Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEMESTER 1st / 2nd (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) **07**

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 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^3/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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