Model Question Paper-1 with effect from 2022-23 (CBCS Scheme)

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Fourth Semester B.E. Degree Examination
Subject Title: Aero Engineering Thermodynamics

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. Use of Thermodynamic Data Hand Book is permitted

		Module -1	***Bloom's Taxonomy Level**	**Marks**
Q.01	a	Distinguish between i) Microscopic and macroscopic approaches of thermodynamics ii) Intensive and extensive Properties iii) Open system and Closed system iv) Point function and path function	L2	10
	b	A constant volume gas thermometer containing helium gives reading of gas pressure p of 1000 mm Hg and 1366 mm Hg at ice point and steam point respectively. Assuming a linear relationship of the form $t = \alpha + \beta p$, express the gas thermometer Celsius temperature t in terms of gauge pressure p. What is the temperature recorded by the thermometer when it registers a pressure of 1074 mm Hg?	L3	10
		OR		
Q.02	a	A system undergoes a process in which the pressure and volume are related by an equation of the form pv^n = a constant. Derive an expression for displacement work during this process.	L2	6
	b	Gas confined in a cylinder by a piston at a pressure of 3x 105 N/m2 and a volume of 12000 cm3 changes its state in such a way that the pressure is inversely proportional to the volume in this process if the pressure Falls to 1/3 of its initial value find the magnitude and direction of workflow	L3	8
	c	Derive an expression for work done for the following process i. Constant Pressure process ii. Constant Volume process iii. Constant Temperature process	L2	6
		Module-2		
Q. 03	a	Starting from the first law of thermodynamics for a closed system undergoing a non-cyclic process derive the steady state, steady flow energy equation for a control volume (open system)	L4	6
	b	Describe an expression for heat transfer per unit mass for a reversible polytrophic process taking place in a closed system containing an ideal gas	L2	6
	c	A fluid system undergoes a non-flow frictionless process following the pressure volume relation as p=5/v+1.5 where p in bar v is in m3 during the process volume changes from 0.15 to 0.05 m3 and the system rejects 45 kj of heat determine change in internal energy and change in enthalpy	L2	8
		OR		

Q.04	a	Modify the general steady flow energy equation (SFEE) for the following cases i)Steam turbine with negligible potential energy change if the process is adiabatic ii)Horizontal steam nozzle with negligible entrance velocity of steam, if the process is non-adiabatic iii)Insulated horizontal throttle valve	L2	10
	b	A turbine operating under steady flow conditions receives 4500 kg of steam per hour steam enters the turbine at a velocity of 2800m/min and an elevation of 5.5m and specific enthalpy of 2800kj/kg Its leaves the turbine at a velocity of 5600m/min elevation of 1.5m specific enthalpy of 2300kj/kg heat losses from the turbine to the surroundings amount to 16000 kj/h determine the power output of the turbine	L3	10
		Module-3		
Q. 05	a	State the Kelvin-Plank and Clausius statements of the Second Law of thermodynamics and show that the violation of the former results in the violation of the later.	L2	8
	b	With a simple block diagram represent PMM of II kind and explain why it is not possible	L2	4
	c	Two reversible engines A and B are connected in series engine A receives heat from a thermal reservoir at T1 and rejects at the temperature T2 while engine B receives heat energy at T2 and rejects to a thermal reservoir at T3. If both engines are equal efficient show that the intermediate temperature T2 is the geometric mean of T1 and T3 what will be the condition for intermediate temperatureT2 when both the engines deliver equal power.	L2	8
		OR		
Q. 06	a	Represent schematically heat engine, heat pump and refrigerator Prove that a reversible engine is more efficient than an irreversible engine operating between the same temperature limits. Give their performance	L2	8
	b	Prove that $COP_{heatpump} = 1 + COP_{refrigerator}$	L2	4
	c	Heat pump to be used to heat the house in winter and reverse to cool the house in summer. The interior temperature is to be maintained at 20°C. heat transfer through the walls and roof is estimated to be 0.525kJ/s per degree temperature difference. Between the inside and outside if the outside temperature in winter is 5°C. What is the minimum power required to drive the heat pump. If the power requirement is same as in the part a what is the maximum outside temperature for which the inside can be maintained at 20°C.	L2	8
		Module-4		
Q. 07	a	Explain P-T diagram for a pure substance with the help of a neat sketch and define i) Triple point ii) Critical Point	L2	6
	b	Define the following i) Pure substance i) Triple Point iii) Quality and iv) Subcooled liquid	L2	6
	c	A vessel having a capacity of 0.05 m3 contains a mixture of saturated water and saturated steam at a temperature of 245C. The mass of the liquid present is 10 kg. Find the following i) The pressure ii) The Mass iii) The specific volume iv) The specific enthalpy v) The Specific entropy	L2	8
		OR		
Q. 08	a	Define dryness fraction of steam. What are the methods to measure dryness fraction. With a neat sketch explain any one method.	L3	6
	b	Derive an expression for TdS relation	L3	6
	c	Using steam tables, determine the mean specific heat for superheated steam	L3	8

		i)At 0.75 bar, between 100°C and 150° C ii)at 0.5 bar between 300°C and 400°C		
		Module-5		
Q. 09	a	With the help of P-V and T-S diagram, derive an expression for air standard efficiency of Diesel cycle	L3	10
	b	The pressure and temperature at the beginning of compression in an air standard Otto cycle are 102 kPa and 315K. Heat is added during the process at the rate of 250 kJ/kg of air and air is used with a compression ratio of 9. Assuming $\gamma = 1.4$ and R = 287 J/kgK for air, determine i)The thermal efficiency of the cycle ii) The maximum Cycle temperature iii) The maximum cycle pressure iv) Mean effective pressure	L3	10
		OR		
Q. 10	a	With the help of neat schematic diagram explain the working of Rankine cycle and derive an expression for efficiency.	L3	10
	b	In a steam power cycle, the steam supply is at 15 bar and dry and saturated. The condenser pressure is 0.4 bar, Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pump work.	L3	10

*Bloom's Taxonomy Level: Indicate as L1, L2, L3, L4, etc. It is also desirable to indicate the COs and POs to be attained by every bit of questions.

