BACHELOR OF POWER ENGINEERING EXAMINATION, 2009

3rd Year–1st Semester (Supplementary)

I. C. ENGINES AND GAS TRUBINE

Time : Three hours | Full Marks : 100

No. of questions		Marks
	Answer any five questions.	
1.a)	Derive an expression of efficiency of air standard dual cycle and from it find out the corresponding expressions for Otto and Diesel cycles. Compare the efficiencies of the three cycles for the same compression ratio and heat input.	10
b)	An oil engine having compression ratio 16 works on air standard Diesel cycle. The engine has a bore of 12 cm and stroke 15 cm and complete 400 working cycles per minute. If the inlet air condition are 1 bar and 30^0 C and cut off takes place at 10% of the stroke, determine: (i) air standard cycle efficiency, (ii) mean effective pressure, (iii) power developed by the engine.	10
2.a)	What do you mean by volumetric efficiency of an I.C. Engine? How does it affect the performance of a S.I. engine at part load?	
b)	Why is the suction valve of a four stroke engine opened before the IDC and closed after the ODC?	
c)	What is detonation in a S.I. engine and why does it occur?	
d)	How does the air-fuel mixture quality vary at different transient conditions in a S.I. engine?	5×4

[Turn over

No. of questions		Marks
3.a)	With the help of a neat sketch explain the working principle of a simple carburettor.	8
b)	A simple jet carburetor is required to supply 6 kg/min of air and 0.45 kg/min of fuel having density 740 kg/m^3. The air is initially at 1.013 bar and 27^0 C. (i) Calculate the venturi throat diameter for a flow velocity of 92 m/s. Velocity coefficient =0.8. (ii) If the pressure drop across the fuel metering orifice is 0.75 of that at the venturi throat, calculate the orifice diameter assuming C_d=0.6.	12
4.a)	What are the different ignition systems in use for S.I. engine? Draw a labeled sketch showing the circuit diagram of a battery ignition system and discuss its principle.	2+8
b)	What do you mean by ignition advance? What will happen if the ignition advance is too high?	2+2
c)	Briefly describe the basic features of different spark advance mechanisms.	6
5.a)	What are the principal objectives of fuel injection system for C.I. engines? What are the advantages and limitations of air injection system?	3+5
b)	A six cylinder, four stroke oil engine operates at an A/F ratio of 20. The diameter and stroke of the cylinder are 100 mm and 140 mm respectively. The volumetric efficiency is 80%. The condition of air at the beginning of compression are 1 bar and 27^0 C. (i) Determine the amount of fuel that can be injected in each cylinder per second. (ii) If the speed of the engine is 1500 rpm, injection pressure is 150 bar, air pressure during fuel injection is 40 bar and fuel injection is carried out for 20^0 crank angle, determine the diameter of the fuel orifice assuming only one orifice per cylinder. Take density of fuel = 960 kg/m^3 and C_d = 0.67.	12

No. of questions		Marks
6.	The following observations were taken during one hour trial of a single cylinder, four stroke petrol engine: Fuel consumption = 10.0 kg, net brake load = 1.5 kN, brake drum diameter = 1.83 m, RPM = 300, Total cooling water circulated = 650 kg, Inlet temperature of CW=15^0 C, Outlet temperature of CW=60^0 C, Temperature of the exhaust gas = 300^0 C, Ambient temperature = 20^0 C, air consumption = 475 kg, IMEP = 6.4 bar, CV of fuel = 45000 kJ/kg, specific heat of exhaust gas = 1 kJ/kg K, bore = 30 cm, stroke = 45 cm. Determine (i) brake power, (ii) mechanical efficiency, (iii) brake thermal efficiency. Also draw up a heat balance for the engine.	20
7.	An open cycle gas turbine plant consists of a two stage compressor and a single stage turbine mounted on a single shaft. The air is cooled in an intercooler where perfect intercooling can be assumed to take place. Each compressor compresses the air through an optimum pressure ratio for which minimum work output can be obtained. A regenerator is used to increase the efficiency of the plant. The following data are given: Inlet air pressure and temperature = 1 bar, 27^0 C, overall pressure ratio = 8. Turbine entry temperature = 1050 K. Effectiveness of the regenerator = 0.75. Assume the processes in the compressor and turbine as isentropic. The air-fuel ratio is 80:1, calorific value of the fuel is 40 MJ/kg and combustion efficiency is 96%. Draw a flow diagram and T-s diagram for the plant. Determine the overall thermal efficiency of the plant and the fuel flow rate for each MW power output. Take the specific heat of air and gas as 1.005 kJ/kg K.	20