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B.E / B.Tech (Full-Time) DEGREE END SEMESTER EXAMINATIONS, APR / MAY 2014

MECHANICAL ENGINEERING

Fourth Semester

ME 9254 THERMAL ENGINEERING-I

(Regulation 2004 / 2008)

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Define cut-off ratio with regard to a diesel cycle.
2. Which cycle (Otto/ Diesel/ Dual) is more efficient for same compression ratio?
3. State the effect of clearance on work required to a compressor.
4. Define Free Air Delivered.
5. State the function of camshaft and connecting rod in an IC engine.
6. Which engine 2S / 4S has higher volumetric efficiency? Why?
7. Deduce the stoichiometric air-fuel ratio for Propane fuel (C_3H_8).
8. Define Ignition delay with regard to a fuel.
9. Represent an open cycle gas turbine on T-s diagram.
10. List some alloys used in gas turbine components.

Part – B (5 x 16 = 80 marks)

11. An engine works on an Otto cycle. It has a compression ratio of 9, and the intake conditions of air are 1 bar, 27°C. Heat added under constant volume is 950 kJ/kg. Find the pressure and temperature at salient points, air-standard efficiency, and mean effective pressure. Assume for air C_v=0.718 kJ/kg.K, and γ =1.4 and R=0.287 kJ/kg.K. Represent the cycle in p-v and T-s diagrams. (16)

12. a) A reciprocating air compressor takes in air at 1 bar, 25 deg. C, and compresses it to a pressure of 3.5 bar running at 350 rpm. The compression follows the $PV^{1.3}$=C. The clearance is 4% of stroke volume and mass flow rate of air 0.1 kg/s. Determine the power input to the compressor, and volumetric efficiency. Represent the process on p-v and T-s planes. Assume for air R=287 J/kg.K (16)

(OR)

b) What is the necessity for multistage compression? Derive an expression for optimum intermediate pressure of a multi-stage compressor with perfect intercooling. Represent the process on p-v plane. Also list the merits and demerits of multistage compression process. (2+8+2+4)

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13. a)i) Classify the IC engines based on fuel supply, type of governing, combustion of fuel, & cycle of operation. (8)

ii) Draw the theoretical and actual valve timing diagram of four stroke SI engine, and comment on the deviation between them. (8)

(OR)

b)i) Draw a schematic of a 4 stroke SI engine and label the parts. (6)

ii) Compare SI and CI engines. (atleast 6 important points) (10)

14. a)i) A 4 stroke eight cylinder engine of 9 cm bore and 8 cm stroke with a compression ratio of 7 is tested at 4500 rpm on a dynamometer which has a 54 cm arm. During 10 minutes test the dynamometer scale beam reading was 42 kg and the engine consumed 4.4 kg of gasoline having a calorific value of 44000 kJ/kg. Air at 27°C and pressure 1 bar was supplied to the carburettor at the rate of 6 kg/min. Find i) Brake power ii) Brake Mean effective Pressure iii) Volumetric Efficiency iv) Brake Thermal Efficiency & A/F ratio. (5x2=10)

ii) List the desirable properties of fuel for petrol engine. (6)

(OR)

b) Describe the functioning of lubrication and cooling systems for a multi-cylinder IC engine. Support your answer with a neat schematic of the same. (8+8)

15. a) In an open cycle Gas turbine plant, air enters the compressor at 1 bar and 25° C. The pressure of air after compression is 5 bar. The A/F ratio is 120:1. The isentropic efficiencies of compressor and turbine are 80 % & 84% respectively. Find the net power developed and the thermal efficiency of the cycle if air flow rate is 1.5 kg/s. Take C.V. of fuel as 42000 kJ/kg, C_p for air and gas= 1 kJ/kg.K. and γ= 1.4 for air and gas. Sketch the cycle on T-s and p-v planes. (6+6+4)

(OR)

b) Describe the operation of an open cycle Gas turbine plant with a schematic. Represent the various processes on p-v and T-s planes. Mention the merits and demerits of a gas turbine compared to an IC engine. Also state the methods to improve efficiency of a Gas turbine. (4+4+3+5)