Ref. No. : Ex/PE/T/312/2017(Old)(S)

B.Power Engineering 3rd Year, 1st Semester Supplementary Examination, 2017 (Old)

Subject : I.C. Engine & Gas Turbine **Time : Three hours** **Full Marks : 100**

Answer any five questions

1. (a) Using the P-v and T-s diagrams explain the different air standard cycles relevant to reciprocating internal combustion engines. Also state with proper justifications which cycle corresponds to which type of engine. **(10)**

   (b) Name the various factors which change the actual indicator diagram of a petrol engine from the corresponding air-standard cycle. Explain their effects. **(10)**

2. (a) Draw the valve timing diagrams for a C.I. engine operating at low speed and high speed. Explain with suitable justification the significance of various timings shown in the diagrams. **(10)**

   (b) What is scavenging? How can it be achieved by adjusting the timings of the valves? **(6)**

   (c) Define volumetric efficiency of an engine and state its significance. **(4)**

3. (a) What are the various qualities of fuel-air mixture required for operating a S.I. engine at different steady state and transient operating conditions? Explain in details. **(10)**

   (b) Explain the operating principle of a simple carburetor with sketch. **(10)**

4. (a) With the help of pressure-crank angle diagram explain the various stages of combustion in a spark ignition engine. **(10)**

   (b) What is detonation in S.I. engine? Why does it occur? What are its adverse effects? **(10)**

5. (a) What is ignition delay in C.I. engine? How is it related to Cetane number? **(6)**

   (b) How does an IDI engine differ from a DI engine operating under compression ignition? **(6)**

   (c) What are the different air motions required in the C.I. engine cylinder to achieve good combustion? **(8)**

6. A four cylinder petrol engine operates on the four stroke cycle. The bore of each cylinder is 80 mm and the stroke is 95 mm. The compression ratio of the engine is 7.5. At a speed of 3000 rpm, the brake specific fuel consumption of the engine is 0.26 kg/kWh and the torque developed is 170 Nm. Calculate : (a) the brake power, (b) brake mean effective pressure, (c) brake thermal efficiency if the heating value of the fuel is 42 MJ/kg, (d) volumetric efficiency if the operating air-fuel ratio by mass is 12.5. Assume ambient pressure as 1.013 bar and temperature as 25°C. **(20)**

7. A test on a four stroke, diesel engine under full load condition gives the following results:

   Indicated Power = 33 kW, Brake Power = 27 kW, Fuel consumption rate = 8 kg/h, Rate of flow of water through exhaust gas calorimeter = 12 kg/min, Jacket cooling water flow rate = 7 kg/min, Calorific value of fuel = 43 MJ/kg, Inlet temperature of cooling water = 15°C, Outlet temperature of cooling water = 75°C, Inlet temperature of water to exhaust gas calorimeter = 15°C, Outlet temperature of water from

exhaust gas calorimeter = 55°C, Final temperature of exhaust gas = 80°C, Ambient temperature = 17°C, Air-fuel ratio = 20, Mean specific heat of exhaust gas = 1 kJ/kg K.

Draw up a heat balance sheet and estimate the thermal and mechanical efficiencies. (20)

8. (a) Derive and show that the efficiency of an ideal gas turbine plant with regeneration depends both on pressure ratio and temperature ratio. (8)

(b) A gas turbine unit operates at a mass flow rate of 25 kg/s. Air enters the compressor at a pressure of 1 bar and temperature 25°C and is discharged from the compressor at a pressure of 9.2 bar. Combustion occurs at constant pressure and results in a temperature rise of 570°C. If the flow leaves the turbine at 1.2 bar, determine the net power output from the unit and also the thermal efficiency considering ideal cycle. Take specific heat of air at constant pressure as 1.005 kJ/kg K and $\gamma = 1.4$. (12)