CBCS SCHEME

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BMR304

Third Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024
Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Derive an expression of displacement work for following process : (i) Isothermal process. (ii) Reversible adiabatic (isentropic process)	10	L2	CO1
	b.	The temperature on a Celsius scale is defined in terms of property 'P' by the relation $P = e^{\left(\frac{t-B}{A}\right)}$ when A and B are constants. Experiments gives values of P as 1.86 and 6.81 at the ice and steam point respectively. Obtain the relation for 't' and also find the temperature 't' for the reading of P = 2.5.	10	L3	CO1
		OR			
Q.2	a.	Define heat and work in thermodynamics. Show that work is path function.	10	L2	CO1
	b.	The mass of 1.5 kg of a substance is compressed in a quasi static process from 0.1 MPa to 0.7 MPa. The initial density of the substance is 1.16 kg/m^3. Determine magnitude of workdone on the substance if, (i) Process is according to law PV = constant. (ii) Process is according to law $PV^{1.4}$ = constant.	10	L3	CO1
		Module – 2			
Q.3	a.	State the first law of thermodynamic applied to cyclic process and non cyclic process (change of state).	4	L2	CO2
	b.	Derive an expression for steady flow energy equation giving assumptions.	6	L2	CO2
	c.	At the inlet to a certain nozzle, the enthalpy of the fluid passing is 3000 kJ/kg and the velocity is 60 m/sec. At the discharge end the enthalpy is 2762 kJ/kg. The nozzle is horizontal and there negligible loss from it. (i) Find the velocity at the exit from the nozzle. (ii) If the inlet area is 0.1 m^3 and specific volume at the inlet is 0.187 m^3/kg, find the mass flow rate (iii) Exit area of nozzle if specific volume is 0.498 m^3/kg.	10	L3	CO2
		OR			
Q.4	a.	State and prove that Kelvin Plank and Clausius statement of 2nd law of thermodynamics are equivalent.	10	L2	CO2
	b.	A reversible engine operates between 3 heat reservoir 1000 K, 800 K and 600 K and rejects heat to a reservoir at 300 K, the engine develops 10 kW and rejects 412 kJ/min. If heat supplied by the reservoir at 1000 K is 60% of heat supplied by the reservoir at 600 K, find quantity of heat supplied by each reservoir. Also sketch the block diagram of the heat engine.	10	L3	CO2

		Module – 3			
Q.5	**a.**	State and prove Clausius in equality.	**7**	**L2**	**CO2**
	b.	Prove that entropy is property of system.	**5**	**L2**	**CO2**
	c.	One kg of ice at -5°C is exposed to the atmosphere which is at 20°C. The ice melts and comes into thermal equilibrium with the atmosphere, (i) Determine the entropy increase of the universe. (ii) What is the minimum amount of work necessary to convert the water back into ice at -5°C? Take C_P of ice is 2.093 kJ/kgK and latent heat of fusion of ice is 333 kJ/kg.	**8**	**L3**	**CO2**
		OR			
Q.6	**a.**	Explain : (i) Subcooled liquid (ii) Tripple point. (iii) Critical point (iv) Dryness fraction	**4**	**L2**	**CO3**
	b.	With neat sketch, explain the working of a throttling calorimeter.	**8**	**L2**	**CO3**
	c.	Vessel having a volume of 0.6 m^3 contains 3 kg of liquid water and water vapour mixture is in equilibrium at a pressure of 0.5 MPa. Calculate (i) Mass and Volume of liquid. (ii) Mass and Volume of vapour	**8**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Define and briefly explain the following terms related to combustion thermodynamics : (i) Excess air (ii) Enthalpy of formation (iii) Internal energy of combustion (iv) Combustion efficiency (v) Adiabatic flame temperature	**10**	**L2**	**CO3**
	b.	The product of combustion of an unknown hydrocarbon C_xH_y have the following composition measured by ORSAT apparatus CO_2 – 8%, CO – 0.9%, O_2 – 8.8%, N_2 – 82.3% Determine: (i) The composition of fuel (ii) Air fuel ratio (iii) The percentage of excess air	**10**	**L4**	**CO3**
		OR			
Q.8	**a.**	With a schematic diagram, explain the working of Reheat rankine cycle. Show the process on T-S diagram.	**10**	**L2**	**CO4**
	b.	Steam at 20 bar, 360°C is expanded in a steam turbine to pressure of 0.08 bar. If then enter a condenser, where it is condensed to saturated liquid water. Assuming the turbine and feed water pump efficiencies as 60% and 90% respectively, determine per kg of steam, network, heat transferred to the working fluid and the Rankine cycle efficiency.	**10**	**L4**	**CO4**
		Module – 5			
Q.9	**a.**	Derive an expression for an air standard efficiency of diesel cycle with help of PV and T-S diagram.	**8**	**L2**	**CO4**
	b.	The minimum pressure and temperature in an otto cycle are 100 KPa and 27°C. The amount of heat added to air per cycle is 1500 kJ/kg. Determine (i) Pressure and temperature at all the points of cycle. (ii) Thermal efficiency if the compression ratio is 8 : 1 Take C_V = 0.72 kJ/kg and γ = 1.4.	**12**	**L4**	**CO4**

		OR			
Q.10	a.	With neat sketch, explain the working of Ram Jet Engine.	8	L2	CO4
	b.	A gas turbine has a minimum and maximum temperature of 60° and 900°C. The compressor and the turbine efficiencies are 0.80 and 0.85 respectively. Estimate the condition for maximum net work done. Also calculate the net work done and the thermal efficiency. The pressure at the inlet of the compressor is 1 bar.	12	L4	CO4

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