suspension  
(ii) McPherson Strut suspension. [(CO4)(Remember/LOCQ)]  
**4 + (4 + 4) = 12**

Group – E

8. (a) A car weighing 1500 kg can move at a speed of 95 kmph on level road. The car has projected frontal area of 2.5 m<sup>2</sup>. The coefficient of air resistance is 0.033 and rolling resistance constant is 0.03,  
(i) calculate the power required to propel the vehicle,  
(ii) calculate the maximum inclination it can travel at a speed of 30 kmph with the same power, as above, available at wheels. [(CO5)(Evaluate/HOCQ)]  
(b) Mention various resistances a vehicle has to overcome to move. What are the causes of each of these resistances and how they vary with vehicle speed? [(CO5)(Remember/LOCQ)]  
**(4 + 4) + 4 = 12**
9. (a) A car weighing 1490 kg can move at a speed of 90 kmph on level road. The car has projected frontal area of 3.5 m<sup>2</sup>. The coefficient of air resistance is 0.033 and rolling resistance constant is 0.03.  
(i) Calculate the power required to propel the vehicle  
(ii) Calculate the maximum inclination it can travel at a speed of 35 kmph with the same power, as above, available at wheels. [(CO5)(Evaluate/HOCQ)]  
(b) Explain with a sketch one architecture of a hybrid vehicle's drive train. [(CO6)(Apply/IOCQ)]  
**8 + 4 = 12**

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	37.5	31.25	31.25

Course Outcome (CO):

After the completion of the course students will be able to	
1	Articulate the different types of automobiles, explain the engine components, functioning of IC engines and classify the fuel supply system for S.I and C.I engines.
2	Differentiate the types of lubrication system; identify different lubrication and cooling systems used in vehicles. Classify ignition system and braking system
3	Review the salient features of different steering mechanisms, describe the methods of wheel alignment and wheel balancing, describe the features and importance of different transmission systems used in an automobile
4	Explain the salient features of different differential gear boxes, axles and suspension systems used in an automobile
5	Calculate the power requirement of a vehicle
6	Trace the evolution of ICE automobiles into hybrid and electric vehicles and explain their salient features

\*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.