B.E./B. TECH (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL/MAY 2011

MECHANICAL ENGINEERING BRANCH

FOURTH SEMESTER

ME 284 – THERMAL ENGINEERING - I

(REGULATIONS 2004)

Time : Three Hours Max Mark : 100

(Use of Thermodynamic Tables and Steam Tables Permitted)

ANSWER ALL QUESTIONS

PART- A (10 x 2 = 20 Marks)

1. Define mean effective pressure and air standard efficiency.
2. Draw the actual and theoretical diagrams of four stroke cycle engine.
3. Why compounding of steam turbines is necessary?
4. Define speed ratio and blade velocity coefficient.
5. How are I.C engines classified based on method of charging and number of cycles.
6. Draw the port timing diagram of a two stroke cycle engine.
7. What do you understand by self ignition temperature and octane number of a fuel.
8. What is detonation in a C.I engine?
9. List down the disadvantages of a closed cycle gas turbine over open cycle gas turbine.
10. Why the maximum temperature in the gas turbine cycle is limited to about $850^{o}C$?

PART B (5 x 16 = 80 Marks)

11. i). Describe with a neat sketch the working of a simple constant pressure open cycle gas turbine. **(8)**

    ii). The temperature range of a simple gas turbine plant working on Brayton cycle is $15^{o}C$ and $727^{o}C$. The pressure ratio of the plant is 6. The isentropic efficiencies of compressor and turbine are 85 % and 90 % respectively. Considering air as working fluid, find the plant efficiency and specific output of the plant. **(8)**

12. a. The compression ratio for a single cylinder engine operating on dual cycle is 8. The maximum pressure in the cycle is limited to 55 bar. The pressure and temperature at the beginning of the cycle are 1 bar and $27^{o}C$. Heat is added during constant pressure process upto 3 % of the stroke. Assuming the cylinder diameter as 25 cm and stroke as 30 cm. Find the work done per cycle and the air standard efficiency of the cycle. **(16)**

(OR)

b i).Obtain the expression for the efficiency of an ideal otto cycle. **(8)**

ii).An engine working on the otto cycle has a volume of 0.5 m^3 ,pressure 1 bar and temperature 27^{o}C at the commencement of compression. At the end of the compression stroke the pressure is 12 bar. Heat added during the constant volume process is 220 kJ. Calculate the pressures, temperatures and volumes at salient points in the cycle. Assume air as the working fluid.**(8)**

13 a i).Explain the essential differences in the manner of expansion of steam in impulse and reaction turbine. Illustrate your answer by sketches of the pressure and velocity changes which occur as the steam passes over successive blade rows. **(8)**

ii).Discuss with a neat sketch the throttle governing of steam turbines. **(8)**

(OR)

b. The following data refer to a single stage impulse turbine: Isentropic nozzle enthalpy drop = 210 kJ/kg, Nozzle efficiency = 90 % Nozzle angle = 25^{o}, Ratio of blade speed to whirl component of steam speed = 0.5, Blade velocity coefficient = 0.9, The velocity of steam entering the nozzle = 30 m/sec. Find (a) the blade angles at inlet and outlet if the steam enters the blades without shock and leaves the blades in an axial direction, (b) blade efficiency, (c) power developed and (d) axial thrust if the steam flow rate is 10 kg/sec. **(16)**

14 a i).Draw the valve timing diagram of a four stroke cycle S.I engine and explain the processes. **(8)**

ii).Compare a two stroke cycle engine with a four stroke cycle engine. **(8)**

(OR)

b i).Draw the layout of a coil ignition system and indicate the function of each component. **(8)**

ii).With a neat sketch explain the principle of pressure type lubrication system. **(8)**

15 a i).Obtain the stoichiometric air fuel ratio for isooctane. **(6)**

ii).Compare and explain the important properties of petrol and diesel. **(10)**

(OR)

b. The following data refer for a 4 stroke, 4 cylinder diesel engine: Diameter of the cylinder = 35 cm, Stroke = 40 cm, Speed of the engine = 315 rpm, Indicated mean effective pressure = 7 bar, Brake power = 260 kW, Fuel consumption = 80 kg/h, C.V. of fuel = 43000 kJ/kg, Hydrogen content in fuel = 13 % and remaining is carbon, Air consumption = 30 kg/min, Cooling water circulated = 90 kg/min, Rise in temperature of cooling water = 38^{o}C, Piston cooling oil used = 45 kg/min, Rise in temperature of cooling oil = 23^{o}C, C_p for cooling oil = 2.2 kJ/kg-K, Exhaust gas temperature = 322^{o}C, C_p for exhaust gases = 1.1 kJ/kg-K, Ambient temperature = 22^{o}C, C_p of superheated steam = 2 kJ/kg-K, Latent heat of steam = 2520 kJ/kg. Find (a) the mechanical efficiency and indicated thermal efficiency and (b) Draw up heat balance sheet on minute and percentage basis. **(16)**

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