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
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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 efficient petrol injection system is [CO1]
         (a) direct injection   (b) port injection
         (c) manifold injection   (d) throttle body injection.

   (ii) To obtain maximum mileage in a car, the drivers should [CO1]
         (a) apply minimum brake
         (b) run the engine at the most optimum rpm by selecting right gear
         (c) apply minimum clutch
         (d) all of above.

   (iii) A component named "Caliper" is found in the following part of an Automobile [CO2]
         (a) Suspension   (b) Gear Box   (c) Differential   (d) Disc Brake.

   (iv) Self Energisation of brake happens in [CO2]
         (a) Disc brakes   (b) Trailing shoe of drum brake
         (c) Both Disc & Drum brakes   (d) Leading shoe of drum brake.

   (v)   Auto restoration of the steering wheel to its neutral position after a turn happens due to [CO3]
         (a) Caster angle   (b) Camber angle
         (c) Steering axis inclination angle   (d) Toe-in angel.

   (vi) Increase in "Scrub Radius" results in [CO3]
         (a) Decreased steering effort   (b) no change in steering effort
         (c) increased steering effort   (d) increase in turning radius.

   (vii) A rear wheel drive vehicle moving in a radius has its differential crown wheel rotating at 50 rpm and inner wheel rotating at 45 rpm. The speed of the outer wheel is [CO4]
         (a) 45 rpm   (b) 65 rpm   (c) 55 rpm   (d) 75 rpm.

(viii)   Which one of the following components DO NOT contribute to 'Unsprung Weight'. [CO4]
         (a) Wheel   (b) Shock absorber   (c) Stub Axle   (d) Brake drum.

(ix)   Magnitude of Air resistance to a moving vehicle is directly proportional to [CO5]
       (a) square of vehicle frontal area and it's velocity
       (b) vehicle frontal area and it's velocity
       (c) vehicle frontal area and square of it's velocity
       (d) aerodynamic shape of the vehicle.

(x)   A hybrid vehicle has better fuel efficiency because [CO6]
      (a) wheels are driven by electric motor
      (b) wheels can be driven by electric motor as well as IC engine
      (c) IC engine is made to run only at the most optimum speed
      (d) all of above.

Group – B

2.   (a)   Draw schematic diagram of MPFI system in a SI engine and explain how it works. Why it is preferred over carburetor? (CO1[Analyze/IOCQ])
     (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])

                                             (4 + 2) + (4 + 2) = 12

3.   (a)   What are the advantages of hydraulic breaking system? What's the advantage of tandem master cylinder over single master cylinder in hydraulic braking system? (CO2[Analyze/IOCQ])
     (b)   To experimentally calculate the coefficient of friction between the road and the wheels a car weighing 13 kN and having a wheelbase of 2.5 m 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 made to move 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, its stops over a distance of 16.4 m. Calculate (CO2[Evaluate/HOCQ])
           (i)   the coefficient of friction between the road and the wheels.
           (ii) load distribution between front and rear axles.

                                             (2 + 3) + (3 + 4) = 12

Group – C

4.   (a)   Derive the equation for perfect steering for a front wheel steered vehicle.
           Describe with sketch how the 'Rack & Pinion' steering mechanism of an independent suspension carovercomes the problem associated with Ackerman steering. (CO3[Remember/LOCQ])
     (b)   What is 'Scrub Radius'. What are the effect of +ve and -ve scrub radius. (CO3[Analyze/IOCQ])

                                             (4 + 4) + 4 = 12

5. (a) What is the purpose of changing gear during driving? Explain with suitable graph. (CO3[Analyze/IOCQ])
   (b) With the help of neat diagram explain the working of a synchromesh system in agearbox and evaluate it's performance w.r.t. non-synchromesh system. (CO3[Analyze/IOCQ])

   6 + 6 = 12

Group – D

6. (a) Explain with sketch working of a 'Differential Gear box'. (CO4[Remember/LOCQ])
   (b) Mention two (2) solutions to overcome the problem of slippage of one driven wheel when it is on a slippery ground for a rear wheel drive vehicle. (CO4[Analyze/IOCQ])

   6 + 6 = 12

7. (a) Give an example with sketch of a Rigid Axle suspension and an Independent suspension. Why are they called independent suspension? (CO4[Analyze/IOCQ])
   (b) What are 'Sprung wight' and 'Unsprung weight'? Give examples. Which should be high for comfortable ride? (CO4[Remember/LOCQ])

   (4 + 4) + 4 = 12

Group – E

8. (a) Briefly explain the different types of resistances a vehicle encounters while travelling. (CO5[Analyze/IOCQ])
   (b) A car weighing 1400kg can move at a speed of 90 kmph on level road. The car has projected frontal area of 2.5 m2. The coefficient of air resistance is 0.032 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])

   4 + (4 + 4) = 12

9. (a) Explain with sketches configuration of the following and what kind of emissions each vehicle will have. (CO6[Evaluate/HOCQ])
      (i) Hybrid Electric Vehicle (HEV)
      (ii) Plug-in Hybrid Electric Vehicle (PHEV)
   (b) (i) Battery Electric Vehicle (BEV)
      (ii) Fuel Cell Electric Vehicle (FCEV) (CO6[Evaluate/HOCQ])

   (3 + 3) + (3 + 3) = 12

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	25%	47%	28%

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

Department & Section	Submission link:
ME	https://classroom.google.com/c/MzQ1NjkwOTA3NDIz?cjc=k43rfuc