Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2024

Subject Code:3161910 Date:15-05-2024

Subject Name:Applied Thermodynamics

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**
5. **Use of Refrigeration Air-Conditioning charts and Steam tables is permitted.**

			MARKS
Q.1	**(a)**	What is compressibility chart? What are the observations can be made from this chart?	**03**
	(b)	Explain the effect of compression ratio on fuel air cycle analysis.	**04**
	(c)	Explain the following terms briefly: (i) Dew point temperature (ii) Cooling and Dehumidification (iii) Comfort Air conditioning (iv) Wet bulb temperature (v) Relative humidity (vi) Degree of saturation (vii) sensible heat factor.	**07**
Q.2	**(a)**	Differentiate Between Vapour Compression System and Vapour Absorption System.	**03**
	(b)	What are desirable characteristics of ideal refrigerant? Explain how refrigerants are designated?	**04**
	(c)	A vessel of 8 m^3 capacity contains two gases A and B in proportion of 40 % and 60 % respectively at 32 ^{0}C. If the value of R for the gases is 0.29 kJ/kg K and 0.296 kJ/kg K and if the total weight of the mixture is 3 kg. Determine (1) the partial pressure (2) the total pressure (3) the mean value of R for the mixture.	**07**
		OR	
	(c)	A R-134a two stage refrigeration system operates between the pressure limits of 1.3 bar and 7.7 bar. The refrigerant leaves the condenser as a saturated liquid and is throttled to a flash chamber operating at 2.9 bar. The part of refrigerant evaporates during the flashing process and this vapour is mixed with the refrigerant leaving the low pressure compressor. Then, the mixture is compressed to the condenser pressure by the high pressure compressor. The liquid in the flash chamber is throttled to the evaporator pressure and cools the refrigerated space. The refrigerant entering lower stage compression is saturated vapour. The mass of refrigerant circulates through condenser is 8 kg/min. Calculate: (1) Mass of liquid refrigerant evaporates in flash chamber (2) Refrigerating capacity and compressor work supplied (3) COP of the system	**07**
Q.3	**(a)**	Briefly explain flash intercooling.	**03**
	(b)	Explain why the specific heats of gases increase with increases in temperature?	**04**

(c) Derive an equation for the variation in air standard efficiency of Diesel cycle on account of variation in C_v. **07**

OR

Q.3 **(a)** Explain the different methods adopted to obtain variable compression ratio in I. C. engine. **03**

(b) Draw P - V diagrams of Otto and Diesel cycle and show the effect of variation of specific heat with temperature on the same. **04**

(c) Derive an Expression for Velocity of Sound Wave in Compressible Fluid Flow and also Express in terms of Bulk Modulus. **07**

Q.4 **(a)** What are the international accepted methods for measuring the NO_x, CO and HC? **03**

(b) What are the different Losses in Actual Cycle? Explain any two with neat sketch. **04**

(c) From the data given below, draw an energy balance sheet for a two stroke diesel engine run for 30 minutes at full load: **07**
RPM - 350, Mena effective pressure – 3 bar, Net brake load – 650 N, Fuel consumption – 1.8 kg, Air used – 32 kg/kg of fuel, Cylinder bore – 210 mm, Cylinder stroke – 260 mm, Brake diameter – 1 m, Cooling water supplied – 175 kg, Water input temperature – 30 ^{0}C, Water output temperature 60 ^{0}C, Room temperature – 25 ^{0}C, Exhaust gas temperature – 300 ^{0}C, Steam formed in exhaust – 1.3 kg/kg of fuel, Specific heat of steam in exhaust - 2 kJ/kg K, Specific heat of dry exhaust gas – 1.005 kJ/kg K, Calorific value of fuel – 43,000 kJ/kg

OR

Q.4 **(a)** What is Mach number? Why is this parameter so important for the study of flow of compressible fluid. **03**

(b) Explain the phenomenon of dissociation. **04**

(c) Derive an expression for the area velocity relationship for a compressible fluid in the form $\frac{dA}{A} = \frac{dV}{V}[M^2 - 1]$ **07**

Q.5 **(a)** Differentiate between positive displacement compressor and dynamic compressor. **03**

(b) Define following terms with reference to centrifugal compressor : **04**
(i) Isentropic efficiency (ii)Power input factor (iii) Slip factor (iv) Pressure co-efficient.

(c) Derive an expression for minimum work input to compress the air in two stage reciprocating compressor. **07**

OR

Q.5 **(a)** Define flow co-efficient and work co-efficient with reference to axial flow compressor **03**

(b) Explain methods of reducing compressor work done in single stage reciprocating air compressor without clearance. **04**

(c) An axial flow compressor stage has mean diameter of 60 cm and runs at 15000 rpm. If the actual temperature rise and pressure ratio developed are 30 ^{0}C and 1.35 respectively. Determine: (1) power required to drive the compressor while delivering 57 kg/s of air, if mechanical efficiency is 86 % and inlet temperature 35^{0}C (2) the stage loading co-efficient (3) the stage efficiency (4) the degree of reaction if the temperature at the rotor exit is 55 ^{0}C. **07**

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