GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-I Examination January 2010

Subject code: 110006   **Subject Name:** Elements of Mechanical Engineering
Date: 07 / 01 / 2010   **Time: 11.00 am – 1.30 pm**
                              Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** State the advantages of gaseous fuels over solid and liquid fuels.   **04**

(b) What do you mean by non-conventional energy sources? How does it differ   **03**
from conventional sources?

(c) An ideal gas is heated from 25ºC to145ºC. The mass of gas is 2 kg.   **07**
Determine (i) Specific heats (ii) change in internal energy, (iii) change in
enthalpy. Assume R = 267 J/Kg K and γ =1.4 for the gas.

Q.2 **(a)** Why Diesel engines are called C.I. engines? Differentiate between S.I. and   **04**
C.I. engine.

(b) What is dryness fraction? Explain throttling calorimeter.   **03**

(c) The following reading were taken during the test of four stroke single   **07**
cylinder petrol engine :
Load on the brake drum = 50 kg   Diameter of brake drum = 1250 mm
Spring balance reading   = 7 kg   Engine speed = 450 rpm
Fuel consumption = 4 kg/hr   Calorific value of the fuel = 43000 kJ/kg
Calculate: (i) indicated thermal efficiency (ii) brake thermal efficiency.
Assume mechanical efficiency as 70%

OR

(c) Determine dryness fraction of steam supplied to a separating and throttling   **07**
calorimeter.
Water separated in separating calorimeter = 0.45 kg
Steam discharge from throttling calorimeter = 7 kg
Steam pressure in main pipe = 1.2 MPa
Barometer reading = 760 mm of Hg
Manometer reading = 180 mm of Hg
Temperature of steam after throttling = 140º C
Take Cps = 2.1 kJ/kg K.

Q.3 **(a)** Derive thermal efficiency formulae for Rankine cycle.   **04**
(b) Define heat engine. What are the essential requirements of heat engine?   **03**
(c) Determine the compression ratio, the cycle efficiency, and the ratio of   **07**
maximum to minimum pressure in an air standard Otto cycle from
following data :
Minimum temperature = 25º C   Maximum temperature = 1500º C
Heat supplied per kg of air = 900 kJ Take Cv = 0.718 kJ/kg K & γ = 1.4

OR

Q.3 **(a)** Differentiate between (i) natural circulation and forced circulation in boiler   **04**
(ii) internally and externally fired boilers

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(b) Explain very briefly the function of following mountings : **03**
(i) Steam stop valve (ii) Feed check valve (iii) Blow-off cock (iv) Water level indicator (v) Pressure gauge (vi) Safety valve.

(c) A steam generator evaporates 17000 kg/hr of steam at 14 bar and quality of 0.95 from feed water at 102º C. When coal is fired at the rate of 2050 kg/hr having calorific value 27400 kJ/kg. Assume specific heat of water as 4.187 kJ/kg K. Calculate (i) Heat supplied per hour (ii) Thermal efficiency (iii) Equivalent evaporation. **07**

Q.4 **(a)** What is the purpose of a governor? Give comparison between governor and flywheel. **04**

(b) What is priming? Why priming is required in centrifugal pump but not in reciprocating pumps? **03**

(c) A single stage air compressor is required to compress 94-m^3 air/min from 1 bar and 25º C to 9 bar. Find the temperature at the end of compression, work done, power required and heat rejected during each of the following process (i) isothermal (ii) adiabatic (iii) polytropic following the law $pV^{1.25}$=constant. Assume no clearance. **07**

OR

Q.4 **(a)** Explain with flow diagram, the working of a vapour absorption refrigerator. **04**

(b) Define air conditioning. State the basic components of air conditioning system. **03**

(c) A single stage single acting air compressor has intake pressure 1 bar and delivery pressure 12 bar. The compression and expansion follows the law $pV^{1.3}$=constant. The piston speed and rotations of shaft is 180 m/min and 350 rpm respectively. Indicated power is 30 kW and volumetric efficiency is 92%. Determine bore and stroke. **07**

Q.5 **(a)** Give the classification of brake and describe with neat sketch the working principle of an internal expanding shoe brake. **04**

(b) Explain with neat sketch the working of cone clutch. What are the advantages of cone clutch compare to disc clutch? **04**

(c) State the application, advantages and disadvantages of (i) belt drive (ii) chain drive (iii) gear drive **06**

OR

Q.5 **(a)** What do you understand by non-metallic materials? Name any six and state their practical importance. **04**

(b) State and explain first law of thermodynamics. **04**

(c) Write short note on **06**
    (i)   Vane pump
    (ii)   Babcock and Wilcox boiler

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