BAS301

Model Question Paper -1

USN

III 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**.

		Module – 1	**Marks**	**CO's**	**RBTL**
Q.1	**(a)**	Explain the thermodynamic microscopic and macroscopic approach	10	CO1	L1
	(b)	Design a temperature scale to measure temperature T in terms of property P according to the relation T=aLnP+b where a and b are constants. It is found that the ice point and steam point are 0° C and 100° C respectively with the instrument showing the value of P as 1.86 and 6.81 respectively. Evaluate the temperature corresponding to the value of P=2.8.	10	CO1	L3
		OR			
Q.2	**(a)**	Differentiate work and heat. Prove that work is a path function.	10	CO1	L2
	(b)	In a two-part process, a gas expands from 0.1m3 to $0.2m^3$ at a constant pressure of 150kPa followed by an expansion from $0.2m^3$ to $0.4m^3$ with linearly increasing pressure from 150kPa to 300kPa. Sketch the process on PV diagram and find the work done.	10	CO1	L3
		Module – 2			
Q.3	**(a)**	Explain Joules experiment with neat sketch.	10	CO2	L2
	(b)	Define first law of thermodynamics. Prove that Internal energy is a property of the system. Also mention the limitations of first law.	10	CO2	L1
		OR			
Q.4	**(a)**	Write the steady flow energy equation for an open system and explain the terms involved in it. Simplify the SFEE for the following systems (i) Steam Turbine (ii) Nozzle.	10	CO2	L2
	(b)	Define COP. Derive an expression for the relationship between COP of refrigerator and COP of heat	10	CO2	L2
		Module – 3			
Q.5	**(a)**	What do you understand by perpetual motion machines PMM-I and PMM-II. With a block diagram represent the same and prove that both violate the laws of thermodynamics.	10	CO2	L2
	(b)	A reversible heat engine works between two reservoirs at 1400K and 350k respectively. A reversible heat pump receives heat from reservoir at 250K and rejects it to the reservoir at 350K to which the heat engine also rejects heat. The work output from the engine is used to drive the heat pump. If the total heat supplied to the reservoir is 350K is 100KW, find the heat to be received by the heat engine.	10	CO2	L3

OR			**Marks**	**CO'S**	**RBTL**
Q.6	**(a)**	Prove that entropy is property of the system	6	CO2	L2
	(b)	Draw available and unavailable energy representing them on a T-S diagram citing thermodynamics process of your choice.	7	CO2	L2
	(c)	A rigid tank contains air at 35˚C and is stirred by a paddle wheel which does 500kJ of work on air. During the stirring process temperature of air remains constant. If the surroundings are at 15˚C estimate the change in entropy of air and change in entropy of the surroundings.	7	CO2	L3
Module – 4					
Q.7	**(a)**	Define the Following: (i) critical point (ii) Tripple point (iii) Dryness Fraction (iv) Compressibility factor (v) Saturation conditions.	10	CO3	L1
	(b)	A vessel having a volume of 0.3m3 is filled with a mixture of 3kg CO2 and 2.5kg N2 at 30˚C. Determine (i) Mole fraction of each component (ii) Molecular weight of the mixture (iii) Pressure of the mixture if R for the mixture is 0.238kL/kg K mol.	10	CO3	L3
OR					
Q.8	**(a)**	Define a pure substance. Define and represent the following on a TS or PH diagram	10	CO3	L1
	(b)	0.1m^3 of air at 5MPa and 356˚ 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 the air behaves as an ideal gas with R=287 J/kg K	10	CO3	L3
Module – 5					
Q.9	**(a)**	With PV and TS Diagram derive an expression for efficiency of carnot's cycle	6	CO3	L2
	(b)	With PV and TS Diagram, derive an expression for air standard efficiency of a diesel cycle.	7	CO3	L2
	(c)	The minimum pressure and temperature in an otto cycle are 100kPa and 37°C. The amount of heat added to the cycle is 1500kJ/kg. Determine (i) The pressure and temperature at all points (ii) The specific work and thermal efficiency of the cycle for the compression ratio of 8:1. Take Cv for air = 0.72kJ/kg and $\gamma = 1.4$	7	CO3	L3
OR					
Q.10	**(a)**	What are the methods to increase the efficiency of Rankine's cycle	7	CO3	L2
	(b)	Consider a steam power plant operating on a simple Rankine cycle. Steam enters the turbine at 3MPa and 350˚C and is cooled in the condenser at a pressure of 75kPa. Determine the thermal efficiency of the cycle.	7	CO3	L3
	(c)	Steam enters the turbine of a steam power plant operating on Rankine cycle at 10Bar, 300˚C. The condenser or pressure is 0.1bar. steam leaving the turbine is 90% dry. Calculate the adiabatic efficiency of the turbine and also the cycle efficiency neglecting the pump work.	6	CO3	L3

