

Seat No.: \_\_\_\_\_

Enrolment No. \_\_\_\_\_

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE SEMESTER 1<sup>st</sup> / 2<sup>nd</sup> (NEW) EXAMINATION WINTER 2016**

**Subject Code: 2110006**

**Date: 23/01/2017**

**Subject Name: Elements of Mechanical Engineering**

**Time: 10:30 AM TO 1:00 PM**

**Total Marks: 70**

**Instructions:**

1. Question No. 1 is compulsory. Attempt any four out of remaining Six questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use of property table is permitted.

**Q.1 Objective Question (MCQ): Choose right answer.**

**Mark**

**(a)**

**07**

1. The sum of internal energy (U) and the product of pressure and volume (p.v) is known as
  - A. workdone
  - B. entropy
  - C. enthalpy
  - D. heat
2. The energy which is not derived from the sun is \_\_\_\_\_.
  - A. bio-mass
  - B. fossil fuels
  - C. nuclear energy
  - D. geo-thermal energy
3. An adiabatic process is one in which
  - A. no heat enters or leaves the gas
  - B. the temperature of the gas changes
  - C. the change in internal energy is equal to the mechanical work done
  - D. all of the above
4. The ratio of specific heat at constant pressure ( $c_p$ ) and specific heat at constant volume ( $c_v$ ) is
  - A. equal to one
  - B. less than one
  - C. greater than one
  - D. none of these
5. Superheated vapour behaves
  - A. exactly as gas
  - B. as steam
  - C. as ordinary vapour
  - D. approximately as a gas
6. The behaviour of a perfect gas, undergoing any change in the variables which control physical properties, is governed by
  - A. Boyle's law
  - B. Charles' law
  - C. Gay-Lussac law
  - D. all of these
7. The efficiency of Diesel cycle increases with
  - A. decrease in cut-off
  - B. increase in cut-off
  - C. constant cut-off
  - D. none of these

(b)

1. Which of the following statement is correct?
  - A. A fire tube boiler occupies less space than a water tube boiler, for a given power.
  - B. Steam at a high pressure and in large quantities can be produced with a simple vertical boiler.
  - C. A simple vertical boiler has one fire tube.
  - D. all of the above
2. The compression ratio for petrol engine is
  - A. 3 to 6
  - B. 5 to 8
  - C. 15 to 20
  - D. 20 to 30
3. The impeller of a centrifugal pump may have
  - A. volute casing
  - B. volute casing with guide blades
  - C. vortex casing
  - D. any one of these
4. The maximum delivery pressure in a rotary air compressor is
  - A. 10 bar
  - B. 20 bar
  - C. 30 bar
  - D. 50 bar
5. During a refrigeration cycle, heat is rejected by the refrigerant in a
  - A. compressor
  - B. condenser
  - C. evaporator
  - D. expansion valve
6. A hydraulic coupling belongs to the category of
  - A. power absorbing machines
  - B. power developing machines
  - C. energy transfer machines
  - D. energy generating machines
7. An open belt drive is used when
  - A. shafts are arranged parallel and rotate in the opposite directions
  - B. shafts are arranged parallel and rotate in the same directions
  - C. shafts are arranged at right angles and rotate in one definite direction
  - D. driven shaft is to be started or stopped whenever desired without interfering with the driving shaft

**Q.2 (a)** State Zeroth law, First law and Second law of thermodynamics. **03**

**(b)** Describe any four form of energy in 100 words. **04**

**(c)** A balloon of spherical shape 6 m in diameter is filled with hydrogen gas at a pressure of 1 bar absolute and 20°C. At a later time, the pressure of gas is 94 per cent of its original pressure at the same temperature : **07**

- 1) What mass of original gas must have escaped if the dimension of the balloon is not changed?
- 2) Find the amount of heat to be removed to cause the same drop in pressure at constant volume.

Take molecular weight for hydrogen,  $M = 2$  and specific heat constant volume for hydrogen,  $c_v = 10400 \text{ J/kg.K}$

**Q.3 (a)** State Boyle's, Charle's and Avogadro law. **03**

**(b)** Identify the advantages and disadvantages of wind energy. **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. Draw p-V diagram and identify the point in p-V diagram. Determine **07**

- 1) the pressure in the tank
- 2) the volume of liquid and water vapour

- 3) quality (dryness fraction) of steam and
- 4) volume of the tank by using dryness fraction
- Q.4** (a) Express the mathematical formula with standard notation/symbol of properties for **03**
- 1) Wetness fraction of steam
  - 2) Enthalpy of superheated steam
  - 3) Specific volume of wet steam
- (b) Explain the construction of Oldham's coupling with neat sketch in 150 words. **04**
- (c) Explain with neat sketch working of any one of the high pressure boiler in 300 words. Tell the two advantages and two disadvantages of it. **07**
- Q.5** (a) Define air standard efficiency. State any four assumptions considered for analysis of air standard cycle. **03**
- (b) In ideal Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Assume flow rate of 9.5 kg/s. Determine : **04**
- 1) The pump work,
  - 2) The turbine work,
  - 3) The Rankine efficiency,
  - 4) The dryness at the end of expansion.
- (c) Compare four stroke engine and two stroke engine based on following point/criteria. **07**
- 1) Number of piston strokes per cycle
  - 2) Number of crank rotation per cycle
  - 3) Number of power stroke per min
  - 4) Power
  - 5) Flywheel
  - 6) Size for same power output
  - 7) Thermal Efficiency and Mechanical Efficiency
- Q.6** (a) Define following terms with respect to compressor. **03**
- 1) Free air delivery
  - 2) Capacity
  - 3) Volumetric efficiency of an air compressor
- (b) A centrifugal pump handles water and drives by motor which consumes 32 kW. The pump running at 2000 rpm. The motor efficiency is 92%. The height of pump axis from sump water surface is 6 m and produces a delivery head of 24 m. The discharge rate of water is 260 m<sup>3</sup>/hr. Calculate the efficiency of pump. **04**
- (c) Sketch fluid flow diagram with component of ideal vapour compression refrigeration system. Sketch p-V, T-s, and p-h chart and show all thermodynamic process of ideal superheated vapour compression refrigeration system **07**
- Q.7** (a) Define following terms. **03**
- 1) Ductility
  - 2) Elasticity
  - 3) Pump
- (b) Classify plain carbon steel. Compare their properties and application. **04**
- (c) Compare belt drive, chain drive and gear drive based on following criteria : **07**
- 1) Main elements
  - 2) Application suitability w.r.t to distance and velocity ratio
  - 3) Space requirement
  - 4) Slip
  - 5) Design & Manufacturing complexity
  - 6) Life
  - 7) Maintenance

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