

GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER-I • EXAMINATION – WINTER • 2014

Subject Code: X11102**Date: 23-12-2014****Subject Name: Elements of Mechanical and Structural Engineering****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) State and explain Zeroth law and First Law of thermodynamics. **07**
(b) Derive the equation of work required in single stage reciprocating air compressor without clearance. **07**

- Q.2** (a) Explain the classification of heat engine. **07**
(b) Explain the working of Four stroke Petrol engine with neat sketch. **07**

OR

- (b) Explain the working of Vapour Compression Refrigeration system with line sketch diagram. **07**

- Q.3** (a) Explain construction and working of window air conditioner with neat sketch. **07**
(b) A petrol engine having a compression ratio of 7 has a brake thermal efficiency which is 40 percent of ideal air standard efficiency. The calorific value of fuel used is 42,000 KJ/Kg. Calculate the fuel consumption in Kg/hr if the engine delivers 15 Kw. **07**

OR

- Q.3** (a) Derive an expression for the efficiency of Carnot cycle. Enlist limitation of Carnot cycle. **07**
(b) Describe the behavior of a mild steel specimen in a tensile test to destruction and Draw a graph of stress against strain measured during the test, marking on it the salient points. **07**

- Q.4** (a) Define Proof Resilience. A steel bar of uniform cross section is 80 cm long and has a cross sectional area of 4 cm². A load of 16 kN is gradually applied to a bar. Find the total strain energy, strain energy per unit volume and also the proof resilience of the bar, if the elastic limit stress of the material steel is 160 Mpa and modulus of elasticity of steel is 200 GPa. **07**
(b) 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**

OR

- Q.4** (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) Define the following properties of structural materials. **07**
i) Hardness ii) Toughness iii) Elasticity iv) Plasticity
v) Ductility vi) Rigidity vii) Resilience

- Q.5 (a)** Explain different types of stresses with neat sketch. Explain Hooke's Law. **07**
- (b)** A steel bar having 50 mm diameter and 4 m length hangs vertically, which is securely fixed at its lower end. If a weight of 35 kN falls on the collar from a height of 20 mm, determine stresses developed in the bar. Also calculate strain energy stored in the bar. Take $E = 200 \text{ Gpa}$. **07**

OR

- Q.5 (a)** Derive the relation between shear force, bending moment and uniformly distributed load. **07**
- (b)** For a simply supported beam as shown below, calculate support reactions and draw shear force and bending moment diagram. **07**


