(b) Explain three mechanisms of lubrication by showing a typical Stribeck diagram corresponding to a journal bearing. What are the various desired properties of a lubricant?

6 + (2 + 4) = 12

Group - E

8. (a) Mention three advantages and two limitations of liquid-cooling system associated with an I C engine.

(b) The following observations recorded after the conduct of a retardation test on a single-cylinder diesel engine are as follows:
Rated power: 8 kW
Rated speed: 475 rpm
Time for the fall of 100 rpm at no load: 8.3 s
Time for the fall of same 100 rpm at half load: 3.4 s
Calculate frictional power and mechanical efficiency.

(3 + 2) + (5 + 2) = 12

9. (a) What are the non-exhaust emissions that come out from an automobile? Briefly describe any one non-exhaust emission control method.

(b) Obtain an expression for net specific work output (w_{net}) of a gas turbine unit in terms of pressure ratio (r_p), the associated isentropic efficiencies of compressor and turbine (η_C and η_T respectively), and the corresponding maximum and minimum temperatures (T_{max} and T_{min} respectively). Hence, show that the pressure ratio for optimum net specific work output is given by

$$r_p = \left(\eta_C \eta_T \cdot \frac{T_{max}}{T_{min}} \right)^{\frac{\gamma}{2(\gamma-1)}},$$

where γ is the ratio of the specific heat at the constant pressure to that at the constant volume ($\gamma = c_p/c_v$).

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

I C 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) Relative efficiency is

(a) $\frac{actual\ thermal\ efficiency}{mechanical\ efficiency}$ (b) $\frac{actual\ thermal\ efficiency}{air\ standard\ efficiency}$

(c) $\frac{air\ standard\ efficiency}{actual\ thermal\ efficiency}$ (d) $\frac{mechanical\ efficiency}{actual\ thermal\ efficiency}$.

(ii) Equivalence ratio is

(a) $\frac{actual\ \frac{fuel}{air}\ ratio}{stoichiometric\ \frac{fuel}{air}\ ratio}$ (b) $\frac{stoichiometric\ \frac{fuel}{air}\ ratio}{actual\ \frac{fuel}{air}\ ratio}$

(c) $\frac{actual\ \frac{air}{fuel}\ ratio}{stoichiometric\ \frac{air}{fuel}\ ratio}$ (d) $\frac{actual\ \frac{fuel}{air}\ ratio}{stoichiometric\ \frac{air}{fuel}\ ratio}$.

(iii) The most accurate gasoline injection is
(a) direct injection (b) port injection
(c) throttle body injection (d) manifold injection.

(iv) Thermal efficiency of a Stirling Cycle is same as that of
(a) an Otto cycle (b) Diesel cycle
(c) Carnot cycle (d) Dual cycle.

(v) For the compression process of an S I engine cycle with variable specific heat, the peak temperature is
(a) lower (b) higher
(c) can be either lower or higher (d) no effect.

(vi) The normal range of compression ratio for a C I engine cycle is
(a) 4 to 6 (b) 6 to 8
(c) 15 to 20 (d) > 25.

(vii) Thermostat is used in radiators to
(a) control the velocity of water
(b) control the distribution of water
(c) control the temperature of water
(d) control the pressure of water.

(viii) Spark advance is usually specified in terms of
(a) engine speed in rev/sec
(b) time in seconds
(c) piston displacement from TDC
(d) degrees of crank rotation.

(ix) Paraffins have molecular structure of
(a) chain saturated (b) chain unsaturated
(c) ring saturated (d) ring unsaturated.

(x) Three way catalytic converters reduce emission of
(a) CO, CO_2, and soot (b) CO, NO_x, and HC
(c) CO_2, NO_x, and HC (d) CO, HC, and soot.

Group - B

2. (a) Determine the ideal efficiency of a diesel engine having a cylinder with bore 250 mm, stroke 375 mm and a clearance volume of 1500 cc, with fuel cut-off occurring at 5% of the stroke. Assume γ = 1.4 for air.

(b) Mention the processes and draw the p-v and T-s diagrams for the following two air standard cycles: (i) Lenoir cycle (ii) Atkinson cycle.

6 + (3 + 3) = 12

3. (a) Explain 'pumping loss' in an S I engine. Determine the percentage change in efficiency of an S I engine with compression ratio 8.5 if the specific heat at constant pressure increases by 1.5%.

(b) What is a 'fuel air cycle'? What are the assumptions made in the analysis? Why does the specific heat of gases, except mono-atomic gases, increase with temperature?

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

Group - C

4. (a) Explain what is meant by 'vapour lock'. What is meant by 'auto ignition temperature. What is the function of a 'choke valve' in a simple carburettor?

(b) Discuss briefly the air fuel mixture requirements at different loads in an S I engine with a diagram. Why is a rich mixture required during idling?

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

5. (a) Explain briefly the phenomenon of knock in an S I engine. Describe what is meant by a motoring curve and its significance.

(b) The venturi of a simple carburettor is 25 mm and the coefficient of flow is 0.78. The fuel orifice has a diameter of 1.35 mm and the coefficient of flow is 0.68. The gasoline surface is 6 mm below the throat. Calculate (i) the air fuel ratio for a pressure drop of 0.1 bar when the nozzle tip is neglected (ii) the air fuel ratio when the nozzle tip is taken into account. Take the densities of air and fuel as 1.20 kg/m^3 and 750 kg/m^3 respectively, and assume incompressibility condition.

(4 + 2) + 6 = 12

Group - D

6. (a) Write a short note on 'Ignition Coil' of a battery ignition system that uses a 12 V battery. Explain the function of a contact breaker. What metal is used for contact points and why?

(b) Discuss the various functions fulfilled by a nozzle in an injection system. How is Solid Injection System further classified?

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

7. (a) A 4-cylinder 4-stroke C I engine develops a power of 180 kW at 1500 rpm. The bsfc is 0.2 kg/kWh. At the beginning of injection, pressure is 30 bar and the maximum cylinder pressure is 50 bar. The injection is expected to be at 200 bar and maximum pressure at the injector set to be 500 bar. Determine the orifice required per cylinder if the injection takes place over 15° crank angle. Assume the following:
C_d for injector = 0.7; S. G. Of fuel = 0.875 ; Effective pressure difference = Average pressure difference over the injection period.