IC ENGINES
(MECH 3201)

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) Engines used for ships are normally
(a) 4 stroke SI engines of very high power
(b) 4 stroke CI engines of very high power
(c) 2 stroke SI engines of very high power
(d) 2 stroke CI engines of very high power.

(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) Maximum exhaust temperature in S I engine will be produced when
(a) the mixture is lean (b) the mixture is rich
(c) the mixture is chemically correct (d) maximum load is applied.

(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) Chemiluminescence technique is used to measure
(a) NO_x (b) CO (c) CO_2 (d) smoke intensity.

(viii) For an SI engine, when the mixture is lean
(a) efficiency is more (b) power output is more
(c) peak temperature and pressure are higher (d) all of these.

(ix) The process of breaking up of a liquid fuel into fine droplet by spraying is called
(a) Vaporisation (b) Carburetion
(c) Ionisation (d) Atomisation.

(x) Crankcase ventilation is provided
(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. How does the specific fuel consumption vary with power for (i) air standard cycle (ii) fuel air cycle and (iii) actual cycle? Explain with a diagram.

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 relative fuel air ratio on efficiency ratio.

(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 J/kg-K, γ = 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 + 5) = 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 $S.G. = \frac{141.5}{131.5 + °API}$.

   (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) The following observations are recorded during a trial of a four-stroke, single-cylinder oil engine. Duration of trial is 30 min; oil consumption is 4 litres; calorific value of the oil is 43 MJ/kg; specific gravity of the fuel = 0.8; average area of the indicator diagram = 8.5 cm^2; length of the indicator diagram = 8.5 cm; spring constant associated with the indicator diagram = 5.5 bar/cm; brake load = 150 kg; spring balance reading = 20 kg; effective brake wheel diameter = 1.5 m; speed = 200 rpm; cylinder diameter = 30 cm; stroke = 45 cm. Brake power of the engine is measured by using a rope brake. Calculate (i) indicated power, (ii) brake power, (iii) mechanical efficiency, (iv) brake specific fuel consumption in kg/kW-h, and (v) indicated thermal efficiency.

5 + (2 + 1 + 1 + 2 + 1) = 12

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

   (b) A gas turbine plant operates on ideal Brayton cycle between 300 K, 0.1 Mpa and maximum temperature 1073 K. The pressure ratio is 6.25. Find (i) the turbine work and pump work per kg of air and (ii) the corresponding cycle efficiency.

(iii) How does this efficiency compare with the Carnot cycle efficiency operating between the same two temperatures?

(2 + 3) + (4 + 2 + 1) = 12

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