Model Question Paper-2 with effect from 2022-23 (CBCS Scheme)

USN | | | | | | | | | |

Fourth Semester B.E. Degree Examination
AERO ENGINEERING THERMODYNAMICS

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. Use of **Thermodynamics tables** are permitted.

		Module -1	*Bloom's Taxonomy Level	Marks
Q.01	a	Compare the following (i) Open and Closed system (ii) Microscopic and Macroscopic approaches (iii) intensive and extensive properties (iv) Path and Point function (v) Thermal and mechanical equilibrium.	L2	10
	b	State zeroth law of thermodynamics. In 1709, Sir Issac Newton proposed a new temperature scale. On this scale temperature was a liner function of Celsius scale. The reading on this at ice point (0^0 C) and the normal human body temperature (37^0 C) were 0^0 N and 12^0 N respectively. Obtain the relation between the Newton's scale and Celsius scale and Fahrenheit scale.	L5	10
		OR		
Q.02	a	Distinguish between work and heat.	L1	4
	b	Prove that work is a path function.	L3	6
	c	A spherical balloon of 0.5m diameter contains air at a pressure of 500 KPa the diameter increases to 0.55m in a reversible process during which pressure is proportional to diameter. Determine the work done by the air during this process.	L5	10
		Module-2		
Q. 03	a	Write the first law of thermodynamics for any process in (i) Open system (ii) Closed system	L2	4
	b	Explain joules experiment with a neat sketch.	L2	10
	c	Prove that internal energy is a property of the system.	L3	6
		OR		
Q.04	a	Construct the steady flow energy equation for an open system and explain the terms involved in it. With the suitable assumptions simplify SFEE for the following systems: (i) Turbine and Compressor (ii) Nozzle and Diffuser.	L3	10
	b	A turbine operating under steady flow conditions receives 4500kg of steam per hour. The steam enters the turbine at a velocity of 2800m/min, an elevation of 5.5m and a specific enthalpy of 2800kJ/kg. It leaves the turbine at a velocity of 5600m/min, an elevation of 1.5m and a specific enthalpy of 2300kJ/kg. Heat losses from the turbine to the surroundings amount to 1600kJ/h. Determine the power output of the turbine.	L5	10
		Module-3		
Q. 05	a	State Kelvin Plank and Clausius statement and justify that they are equivalent.	L3	6
	b	A reversible heat engine operates with two environments. In the first, it draws 1200kW from a source at 400^0C and in second it draws 25000kW from a source at 100^0C. in both the operations, the engine rejects heat to a thermal sink at 20^0C. Determine the operation in which the engine delivers more power.	L5	10
	c	Show schematically and give performance equation for: (i) Heat engine (ii) Refrigerator (iii) Heat pump	L2	4
		OR		
Q. 06	a	State and prove Clausius inequality.	L2	10
	b	Prove that entropy is a system.	L2	5

	c	One Kg of water at 273K is heated to 373K by first bringing it in contact with reservoir at 323K and then reservoir at 373K. Determine the change in entropy of the universe?	L5	5
Module-4				
Q. 07	a	Define: (i) Compressibility factor (ii) Triple point (iii) Critical point (iv) Latent heat	L1	8
	b	Construct Vander Waal's constants in terms of critical properties.	L3	8
	c	Determine the specific volume, enthalpy, and internal energy of wet steam at 18 bar, dryness fraction 0.85	L5	4
OR				
Q. 08	a	Write Maxwell relation and explain the terms involved.	L2	4
	b	A rigid vessel of volume $0.3m^3$ contains 10Kg of air at 300K. Determine the pressure that would be exerted by air on the vessel, using (i) Perfect gas equation (ii) Vander Waal's equation. Take for air, R = 287.1J/Kg K, Molecular weight = 28.96, Vander Waal's constants, a = 135.8kN $m^4(Kg.mol)^2$, b = 0.0365 m^3/Kg.mol.	L5	8
	c	$0.1m^3$ of air at 5MPa, 356^0C contained in a cylinder expands reversibly and isothermally to 0.25MPa. Calculate for air (i) Work transfer (ii) Heat transfer (iii) Change in entropy, assuming that air behaves as an ideal gas with R = 287 J/Kg K	L5	8
Module-5				
Q. 09	a	Construct an expression for air standard efficiency of an Otto cycle, representing all the process on a P-V and T-S diagram.	L3	10
	b	Compare Otto and Diesel cycles.	L4	6
	c	A Carnot engine rejects heat to the heat sink at 32^0C and has a thermal efficiency of 52.3%. The work output from the engine is 120kJ. Determine: (i) The maximum working temperature of the engine and (ii) The heat added in kJ.	L5	4
OR				
Q. 10	a	Sketch the schematic diagram and corresponding TS and HS diagram, derive an expression for efficiency of Rankine cycle.	L3	10
	b	In a single heater regenerative cycle, the steam enters the turbine at 30 bar, 400^0C and the exhaust pressure is 0.10 bar. The feed water heater is a direct contact type which operates at 5 bar. Find (i) The efficiency of the cycle (ii) The increase in meant temperature of heat addition, efficiency, and steam rate, as compared to Rankine cycle (without regeneration). Neglect pump work.	L5	10

*Bloom's Taxonomy Level: Indicate as L1, L2, L3, L4, etc. It is also desirable to indicate the COs and POs to be attained by every bit of questions.