Ref No. Ex/PG/MEC/PE/T/122G/2025

M.E. MECHANICAL ENGINEERING FIRST YEAR SECOND SEMESTER – 2025

Combustion Engines

Time: 3 Hours **Full Marks: 100**

Answer any four questions. Assume any unfurnished data suitably.

1. a) Explain why rich mixture is required in power zone of engine operation. Explain the arrangement made to provide this rich mixture through carburetor with the help of a schematic diagram (10)
   b) A single cylinder four stroke petrol engine has 8cm bore and 10 cm stroke. The maximum speed of the engine crank is 2000 rpm. Design a simple carburetor to cater to the engine for a fuel-air ratio of 1:15. (15)

2. a) Draw a labelled sketch of a simple carburetor and describe its operation. (10)
   b) State the disadvantages of carburetor used in SI engine. (5)
   c) Describe throttle body injection and multi-point injection systems in SI engine? (5)
   d) State how the disadvantages of carburetor are mitigated using SI engine injection systems. (5)

3. a) A closed type injector has a nozzle orifice diameter of 0.949 mm and the maximum cross sectional area of the passage between the needle cone and the seat is 1.75 mm^2. The discharge coefficient for the orifice is 0.85 and for the passage is 0.80. The injection pressure is 175 bar and the average pressure of charge during injection is 25 bar, when the needle cone is fully lifted up. Calculate the volume rate of flow per second of fuel through the injector and the velocity of jet at that instant. Density of fuel is 850 kg/m^3. (10)
   b) Write a short note on common rail system. (5)
   c) With a labeled sketch, describe the operating principle of a distributor pump for CI engine injection. (7)
   d) State the advantage of a pintle type nozzle for fuel injection. (3)

4. a) State the principle of supercharging and its advantages. (10)
   b) Why is supercharging problematic in SI engines? (3)

[Turn over

c) A 3 litre four stroke diesel engine develops 12 kW per m^3 of free air inducted per minute. The volumetric efficiency is 82% at 3600 rpm referred to atmospheric condition of 1 bar and 27°C. A rotary compressor, mechanically coupled to the engine, is used to supercharge the engine. The pressure ratio and the isentropic efficiency of the compressor are 1.6 and 70% respectively. Calculate the percentage increase in brake power due to supercharging. Assume air intake to the cylinder to be at the pressure equal to 5.6°C less than the delivery temperature of the compressor. Also assume that cylinder contains volume of charge equal to swept volume. (12)

5.a) In a test of an oil engine under full load condition the following results were obtained: (15)
Ip = 33kW, bp = 27 kW, fuel used 8 kg/hr, calorific value of fuel = 43 MJ/kg, rate of water flow through exhaust gas calorimeter = 12 kg/min, Inlet water temperature at exhaust gas calorimeter = 15°C, outlet water temperature at exhaust gas calorimeter = 55°C, cooling water flow rate 7 kg/min, inlet temperature of cooling water = 15°C, outlet temperature of cooling water = 75°C, Final temperature of exhaust gas 80°C, room temperature = 17°C, air-fuel ratio on mass basis = 20, mean specific heat of exhaust gas = 1 kJ/kg K, specific heat of water = 4.18 KJ/kg K.
Estimate the thermal and mechanical efficiencies. Draw up a heat balance chart.

b) Write down the procedure of Morse test. Explain why Morse test is most popular one. (10)

6. a) Draw a normal p-θ diagram of an SI engine, along with the motoring curve. (4)

b) Why is the peak pressure resulted slightly after the TDC? (6)

c) Explain the phenomenon of abnormal combustion in Diesel engine. (8)

d) Write a short note on Octane number. (7)