CBCS SCHEME

USN | | | | | | | | | | |

BMR304

Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
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.***
3. ***Use of Thermodynamics Data Handbook is permitted.***

		Module – 1	M	L	C
Q.1	a.	State and explain Zeroth law of thermodynamics.	4	L2	CO1
	b.	Two Celcius thermometr A and B agree at ice point and steam point and the related equation is $t_A = \alpha + Mt_B + N t_B^2$ where L, M and N are constants. When both the thermometer are immersed in a fluid. A registers 26°C while B registers 25°C. Determine the reading of A when B reads 37.4°C.	10	L3	CO1
	c.	Define Point function and path function. Prove that heat is path function.	6	L2	CO1
		OR			
Q.2	a.	Derive and expression for displacement work for polytropic process.	8	L3	CO1
	b.	A fluid at 0.7 bar occupying 0.09 m^3 is compressed reversibly to a pressure of 3.5 bar according to a law PV^n = constant. The fluid is then heated reversibly at constant volume until the pressure is 4 bar, the specific volume is then 0.5 m^3/kg. A reversible expansion according to a law $PV^2 = C$, restores the fluid to its initial state. Sketch the cycle on a P-V diagram and calculate : i) the mass of fluid present ii) the value of 'n' in the first process iii) the network of the cycle.	12	L3	CO1
		Module – 2			
Q.3	a.	State the 1st law of thermodynamic for a closed system undergoing a cycle and prove that internal energy is property.	6	L2	CO2
	b.	Explain all the terms involved in Steady Flow Energy Equation (SFEE).	6	L2	CO2
	c.	A small turbine runs an aircraft refrigeration system. Air enters the turbine at 4 bar and 40°C with a velocity of 40 m/s. At the exit the air is at 1 bar, 25°C and having a velocity of 200m/s. If the work output of a turbine is 52 kJ/kg of air, calculate the heat transferred per kg of air.	8	L3	CO2
		OR			
Q.4	a.	Define the two statements of II law of thermodynamic. Show that violation of Clausius statement of second law of thermodynamics leads to violation the Kelvin-Planck statement of II law of thermodynamics.	10	L3	CO2
	b.	A heat pump is used for looking in summer and heating in winter. The house is maintained at 25°C year round. The heat loss is 50kW per degree difference between outside and inside temperature. The average outside temperature is 35°C in summer and -5°C in winter. Determine the power requirements for both heating and cooling.	10	L3	CO2

		Module – 3			
Q.5	**a.**	Derive Clausius inequality and prove that entropy is a property.	**10**	**L3**	**CO3**
	b.	A 30 Kg steel ball at 427°C is dropped in 150kg oil at 27°C, the specific heat of steel and oil are 0.5kJ/kg and 2.5kJ/kg K respectively. Estimate the entropy change of steel, oil and that of the system containing oil and steel.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	Define 'Quality of Stream'. Explain any one method for determining the quality of stream with a sketch.	**10**	**L2**	**CO3**
	b.	Steam at 1MPa and 250°C enters a nozzle with a velocity of 60m/s and leaves the nozzle at 10 KPa. Assuming the flow process to be isentropic and the mass flow rate to be 1 kg/s determine: i) the exit velocity ii) the exit diameter.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Define the following : i) Adiabatic flame temperature ii) Stoichiometric air/fuel ratio iii) Entropy of formation iv) Combustion efficiency v) Higher and Lower Calorific values.	**10**	**L2**	**CO4**
	b.	The products of combustion of an unknown hydrocarbon C_xH_y have the following composition as measured by an orsat apparatus CO_2 = 8%, CO = 0.9%, O_2 = 8.8%, N_2 = 82.3%. Determine: i) The composition of the fuel ii) The air fuel ratio iii) The percent excess air used.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	With the help of a schematic diagram and T-S diagram, explain the working of a regenerative vapour power cycle and derive an expression for its overall efficiency.	**10**	**L2**	**CO4**
	b.	A simple Rankine cycle works between the boiler pressure of 3 MPa and condenser pressure of 4 KPa. The steam is dry saturated before the throttling in the turbine. Determine: i) Rankine cycle efficiency ii) Work ratio iii) Specific Steam consumption.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Derive expression for the thermal efficiency of a diesel cycle is terms of compression ratio and cut off ratio.	**10**	**L3**	**CO5**
	b.	In an air standard Diesel cycle, the compression ratio is 5 and the fluid properties at the beginning of compression are 100 KPa and 300 K. For a peak temperature of 1600 K, calculate the percentage of stroke at which the cutoff takes place, the cycle efficiency the workdone/Kg of air.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Explain with a neat sketch the difference between open and closed cycle gas turbine.	**10**	**L2**	**CO5**
	b.	Air is drawn in a gas turbine at 18°C and 1 bar and leaves the compressor at 5 bars. Data observed are temperature of gases entering the turbine 678°C. pressure loss is combustion chamber = 0.1 bar η_{comp} = 85%, γ = 1.4 for air $\eta_{combustion}$ = 85% C_p = 1.024 kJ/Kg K for gas $\eta_{turbine}$ = 80%, find : i) Quantity of air, if plant develops 1065kW ii) heat supplied per kg of air circulated ii) Thermal efficiency of cycle.	**10**	**L3**	**CO5**

* * * * *