

GUJARAT TECHNOLOGICAL UNIVERSITY
P.D.D.C. Sem- I Regular / Remedial Examination January. 2011

Subject code: X11102

Subject Name: Elements of Mechanical and Structural Engineering

Date: 10 / 01 / 2011

Time: 10.30 am – 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.

- Q.1 (a)** Define the following terms **07**
i) Power ii) Heat iii) Specific heat
iv) Internal energy v) Enthalpy vi) Entropy
vii) Efficiency
- (b)** State the different types of beam and draw it. State the different type of loads on beam. **07**

- Q.2 (a)** Explain the working of Vapour Compression Refrigeration system with line sketch diagram. **07**
- (b)** A steam turbine is supplied with 1200 kg of steam per min. The steam enters the turbine with velocity of 20 m/s and leave it with a velocity of 150 m/s. During expansion in the turbine there is enthalpy drop of 425 kJ/kg of steam. There is a heat loss of 24000 kJ/min from the turbine casing to the surrounding. Assuming steady flow conditions determine the power in kW of the turbine. **07**

OR

- (b)** An engine operating on Diesel cycle has maximum pressure and temperature of 45 bar and 1500° C. Pressure and temperature at the beginning of compression are 1 bar and 27° C. Determine air standard efficiency of the cycle. Take $\gamma = 1.4$ for air. **07**

- Q.3 (a)** Explain the working of Four stroke Diesel engine with neat sketch. **07**
- (b)** Give the classification of Governors. Explain the working of Watt Governor with neat sketch. **07**

OR

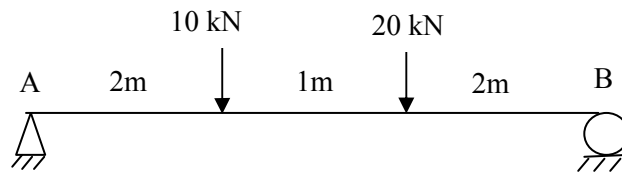
- Q.3 (a)** Explain the construction and working of Centrifugal pump with neat sketch. **07**
- (b)** A single stage, single acting compressor has a bore of 170 mm and stroke of 260 mm. It runs at 130 rpm. The suction pressure is 1 bar and delivery pressure is 9 bar. Find the indicated power if compression i) follows the law $pV^{1.25} = \text{constant}$ and ii) is isothermal. Also find isothermal efficiency. Assume there is no clearance volume. **07**

- Q.4 (a)** Define the following terms **07**
i) Stress ii) Strain iii) Hardness iv) Toughness
v) Factor of Safety vi) Proof resilience
vii) Modulus of resilience
- (b)** Calculate the strain energy stored in a bar 200 cm long, 5 cm wide and 4 cm thick, when it is subjected to a tensile load of 10000 N. Take $E = 2 \times 10^5 \text{ N/cm}^2$ **07**

OR

- Q.4 (a)** A solid shaft is subjected to a torque of 15000 N-m. Find the necessary diameter of the shaft, if the allowable shear stress is 6000 N/cm^2 . The allowable twist of 1° for every 20 diameter length of the shaft. **07**
 Take Modulus of rigidity = $0.8 \times 10^7 \text{ N/cm}^2$.
- (b)** Explain the different types of stresses with sketch. State Hooke's law and explain in brief. **07**

- Q.5 (a)** Two steel plates of uniform cross section 10 mm X 85 mm are welded together. If an axial tensile force of 100 kN is applied to welded plates and inclination of welded joint $\beta = 30^\circ$, calculate a) normal stress perpendicular to weld and b) in-plane shear stress parallel to weld. **07**
- (b)** Find reactions about support A and B for the simply supported beam as shown in figure below. **07**



OR

- Q.5 (a)** A 25 mm diameter steel bar of length of 3 m is subjected to an axial pull of 30 kN. If modulus of elasticity is 200 GPa and poisson's ratio 0.25 (i.e. $\mu = 0.25$), find the change in length, diameter and volume. **07**
- (b)** An aluminium rod of 20 mm diameter and 1.5 m long is subjected to rise in temperature by 35°C . Calculate i) natural expansion ii) if natural expansion is prevented, the stress developed in the bar iii) axial force in the bar. **07**
 Take $E = 70 \text{ GPa}$
 Coefficient of thermal expansion $\alpha = 18 \times 10^{-6} \text{ per } ^\circ\text{C}$.
