Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2023

Subject Code:3161910 Date:04-07-2023

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 steam table is allowed.**

			MARKS
Q.1	**(a)**	State the assumptions to be made for fuel-air cycle analysis.	**03**
	(b)	Define the following (i) Relative Humidity (ii) wet bulb depression (iii) Dew point temperature (iv) saturated air	**04**
	(c)	What are the needs of multi-staging? Derive the equation of work done on air for multi-stage reciprocating air compressor.	**07**
Q.2	**(a)**	Define engine. What are the main objectives of IC engine testing?	**03**
	(b)	Explain designation system of refrigerants.	**04**
	(c)	Explain Vander Waal's Equation of State. Derive an expression for Evaluation of Constant 'a' and 'b'.	**07**
		OR	
	(c)	1 kg of oxygen occupies a volume of 0.25 m^3/kg at 330 K is subjected to isothermal expansion process tillit's volume becomes 0.75 m^3/kg. Assuming that the gas obey Vanderwall's gas equation, find the final pressure of the gas and the work done during the process. Assume Vanderwall's gas constant as : a = 138000 Nm^4 /$(kg_{mol})^2$, b = 0.0318 m^3/ kg_{mol}	**07**
Q.3	**(a)**	Explain sensible cooling process.	**03**
	(b)	In an absorption system heating cooling and refrigeration takes place at temperature of 115 ^oC 30 ^oC and -20 ^oC respectively find theoretical COP of the system. If the generator temperature increased to 200 ^oC and evaporator temperature decreased to -40 ^oC, find the % change in COP of system.	**04**
	(c)	Explain working of two stage compression with liquid intercooler with neat sketch and p-h diagram.	**07**
		OR	
Q.3	**(a)**	Explain Global warming potential of refrigerants.	**03**
	(b)	What are secondary refrigerants? State advantages of secondary refrigerants.	**04**
	(c)	Atmospheric air at 101.325 kPa has 30^o C DBT and 15^{o}C DPT. Without using psychrometric chart calculate partial pressure of air and vapour, specific humidity, relative humidity,vapour density and enthalpy of moist air.	**07**

Q.4	**(a)**	Differentiate Centrifugal and Axial Flow Compressor	**03**
	(b)	Explain dissociation loss and its effect on maximum temperature and pressure of the cycle.	**04**
	(c)	Derive an Expression for Velocity of Sound Wave in Compressible Fluid Flow and also Express in terms of Bulk Modulus.	**07**
		OR	
Q.4	**(a)**	Define zone of action, zone of silence and mach cone.	**03**
	(b)	Explain time loss, spark timing loss and heat loss in actual cycle.	**04**
	(c)	In a diesel cycle, air at the beginning of compression is 1 bar and 50^{o}C. The air-fuel ratio is 25:1 and compression ratio is 15. Assuming Cv = $0.71 + 21 \times 10^{-5}T$ and law of compression is $pv^{1.35}$ = constant. Calculate the % stroke at which combustion is completed. Take calorific value of fuel as 44000 kJ/kg and R= 287 J/kg-K.	**07**
Q.5	**(a)**	Explain working of catalytic converter.	**03**
	(b)	Write short note on variable compression ratio engine.	**04**
	(c)	The following observations were recorded from test on a single cylinder four stroke oil engine having following parameters : cylinder bore = 150 mm, engine stroke = 250 mm, engine speed = 420 rpm, brake torque = 217 N-m, fuel consumption = 2.95 kg/h, calorific value of fuel = 44000 kJ/kg, cooling water flow rate = 0.068 kg/s, cooling water temperature rise = 45 K, specific heat capacity of cooling water = 4.18 kJ/ kg-K, mean effective pressure = 7.5 bar, calculate (i) mechanical efficiency (ii) brake thermal efficiency (iii) specific fuel consumption (iv) draw heat balance sheet.	**07**
		OR	
Q.5	**(a)**	What are the major pollutants emitted from diesel engine?	**03**
	(b)	State and explain losses in centrifugal compressor.	**04**
	(c)	For a multistage axial flow compressor, initial state of air is 1 bar, 30^{o}C and final state is 6 bar, 300 ^{o}C. Calculate the overall isentropic and polytropic efficiencies.When the actual temperature rise per stage is 16 ^{o}C, calculate the number of stages required , assuming polytropic efficiency as the stage efficiency.	**07**