

**IC ENGINE
(MECH 3211)**

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 theoretically correct air fuel ratio for petrol engine is of the order of
(a) 6:1 (b) 9:1 (c) 12:1 (d) 15:1
 - (ii) Which is not the common component between a CI engine and an SI engine?
(a) Camshaft (b) Dynamo
(c) Spray nozzle (d) Exhaust silencer.
 - (iii) Compared to a 4-stroke cycle engine, a 2-stroke cycle engine
(a) can be easily started
(b) has lesser shocks
(c) is smaller in size for the same output
(d) has lower fuel consumption for same output.
 - (iv) Under idling conditions, throttle valve of a petrol engine is more or less closed.
That provides
(a) lean mixture (b) rich mixture
(c) chemically correct air-fuel mixture (d) only air flow.
 - (v) Detergents are oil additives used to
(a) reduce viscosity (b) increase fire point
(c) prevent sludge formation (d) prevent foaming
 - (vi) Modern carburettors provide correct quality of fuel air mixture during
(a) high power running only (b) cruising only
(c) idling only (d) all conditions.
 - (vii) The ability of the oil to resist internal deformation due to mechanical stresses is
due to its property of
(a) Viscosity (b) Flash point
(c) Fire point (d) auto ignition.

- (viii) When the mixture is lean
(a) efficiency is less (b) power output is less
(c) maximum temperature and pressure are higher (d) all of these.
- (ix) Time loss factor in Actual Cycle is due to
(a) progressive combustion (b) heat loss through cylinder walls
(c) gas leakage (d) friction.
- (x) Crankcase ventilation is provide
(a) to cool cylinder (b) to cool crankcase
(c) to cool piston (d) to remove blowby.

Group – B

2. (a) Find the bsfc of an engine which consumes 6 kg of fuel in 20 minutes and develops a break power of 60 kW. If the fuel has a heating value of 42 MJ/kg, find the brake thermal efficiency. If the indicated thermal efficiency is 40%, what is the mechanical efficiency of the engine?
- (b) Discuss the phenomenon of 'Dissociation' in the analysis of fuel air cycle. Explain with a diagram how the specific fuel consumption varies with power output for (i) air standard cycle (ii) fuel air cycle and (iii) actual cycle.
- 6 + (3 + 3) = 12**
3. (a) Discuss briefly how a fuel air cycle is different from an air standard cycle and its significance. In this context, draw a curve to show the effect of equivalent ratio on the ratio of efficiencies of F/A cycle to Air standard cycle for an SI engine.
- (b) A 4-stroke engine with an indicated thermal efficiency of 25% and mechanical efficiency of 75% consumes 13 kg/h of fuel of calorific value of 42 MJ/kg at a fixed speed. The brake mean effective pressure is 5 bar and the mean piston speed is 15 m/s. Assuming it to be a single cylinder square engine determine the crank radius and rpm.
- (4 + 2) + (3 + 3) = 12**

Group – C

4. (a) Define Octane Number. Describe the laboratory method for determining the Octane Number of a fuel.
- (b) Derive an expression of air fuel ratio in a simple carburettor assuming a compressible and adiabatic flow.
- (2 + 3) + 7 = 12**
5. (a) What are the effects of (i) sulphur content and (ii) gum deposits in SI engine fuels? Why do paraffins have more heating value than aromatics?
- (b) A simple jet carburettor is designed to supply 5 kg of air and 0.5 kg of fuel per minute. The fuel specific gravity is 0.75. The air is initially at 1 bar and 300 K.

Calculate the throat diameter of the venturi for air flow rate of 100 m/s. Take velocity coefficient to be 0.8. If the pressure drop across the fuel metering orifice is 80% of that of the choke, calculate the orifice diameter; assuming $C_{df} = 0.60$. Take $R_{air} = 287 \text{ J/kg-K}$, $\gamma = 1.4$.

(4 + 2) + 6 = 12

Group – D

6. (a) Clearly explain wet sump lubrication system with the help of a suitable schematic diagram showing its basic components. Compare wet sump and dry sump lubrication system.
- (b) What is the purpose of a fuel injector? Describe in short a 'Unit Injection System' with a schematic diagram.

6 + (1 + 2 + 3) = 12

7. (a) Calculate the diameter of the fuel orifice of a 4-stroke engine which develops a brake power of 60 kW per cylinder running at 3000 rpm. The bsfc is 0.27 kg/kWh of fuel with 30° API. The fuel is injected at a pressure of 160 bar over a crank travel of 20°. The pressure in the combustion chamber is 45 bar. Coefficient of velocity is 0.85 and specific gravity is given by $S.G. = \frac{141.5}{131.5 + ^\circ API}$.
- (b) What is meant by 'Ignition' in SI engine? What relation does it have with 'Combustion'? Explain 'Ignition timing' and how it depends on various factors.

6 + (2 + 4) = 12

Group – E

8. (a) Mention the various parameters which affect the engine heat transfer and explain their effect.
- (b) In a test of a 4-cylinder, 4 stroke engine 75mm bore and 100 mm stroke, the following results were obtained at full throttle at a particular constant speed and with fixed setting of fuel supply of 6.0 kg/h.
 B.P. with all cylinder working = 15.6 kW;
 B.P. with cylinder no. 1 cut out = 11.1 kW
 B.P. with cylinder no. 2 cut out = 11.03 kW
 B.P. with cylinder no. 3 cut out = 10.88 kW
 B.P. with cylinder no. 4 cut out = 10.66 kW
 Given that the calorific value of the fuel is 83600 kJ/kg and clearance volume is 0.0001 m³.
 Calculate: (i) Mechanical efficiency, (ii) Indicated thermal efficiency, and (iii) air standard efficiency.

5 + 7 = 12

9. (a) What is crankcase blowby? How is it controlled?

- (b) A gas turbine plant operates on Brayton cycle between 300 K and 1073 K. Find the maximum work output per kg of air and the corresponding cycle efficiency. What is the value of work ratio? How does this efficiency compare with the Carnot cycle efficiency operating between the same two temperatures?

(2 + 3) + 7 = 12

Department & Section	Submission Link
ME	https://classroom.google.com/c/Mjk3MjQwMDkxNjc3?cjc=ui3biy2 for sec A; class code: ui3biy2
	https://forms.gle/NEHivCkXgMrYrPo7A for sec B; Google Classroom code: sn5ljbm