

**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

\*\*\*\*\*