B.E.(with Credits)-Regular-Semester 2012-Mechanical Engineering Sem. VII

ME - I.C. Engine and Gas Turbines

P. Pages : 3 **GUG/W/16/6622**

Time : Three Hours * 4 6 9 3 * Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Answer Q.1 OR Q.2, Q.3 OR Q.4, Q.5 OR Q.6, Q.7 OR Q.8, Q.9 OR Q.10.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.
5. Use of Steam tables, Drawing instruments is permitted.

1. a) Explain the following terms as applied to I.C. engines : **8**
Bore, Stroke, TDC, BDC, Clearance volume, Swept volume, Compression ratio and piston speed.

b) Discuss the difference between ideal and actual valve timing diagrams of a petrol engine. **5**

c) How are SI engine fuel rated? **3**

OR

2. a) Explain briefly the essential features of good commercial carburetor for automotive engines. **5**

b) Describe with suitable sketches the following systems of a modern carburetor. **5**

i) Main metering system.

ii) Acceleration pump system.

c) A simple Jet carburetor is required to supply 6 kg of air per minute and 0.45 kg of fuel of density $740\,kg/m^3$, the air initially at 1.013 bar and 27°C. **6**

i) Calculate the throat diameter of the choke for a flow velocity of 92 m/s. velocity co-efficient = 0.8.

ii) If the pressure drop across the fuel metering orifice is 0.75 of that at the choke, calculate the orifice diameter assuming Cd = 0.60.

3. a) Explain the phenomenon of knocking in S.I. engines. What are the different factors which influences the knocking? Describe the methods used to supress it. **8**

b) What is ignition lag? Discuss the effect of engine variables on ignition lag. **5**

c) Discuss the ignition limits of hydrocarbon fuels. **3**

OR

4. a) What is delay period in C.I. engine? **2**

b) How are CI engine combustion classified? What type of swirl is used in these chambers? **6**

c) Explain the effect of the following factors on delay period. **8**

i) Fuel properties ii) Compression ratio

iii) Types of combustion chamber iv) Injection advance

5. a) A 4 – cylinder, 4 – stroke diesel engine has a bore of 212mm and a stroke of 292 mm. At fuel load at 720 r.p.m., The b.m.c.p. is 5.93 bar and sp. fuel consumption is 0.226 kg/kwh. The air / fuel ratio as determined by exhaust gas analysis is 25 : 1. Calculate the break thermal efficiency & volumetric efficiency of the engine. Atmospheric condition are 1.01 bar & 15ºC & C.V. of fuel is 44.2 MJ/kg. **8**

b) Describe the method commonly used in laboratory for measuring the air supplied to an IC engine. **5**

c) What do you mean by octane numbers & cetane number. **3**

OR

6. a) Explain the method of measurement of indicated power in multi cylinder SI engine. **6**

b) From the data given below, calculate indicator power, brake power and draw up or heat balance sheet for a two-stroke diesel engine run for 20 minutes at full load : **10**
RPM = 350, m.e.p. = 3.1 bar, Net load = 640 N. Fuel consumption = 1.52kg, Cooling water = 1.52 kg. Water inlet temperature = 30ºC, water outlet temperature = 55ºC, Air used = 32 kg/kg of fuel Room temp. = 25ºC, Exhaust temp. = 305ºC, cylinder bore = 200 mm, stroke = 280 mm, brake diameter = 1 meter, C.V. of fuel = 43900 kJ/kg, steams formed per kg of fuel in the exhaust = 1.4kg, Sp. heat of steam in exhaust = 2.09 kJ/kgºk, Sp. heat of dry exhaust gases = 1.0 kJ/kgºk.

7. a) Define rotary compressor. **6**
Explain with neat sketch the following rotary compressor :

i) Roots compressor.

ii) Sliding Vane Compressor

iii) Screw compressor

b) A centrifugal compressor used as a supercharger for aero-engines handles 150kg/min of air, the suction pressure and temperature are 1 bar and 290ºK. The suction velocity is 80m/s; After compression in the impeller the conditions are 1.5 bar, 345 ºK and 220 m/s. Calculate : **10**

i) Isentropic efficiency,

ii) Power required to drive the compressor

iii) The overall efficiency of the unit.

It may be assumed that K.E. of air gained in the impeller is entirely converted into pressure in the diffuses.

OR

8. a) Describe with a neat sketch the construction and working of a single stage single acting reciprocating air compressor. **5**

b) A two stage double air compressor, operating at 220 r.p.m. takes in air at 1.0 bar and 27ºC. The size of the L.P. cylinder is 360 x 400mm; the stroke of H.P. cylinder is the same as that of the LP cylinder and the clearance of both the cylinder is 4%. The LP cylinder discharges the air at a pressure of 4.0 bar. The air passes through the intercooler so that it enters the HP cylinder at 27ºC and 3.80 bar, finally it is discharged from the compressor at 15.2 bar. The value of 'n' in both the cylinder is 1.3, Cp = 1.0035 kJ/kg ºk and R = 0.287 kJ/kg ºk. **11**

Calculate :

i) the heat rejected in the intercooler;

ii) Diameter of HP cylinder

iii) The power required to drive HP cylinder.

9. a) Describe with neat sketch a closed cycle gas turbine. State also its merits and demerits. **6**

b) In a gas turbine the compressor is driven by the high pressure turbine. The exhaust from the high pressure goes to a free low pressure turbine which runs the load. The air flow rate is 20kg/s and the minimum and maximum temperatures are respectively 300K and 1000K. The compression pressure ratio is 4. Calculate the pressure ratio of the low pressure turbine and the temperature of exhaust gases from the unit. **10**
The compressor and turbine are isentropic Cp of air and exhaust gases = 1kJ/kg ºk and $\gamma = 1.4$.

OR

10. a) State the principle of a Jet propulsion. Classify propulsion system & explain with neat sketch & T-S diagram Gas turbine plant for turbo jet. **10**

b) Explain the working difference between propeller – jet, turbo jet & turbo propeller. **6**

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