

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE- SEMESTER-I & II(NEW) EXAMINATION – SUMMER 2023****Subject Code:3110006****Date:28-07-2023****Subject Name:Basic Mechanical Engineering****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 Tables is permitted.

- Q.1** (a) Classify boilers according to (i) relative position of hot gases and water, (ii) axis of the shell, (iii) method of water circulation. Give examples in each. **03**
- (b) Make a list of (i) natural fuels and (ii) artificial (prepared) fuels. Write two effective points to reduce global warming. **04**
- (c) i. Determine the amount of heat required to raise the temperature of a steel workpiece from 40 to 160 °C. The mass of workpiece is 20 kg and specific heat is 460 J/kg K. **07**
- ii. A thermodynamic cycle has four processes. The heat and work interaction with surroundings is given in the table. Determine the work done during process 3-4. What will be the change in internal energy after completion of one cycle?

Process	Heat transfer (kJ)	Work done (kJ)
1-2	+925	+70
2-3	-110	-50
3-4	-770	?
4-1	+220	+170

- Q.2** (a) State the function of the following in boilers: feed check valve, blow off cock, fusible plug. **03**
- (b) Identify the following properties of materials: **04**
- 1) This property is desirable for parts subjected to impact loads and vibrations.
  - 2) By this property gold, silver, can be flattened or bent without cracking when hammered.
  - 3) This property is useful for materials subjected to high temperatures like boilers and turbines.
  - 4) This property is necessary for a material to be used in making springs.
- (c) Air has a volume of 0.15 m<sup>3</sup>, pressure 1.5 bar and temperature 107 °C. It is compressed at constant pressure, until its volume becomes 0.11 m<sup>3</sup>. Determine: (i) temperature at the end of compression, (ii) work done during compression, (iii) change in internal energy.  $c_p = 1.005$  kJ/kg K,  $c_v = 0.718$  kJ/kg K **07**

**OR**

- (c) 0.35 m<sup>3</sup> of gas at 10 bar, 157 °C expands adiabatically to 4 bar. It is then compressed isothermally to its original volume. Find the final temperature and pressure of the gas.  $c_p = 0.996$  kJ/kg K,  $c_v = 0.703$  kJ/kg K **07**
- Q.3** (a) State the need of couplings along with the purposes they serve in machineries. **03**
- (b) Draw a schematic diagram of vapour compression refrigeration system. State the function of each main component. **04**

- (c) Steam is initially dry saturated at 9 bar in each of the following cases. **07**  
 Determine,  
 1) its dryness fraction if it loses 50 kJ/kg heat at constant pressure,  
 2) the degree of superheat if it receives 150 kJ/kg heat at constant pressure.

**OR**

- Q.3** (a) Draw a half-sectional view of the sleeve (muff) coupling. **03**  
 (b) Draw a labeled diagram of split air-conditioner. Why does the split air-conditioner consume more power than a window air-conditioner of same capacity? **04**  
 (c) Draw a neat self-explanatory diagram of separating calorimeter. During the test on a separating calorimeter, 2.2 kg moisture was collected and 16 kg of steam left the calorimeter. Calculate dryness fraction of steam. **07**

- Q.4** (a) Classify clutches. **03**  
 (b) Draw a schematic diagram of reciprocating pump. Show the variation of discharge of water with crank angle for single-acting reciprocating pump. **04**  
 (c) A Carnot cycle works with isentropic compression ratio of 6 and isothermal expansion ratio of 2. The volume of air at the beginning of isothermal expansion is  $0.2 \text{ m}^3$ . If  $T_{max}$  and  $p_{max}$  is limited to 600 K and 20 bar respectively, determine: (i) minimum pressure during the cycle, (ii) thermal efficiency of cycle. Show the  $T-s$  and  $p-v$  diagram. **07**

**OR**

- Q.4** (a) State the function of brakes and classify them. **03**  
 (b) Draw a labeled figure of centrifugal pump indicating all main components. **04**  
 (c) The compression ratio of an ideal air standard diesel cycle is 15. Heat supplied at constant pressure is 1470 kJ/kg of air. Show the cycle on  $p-v$  diagram and determine the cycle efficiency if inlet conditions are 300 K and 1 bar. **07**

- Q.5** (a) Enlist various belt drives. Name any three belt materials. **03**  
 (b) Outline the technical meaning of following terms used in air compressor: single acting compressor, single stage compressor, pressure ratio, swept volume, volumetric efficiency. **04**  
 (c) Indicated power of a 6-cylinder 4-stroke engine is 150 kW at an average piston speed of 300 m/min. Stroke to bore ratio is 1.25. If mean effective pressure is  $650 \text{ kN/m}^2$ , determine crankshaft speed. **07**  
 What is a flywheel and what is its function in IC engine?

**OR**

- Q.5** (a) Match the following: **03**

Spiral gears	Parallel shafts
Bevel gears	Intersecting shafts
Worm gears	Non-parallel non-intersecting shafts
Helical gears	Shaft axes at right angles & non-intersecting

- (b) Define with regard to compressors: mean effective pressure, indicated power, brake power, mechanical efficiency. **04**  
 (c) A 4-cylinder 4-stroke petrol engine has a bore 60 mm and a stroke of 90 mm. The rated speed is 2800 rpm and torque is 55 N-m. Fuel consumption is 6.75 litre/hr. Specific gravity of petrol is 0.76 and calorific value is 44200 kJ/kg. Calculate brake power, brake mean effective pressure, brake thermal efficiency and brake specific fuel consumption. **07**

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