

GUJARAT TECHNOLOGICAL UNIVERSITY**PDDC - SEMESTER-I • EXAMINATION – SUMMER 2013****Subject Code: X11102****Date: 11-06-2013****Subject Name: Elements of Mechanical and Structural Engineering****Time: 02.30 pm - 05.00 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) Explain Enthalpy and calculate the change in enthalpy of a system in which a gas enters at an initial pressure of 0.4 MPa and flow rate of $0.20 \text{ m}^3/\text{s}$ and leaves it at a pressure of 0.95 MPa and flow rate of $0.10 \text{ m}^3/\text{s}$. During the passage through the system, the increase in internal energy of 21 kJ/sec. **07**

- Q.2** (a) Explain the processes of an Otto Cycle and represent the same on P-V diagram. Derive equation for an air standard efficiency of an Otto Cycle. **07**
(b) The following results refer to a test on IC engine. **07**
Indicated power = 45 kW
Friction power = 7 kW
Engine Speed = 1500 rpm
Specific Fuel Consumption = 0.30 kg/kWh
Calorific Value of fuel = 44000 kJ/kg.
Calculate: Mechanical efficiency, Brake thermal efficiency and indicated thermal efficiency.

OR

- (b) Explain construction and working of single stage reciprocating air compressor with neat sketch. **07**

- Q.3** (a) Explain types of IC engine governing methods. **07**
(b) Explain construction and working of double acting reciprocating pump with neat sketch. **07**

OR

- Q.3** (a) Explain construction and working of window air conditioner with neat sketch. **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.4** (a) 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**
(b) Define Hooke's law and Young's modulus. Also calculate stress, strain and elongation of an M.S. bar of 40mm diameter is acted upon by a tensile force of 60 kN. If the length of bar is 1.2 m and modulus of elasticity is $2.0 \times 10^5 \text{ N/mm}^2$. **07**

OR

- Q.4 (a)** Explain Longitudinal and lateral strain and define Poisson's ratio, Bulk modulus and modulus of rigidity. **07**
- Q.4 (b)** Define Proof Resilience. A steel bar of uniform cross section is 80 cm long and has a cross sectional area of 4 cm^2 . 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**
- Q.5 (a)** A steel shaft of 5 cm diameter and 50 cm length is twisted in a testing machine until one end rotates through an angle 0.5° with respect to other end. Torque of 15000 N.m is required to cause the twist. What is the maximum shear stress of the shaft and what is the value of modulus of rigidity? **07**
- (b)** Explain different types of beams and supports with neat symbolic sketch, showing all possible reactions for general loading condition. **07**

OR

- Q.5 (a)** Derive the relation between shear force, bending moment and uniformly distributed load. **07**
- (b)** Draw Shear force and Bending moment diagram for a beam loaded as shown in figure. **07**