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Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE.**

		Module – 1	**Marks**
Q.1	**(a)**	What is thermodynamic system. Explain the types of thermodynamics system with an example.	10
	(b)	A thermodynamic property X (length of mercury column) is equal to 7.5cm and 52.5cm at ice point and steam point respectively. If a temperature scale is defined by equation $T=a+bx^2$, where t=32 and 212 at ice point and steam point. Find 't' on this scale when temperature is 100° on the Fahrenheit scale .	10
		OR	
Q.2	**(a)**	Prove that work is a path function.	10
	(b)	A gas has an initial volume of $0.4m^3$ and expands to 0.8m3. the initial temperature and pressure of gases are 0.1MPa and 27°C respectively. Find the work done by assuming the pressure between initial and final state of the system is (i) Constant (ii) Inversely proportional to volume (iii) Following an ideal gas equation PV=mRT	10
		Module – 2	
Q.3	**(a)**	Explain Joules experiment with neat sketch.	10
	(b)	Prove that Internal energy is a property of the system.	10
		OR	
Q.4	**(a)**	Derive an expression for steady flow energy equation.	10
	(b)	A steam turbine operating under steady flow conditions receives 4500 kg of steam per hour. The steam enters the turbine at a velocity of 2500m/min at an elevation of 4m and a specific enthalpy of 2785 kJ/kg. It leaves the turbine at a velocity of 500m/min at an elevation of 10m and specific enthalpy of 2262 kJ/kg. The heat loss from the turbine to the surroundings amounts to 16750 kJ/hr. Determine the power output of the machine HP.	10
		Module – 3	
Q.5	**(a)**	State kelvin planck and Clausius statements of second law o thermodynamics and show that they are equivalent.	10
	(b)	A reversible heat engine works between two reservoirs at 1400K and 350k respectively. A reversible heat pump receives heat from reservoir at 250K and rejects it to the reservoir at 350K to which the heat engine also rejects heat. The work out put from the engine is used to drive the heat pump. If the total heat supplied to the reservoir is 350K is 100KW, find the heat to be received by the heat engine.	10

OR			Marks
Q.6	**(a)**	Prove that entropy is property of the system	6
	(b)	Define Clausius inequality and entropy of a system. Show that for an irreversible process $ds \geq \frac{\partial Q}{T}$	7
	(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. what is the change in entropy of the universe.	7
Module – 4			
Q.7	**(a)**	Define the Following: (i) critical point (ii) Tripple point (iii) Dryness Fraction (iv) Compressibility factor (v) Saturation conditions.	10
	(b)	Derive vander waal's constants in terms of critical properties.	10
OR			
Q.8	**(a)**	Define a pure substance. Define and represent the following on a TS or PH diagram	10
	(b)	Using maxwell relation $\left({\partial s}/{\partial v}\right)_T = \left({\partial p}/{\partial T}\right)_v$ and noting $Td_5=du+pdv$, show that internal energy of a perfect gas is function of temperature only.	10
Module – 5			
Q.9	**(a)**	Compare Otto cycle engine and Diesel cycle engine.	6
	(b)	With PV and TS Diagram, derive an expression for air standard efficiency of an otto cycle.	7
	(c)	The compression ratio of a diesel cycle is 14 and cut off ration is 2.2. At the beginning of the cycle the air is at 0.98 bar and 100°C. Find (i) The temperature and pressure at all points (ii) Air standard efficiency (iii) Mean effective pressure.	7
OR			
Q.10	**(a)**	What are the methods to increase the efficiency of Rankine's cycle	7
	(b)	Consider a steam power plant operating on a simple Rankine cycle. Steam enters the turbine at 3MPa and 350°C and is cooled in the condenser at a pressure of 75kPa. Determine the thermal efficiency of the cycle.	7
	(c)	Explain with T-S Diagram, limitations of Carnot's cycle and how can we overcome the same in Rankine cycle.	6