Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - 1/2 EXAMINATION - WINTER 2025

Subject Code: 3110006 **Date: 13-01-2026**

Subject Name: Basic Mechanical Engineering

Time: 02:30 PM TO 05:00 PM **Total Marks: 70**

Instructions

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of Steam Tables is permitted.**

			Marks
Q.1	**(a)**	Give classification of Cochran boiler and Lancashire boiler.	**03**
	(b)	Write a short note on CNG as a fuel.	**04**
	(c)	(i) The absolute pressure in a compressed air tank is 200 kPa. What is the gauge pressure in the tank if atmospheric pressure is 1.01 bar? (ii) The temperature of a system rises by 130°C during a heating process. Express this rise in temperature in kelvins. (iii) A 4-kW resistance heater in a water heater runs for 3 hours to raise the water temperature to the desired level. Determine the amount of electric energy used in both kWh and kJ.	**07**
Q.2	**(a)**	State the function of any three mountings in boilers.	**03**
	(b)	Classify engineering materials.	**04**
	(c)	0.4 kg of gas is expanded isentropically from 10 bar and 340^{o}C to 1 bar. It is then heated at constant volume to 3 bar and 340 ^{o}C and then finally it is compressed isothermally until the initial pressure of 10 bar is attained. Draw the p-V diagram for these processes and find the value of the adiabatic index γ. Take C_p = 1.005 kJ/kgK.	**07**
		OR	
	(c)	A gas expands from 450 kPa and 130 litres to 150 kPa and 260 litres. The decrease in enthalpy during the process is 55 kJ. Taking C_v = 718 J/kgK, determine (i) change in internal energy, (ii) value of C_p, and (iii) value of R.	**07**
Q.3	**(a)**	What is a rigid coupling? What are its types?	**03**
	(b)	Draw a schematic diagram of the vapor compression refrigeration system. Where is the condenser located in a split air-conditioner?	**04**
	(c)	A rigid tank contains 10 kg of water at 90°C. If 8 kg of the water is in the liquid form and the rest is in the vapor form, determine (a) the pressure in the tank and (b) the volume of the tank.	**07**
		OR	
	(a)	What is a friction clutch? What are its types?	**03**

(b) What is the difference between the working principle of vapor compression and vapor absorption refrigeration system? **04**

(c) Find the dryness fraction of steam supplied in a combined separating-and-throttling calorimeter from following data: initial pressure = 10 bar, final pressure = 1 bar, water separated = 1.5 kg, steam discharged from throttling calorimeter = 20 kg, temperature of steam after throttling = 120^{o}C. Take specific heat of superheated steam as 2.1 kJ/kg K. **07**

Q.4 **(a)** Find the incorrect statements from the following and correct them. **03**

-Rigid flange coupling is used when axes of shafts are parallel but not in alignment.

-Pin type flexible coupling is used where angular misalignment is more.

-Universal coupling requires proper alignment of shaft axes.

-Oldham's coupling is for small angular misalignment.

(b) Describe main parts of a centrifugal pump in short. **04**

(c) A Diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place 6% of the stroke. Find the air standard efficiency of the engine. **07**

OR

(a) Draw a labeled diagram of a simple band brake. **03**

(b) Explain any one type of rotary pumps with figure. **04**

(c) In an air standard Otto cycle, the upper and lower limits of absolute temperatures are T_3 and T_1 respectively. Show that for maximum work, the ratio of compression should have the value $r = \left(\frac{T3}{T1}\right)^{1.25}$. **07**

Q.5 **(a)** Which mechanical drive will you suggest in each of the following different situations: **03**

-When there is less space available.

-Where 'slip' is permitted.

-When high velocity ratio is required.

(b) What is isothermal efficiency, clearance ratio, and volumetric efficiency of a compressor? **04**

(c) Distinguish between petrol engine and diesel engine. Use the following points: cycle of operation, compression ratio, fuel ignition, governing, engine speed, thermal efficiency, engine weight. **07**

OR

(a) State three disadvantages of using gear drives. **03**

(b) Give classification of air compressors. **04**

(c) The following data refer to a test on I.C. engine: **07**

Indicated power = 42 kW, frictional power = 7 kW, engine speed = 1800 rpm, specific fuel consumption per B.P. = 0.30 kg/kWh, calorific value of fuel used = 43000 kJ/kg. Calculate: (i) mechanical efficiency, (ii) brake thermal efficiency, and (iii) indicated thermal efficiency.

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