CBCS Scheme

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15AU33

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Engineering Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer FIVE full questions, choosing one full question from each module.
2. Use of TD data handbook permitted.

Module-1

1 a. Define the following terms, with respect to thermodynamics : System, Property, State, Process, Cycle, Quasi static process. **(06 Marks)**

b. Differentiate : i) Intensive and Extensive properties ii) Cyclic and non – cyclic processes. **(04 Marks)**

c. State and explain Zeroth law of thermodynamics. **(06 Marks)**

OR

2 a. Define Work and heat. Write three important similarities between them. **(05 Marks)**

b. Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. **(05 Marks)**

c. The properties of a closed system change following the relation between pressure and volume as P-V = 3.0, where 'P' is in bar and 'V' is in m^3. Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. **(06 Marks)**

Module-2

3 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. **(04 Marks)**

b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. **(05 Marks)**

c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are : $P_1 = 1.5$ bar ; $\rho_1 = 26$ kg/m^3 ; $V_1 = 110$ m/s and $u_1 = 910$ kJ/kg and at the exit are : $P_2 = 5.5$ bar , $\rho_2 = 5.5$ kg/m^3 , $V_2 = 190$ m/s and $u_2 = 710$ kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. **(07 Marks)**

OR

4 a. Write two statements of second law of thermodynamics. **(04 Marks)**

b. Prove that entropy is a property of a system. **(06 Marks)**

c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? **(06 Marks)**

Module-3

5 a. Distinguish between : i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. **(04 Marks)**

b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. **(07 Marks)**

c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. **(05 Marks)**

OR

6 a. Define the following terms with respect to IC engine : i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal efficiency. **(05 Marks)**

b. Explain Morse test method of determining indicated power and hence the frictional power of IC engine. **(05 Marks)**

c. A four cylinder, four stroke S.I engine has a compression ratio of 8 and bore of 100 mm, with stroke equal to the bore. The volumetric efficiency of each cylinder is equal to 75%. The engine operates at a speed of 4800 rpm with an air fuel ratio 15. Given that the calorific value of fuel as 42 MJ/kg, atmospheric air density = 1.12 kg/m^3, Mean effective pressure = 10 bar and Mechanical efficiency of the engine = 80%, determine the indicated thermal efficiency and the brake power. **(06 Marks)**

Module-4

7 a. Explain steam jet refrigeration system with a neat sketch. Write its draw backs. **(07 Marks)**

b. Write the desirable properties of a good refrigerant. **(04 Marks)**

c. In a standard (dry compression) vapour compression refrigeration cycle, operating between an evaporator temperature of – 10^{0}C and a condenser temperature of 40^{0}C, the enthalpy of the refrigerant, Freon – 12, at the end of compression is 220 KJ/kg. Represent the cycle on T-S diagram and calculate : i) the COP of the cycle ii) the refrigerating capacity and the compressor power assuming a refrigerant flow rate of 1kg/min. You may use the extract of Freon – 12 property table given below : **(05 Marks)**

t^0C	P (MPa)	h_f (kJ/kg)	h_g (kJ/kg)
-10	0.2191	26.85	183.1
40	0.9607	74.53	203.1

OR

8 a. Distinguish between : i) Specific humidity and Relative humidity ii) Dry bulb and wet bulb temperature iii) Dry air and atmospheric air. **(06 Marks)**

b. With a neat sketch, describe the working of summer air – conditioning system for hot and dry weather. **(05 Marks)**

c. The dry and wet bulb temperatures of atmospheric air at 1 atm pressure are measured with a Bling psychrometer and determined to be 25^{0}C and 15^{0}C respectively. Determine using psychrometric chart i) Specific humidity ii) Relative humidity iii) Enthalpy of air. **(05 Marks)**

Module-5

9 a. Derive the condition for minimum work input to a two – stage compressor with perfect inter – cooling between stages. **(05 Marks)**

b. Explain the necessity of multi – stage compression using P-V diagram. **(05 Marks)**

c. A single stage double acting air compressor is required to deliver 14m^3 of air per minute measured at 1.013 bar and 15^{0}C. The delivery pressure is 7 bar and the speed is 300 rpm. Take the clearance volume as 5% of swept volume with a compression and reexpansion index n = 1.3. Calculate the swept volume of the cylinder, the delivery temperature and the indicated power. **(06 Marks)**

OR

10 a. Explain Open and Closed cycle gas turbine cycles. **(04 Marks)**

b. Explain Turbo – jet with the help of a neat sketch. Write its advantages and disadvantages. **(06 Marks)**

c. A gas turbine unit has a pressure ratio of 6:1 and maximum cycle temperature of 610^{0}C. the isentropic efficiency of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output in kilowatts when the air enters the compressor at 15^{0}C at the rate of 16 kg/s. Take C_p = 1.005 kJ/kg.K and γ = 1.4 for the compression process and take C_p = 1.11 kJ/kg.K and γ = 1.333 for the expansion process. **(06 Marks)**

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