GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–I (NEW) EXAMINATION – WINTER 2023

Subject Code:3110006   **Date:29-01-2024**
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. **Simple and non-programmable scientific calculators are allowed.**
5. **Use of Steam Tables is permitted.**

Q.1	**(a)** What do you mean by 'boiler mountings' and 'boiler accessories? Write three examples of them.	**03**
	(b) Explain advantages and disadvantages of wind energy.	**04**

	(c) i. Fill in the blanks: 1 bar = _____ Pa = _____ kPa = _____ MPa
	               1 atm = _____ bar
	  ii. Write the equation of 1st law of thermodynamics for a stationary closed system.
	  iii. Determine the power required to accelerate a 900-kg car from rest to a velocity of 80 km/h in 20 sec on a horizontal road. (Neglect friction, rolling resistance, air drag, etc.)
		07

Q.2	**(a)** State the function of the following in boilers: Economizer, air preheater, superheater.	**03**
	(b) Provide meaning of the following statements regarding cast iron material: 1) It is brittle and has low ductility. 2) It has high compressive strength but low tensile strength. 3) It has excellent castability. 4) It has poor formability.	**04**
	(c) A gas whose pressure, volume, and temperature are 2.75 bar, 0.09 m³, and 185°C respectively has the state changed at constant pressure until its temperature becomes 15°C. Calculate (i) the heat transferred, and (ii) the work done. Take R = 0.29 kJ/kg K and c_p = 1.005 kJ/kg K.	**07**
	OR	
	(c) The gauge pressure of an automobile tire is measured to be 210 kPa before a trip and 220 kPa after the trip at a location where the atmospheric pressure is 95 kPa. Assuming the volume of the tire remains constant and the air temperature before the trip is 25°C, determine air temperature in the tire after the trip. Convert this change in temperature into percentage change.	**07**
Q.3	**(a)** Classify clutches.	**03**
	(b) Draw a schematic diagram of the vapor absorption refrigeration system.	**04**
	(c) Determine the missing properties and the phase descriptions in the following table for water. Use steam tables and write necessary explanations.	**07**

	T, °C	P, kPa	h, kJ/kg	x	Phase description
(i)		200		0.6	
(ii)	124		1835.2		

Q.3 **(a)** Draw a labeled diagram of a shoe brake used in automobiles. **03**
(b) Draw a self-explanatory diagram of window room air-conditioner. **04**
(c) Draw a neat, labeled diagram of barrel calorimeter. Write the equation used for this calorimeter for finding dryness fraction and state what each term in it indicates. **07**

Q.4 **(a)** Match the following: **03**

Rigid flange coupling	Axis of shafts are parallel but not in alignment
Pin type flexible coupling	Where angular misalignment is more
Universal coupling	Requires proper alignment of shaft axes
Oldham's coupling	For small angular misalignment

(b) Compare centrifugal pumps v/s reciprocation pumps. **04**
(c) Consider a steam power plant operating on the simple ideal Rankine cycle. Steam enters the turbine at 3 MPa and 350°C and is condensed in the condenser at a pressure of 74 kPa. Draw the *T-s* diagram and determine the thermal efficiency of this cycle. (Do not neglect the pump work.) **07**

OR

Q.4 **(a)** Give the similarities and differences between a clutch and a brake. **03**
(b) Explain any one type of rotary pumps with figure. **04**
(c) Derive, using *P-v* diagram, the equation to find air standard efficiency of Otto cycle. Use the formula you derived to find which gas from the following will give maximum efficiency for the same compression ratio: exhaust gas ($\gamma=1.3$), air, and monatomic gas ($\gamma=1.67$) **07**

Q.5 **(a)** Draw a schematic diagram of the fast and loose pulley drive. **03**
(b) Give classification of air compressors. **04**
(c) A 4-stroke 6-cylinder IC engine has a stroke volume of 1.75 liters and is operating at a mean effective pressure of 6 bar. At what crankshaft rpm will the engine develop 35 hp? (Take 1 hp = 736 watts) **07**
What is the function of a carburetor and a fuel injector in an IC engine?

OR

Q.5 **(a)** Differentiate between a belt drive and a gear drive. **03**
(b) Define with regard to compressors: double-acting compressor, multistage compressor, displacement (swept) volume, pressure ratio. **04**
(c) A petrol engine has a compression ratio of 6 and develops 15 kW. Its brake thermal efficiency is half of its air standard efficiency. Find the fuel consumption. Take calorific value of petrol as 41500 kJ/kg. **07**
Why are more two-wheeler automobiles made with a 4-stroke engine instead of a 2-stroke engine? Give three technical reasons for this.

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