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CBCS SCHEME

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15MA33

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Thermodynamic Data Handbook permitted.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Distinguish between :
i) Intensive and extensive properties
ii) Reversible and irreversible processes
iii) Macroscopic and Microscopic approach **(06 Marks)**

b. Explain the following with example
i) Thermodynamic cycle and its importance
ii) Zeroth law of thermodynamics. **(04 Marks)**

c. There are two scales one is Celsius scale and the other is GKVK scale
Celsius Scale : Ice print 0°C steam point 100°C
GKVK scale : Ice point 0°G steam point 1000°G
Find the relation between the scales both being linear. **(06 Marks)**

OR

2 a. Distinguish between mechanics and Thermodynamic definition of work. **(04 Marks)**

b. Derive the P dv work during the following processes for a closed system with unit mass
i) Isobaric process ii) Polytropic process iii) Isothermal process. **(06 Marks)**

c. An elastic baloon has a diameter of 0.5m and is filled with a gas pressure of 200KPa. The gas is heated so that the diameter increases to 0.6m and a pressure of 250KPa. During the process the pressure is proportional to diameter. Calculate:
i) The workdone during the process by the gas
ii) The workdone by the baloon on the atmosphere. **(06 Marks)**

Module-2

3 a. Apply I law of thermodynamic to a process and prove that energy is a property. **(06 Marks)**

b. Obtain heat transfer equations for the following processes performed by a closed system containing unit mass of substance.
i) Constant volume process **(02 Marks**
ii) Polytrophic process. **(03 Marks)**

c. An ideal gas in heated at constant volume until its temperature is doubled. Then it is expanded isothermally till it reaches the original pressure. Finally the gas is cooled at constant pressure till it is restored to the initial state. Draw PV and TS diagrams and determine the network done per kg of gas when the initial temperature is 300K. R – 0.287kJ/Kg K. Why $\oint \Delta u = 0$ **(05 Marks)**

OR

4 a. State the Steady flow energy equation with units. **(04 Marks)**

b. Apply the SFEE equation to following systems.
i) Centrifugal water pump
ii) Hydraulic turbine
iii) Steam nozzle. **(06 Marks)**

c. A steam turbine develops 600kW with a heat loss of 525kJ/min to the surroundings. Using the following data and assuming steady flow condition find the mass flow rate in Kg/hr

Properties	Inlet	Outlet
Pressure	2×10^6 N/m^2	1.1×10^6 N/m^2
Velocity	180m/s	50m/s
Elevation	5m	3m
Enthalpy	3200kJ/kg	3200kJ/kg

(06 Marks)

Module-3

5 a. Derive an expression for the thermal efficiency of a Diesel cycle with assumptions. **(06 Marks)**

b. Compare Otto Diesel and Dual cycles for the same compression ration and heat input. **(03 Marks)**

c. An engine with 200mm cylinder diameter and 300mm stroke works on theoretical diesel cycle. The initial pressure and temperature are 1 bar and 27°C. The cutoff is 8% of the stroke. Determine :

i) Pressure and temperature at all points
ii) Theoretical air standard efficiency
iii) Power of the engine if the working cycles per minute are 380. Take compression ratio as 15 and working fluid in air. Consider ideal processes. **(07 Marks)**

OR

6 a. Obtain an expression for thermal efficiency of a simple Rankine cycle. Explain all processes. Show H-S and T-S diagrams. **(06 Marks)**

b. Compare Carnot and Rankine cycle and report inference. **(04 Marks)**

c. In a Rankine cycle, the steam enters the thermal at 15bar, dry saturated. The conductor pressure is 0.4 bars. Calculate the Rankine efficiency of the cycle. Neglect pumps work. **(06 Marks)**

Module-4

7 a. State and prove Clausius on equality. **(04 Marks)**

b. Discuss principle of increase of entropy and explain its implications. **(06 Marks)**

c. Obtain an expression for change is entropy during :

i) Constant volume process
ii) Polytropic process. **(06 Marks)**

OR

8 a. Explain the P-T diagram of pure substance. **(06 Marks)**

b. Draw the PVT surface. **(04 Marks)**

c. Determine the amount of heat which should be supplied to 2kg of water at 25°C to convert it the steam at 5 bar and 0.9 dry. **(06 Marks)**

Module-5

9 a. Explain the following with reference to Refrigeration

i) Refrigeration effect
ii) Unit of refrigeration
iii) COP **(06 Marks)**

b. Obtain an expression for the COP of a Bell – Coleman cycle with polytropic compression and expansion. **(05 Marks)**

c. A refrigeration system uses Fr – 12 as refrigerant. The temperature of the refrigerant in the evaporator is -10°C. The condensing temperature is 40°C. The cooling load is 150W and volumetric efficiency of the compressor is 80%. The speed of the compressor is 720rpm. Calculate mass flow rate of the refrigerant and displacement volume of the compressor.

Properties of Fr - 12

Temp, °C	Sat. pressure MPa	Enthalpy kJ/kg		Sp. Volume m^3/kg, Sat vapor
		Liquid	Vapor	
-10	0.22	26.8	183	0.08
40	0.96	74.5	203.1	0.02

(05 Marks)

OR

10 a. Define the following :
   i) Dry Bulb Temperature
   ii) Dew Point Temperature
   iii) Relative humidity **(06 Marks)**

b. Explain summer air conditioning **(05 Marks)**

c. Explain the construction and use of Psychometric chart. **(05 Marks)**

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