

**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 neat 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**

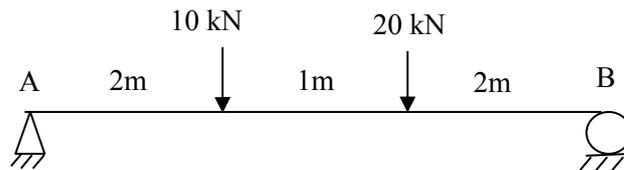
- |                     |                      |                            |               |
|---------------------|----------------------|----------------------------|---------------|
| i) Stress           | ii) Strain           | iii) Hardness              | iv) Toughness |
| v) Factor of Safety | 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  $6000 \text{ N/cm}^2$ . The allowable twist of  $1^\circ$  for every 20 diameter length of the shaft. Take Modulus of rigidity =  $0.8 \times 10^7 \text{ N/cm}^2$ . **07**
- (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.  $\nu = 0.25$  ), 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  $35^\circ \text{C}$ . 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  $\alpha = 18 \times 10^{-6} \text{ per } ^\circ\text{C}$ .

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