

GUJARAT TECHNOLOGICAL UNIVERSITY**B. E. - SEMESTER – III • EXAMINATION – WINTER 2012****Subject code: 130103****Date: 03-01-2013****Subject Name: Analysis of Mechanisms & Machine elements****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) Find the degree of freedom for the mechanisms as shown in the figure 1 using Grubler's criteria. **07**
- (b) Define: (i) Poisson's ratio (ii) Impact stress (iii) Factor of safety (iv) Resilience (v) Volumetric strain (vi) Bulk modulus (vii) Principal stress. **07**

- Q.2** (a) The crank OA and connecting rod AB of a reciprocating engine are 200 mm and 700 mm respectively. The crank is rotating in clockwise direction at 120 rad/s. Find following with the help of relative velocity method. **07**
- (i) Velocity and acceleration of the piston.
- (ii) Velocity and the acceleration of the midpoint of the connecting rod.
- (iii) Angular velocity and angular acceleration of the connecting rod, at the instant when the crank is at 30° to I.D.C.
- (b) A cylindrical shaft made of steel of yield strength 700 MPa is subjected to static loads consisting of bending moment 10 kN-m and a torsional moment 30 kN-m. Assume a factor of safety of 2. Take $E = 210\text{GPa}$ and Poisson's ratio = 0.25. Determine the diameter of the shaft using following theories of failure (i) Maximum Shear stress theory (ii) Maximum Principal stress theory. **07**

OR

- (b) The lengths of crank and connecting rod of a vertical reciprocating engine are 300 mm and 1.5 m respectively. The crank is rotating at 200 rpm clockwise as shown in figure 2. Find analytically, (i) acceleration of piston (ii) velocity of piston and (iii) angular acceleration of the connecting rod when the crank has turned through 40° from the top dead centre and piston is moving downwards. **07**
- Q.3** (a) A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load $P = 15\text{ kN}$ as shown in figure 3. Find the size of weld required if shear stress in same is not to exceed 85 MPa. **07**
- (b) Explain different modes of failures of a riveted joint with neat sketches. **07**

OR

- Q.3** (a) A double riveted lap joint with zig-zag riveting is to be designed for 13 mm thick plates. Assume $\sigma_t = 80\text{ MPa}$, $\tau = 60\text{ MPa}$ and $\sigma_c = 120\text{ MPa}$. State how the joint will fail and find the efficiency of the joint. **07**
- (b) What are the assumptions to be made while designing riveted joints for a boiler? Give the designing procedure for a longitudinal butt riveted joint for a boiler. **07**

- Q.4** (a) The hydraulic press, having a working pressure of water as 16 N/mm^2 and exerting a force of 80 kN is required to press materials up to a maximum size of 800 mm x 800 mm, the stroke length is 80 mm. Design the ram which is made hollow from mild steel and cylinder from cast iron having allowable stress 75 N/mm^2 and 30 N/mm^2 respectively. **07**

- (b) Draw the stress distribution diagrams for thick cylindrical shell subjected to an internal pressure. Write down the different equations used for designing thick cylindrical shell. 07

OR

- Q.4 (a) A hollow steel shaft is to transmit 20 kW at 300 rpm. The loading is such that the maximum bending moment is 1000 N-m, the maximum torsional moment is 500 N-m and axial compressive load is 15 kN. The shaft is supported on rigid bearings 1.5 m apart. The maximum permissible shear stress on the shaft is 40 MPa. The inside diameter is 0.8 times the outside diameter. The load is cyclic in nature and applied with shocks. The values for the shock factors are $K_t = 1.5$ and $K_m = 1.6$. 07
- (b) Derive that a hollow shaft has greater strength and stiffness than solid shaft of equal weight. 07

- Q.5 (a) Define inversion of mechanism. List the inversion of double slider crank chain and explain with neat sketch construction and working of Elliptical Trammel. 07
- (b) Explain in detail: (i) D'Alembert's principle (ii) Principle of virtual work. 07

OR

- Q.5 (a) Differentiate between following. (i) Mechanism and Machine 07
(ii) Rigid body and Resistant body 07
- (b) What is the Significance of coriolis's component of acceleration? How will you decide the direction of coriolis's component of acceleration? 07

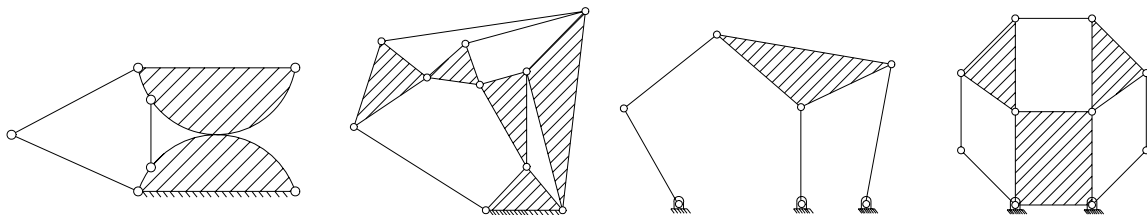


Figure -1

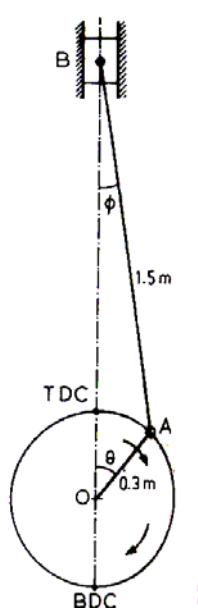


Figure - 2

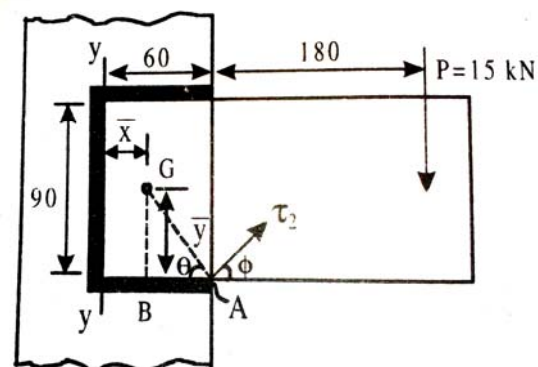


Figure - 3

(All dimensions are in mm.)
