

Seat No.: \_\_\_\_\_

Enrolment No. \_\_\_\_\_

## GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEM-V Examination-Nov/Dec.-2011

Subject code: 151902

Date: 24/11/2011

Subject Name: Theory of Machines

Time: 2.30 pm -5.00 pm

Total marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Illustrate your answer with neat sketches wherever required.

- Q.1 (a)** Prove the Freudenstein's equation for slider crank mechanism. **04**  
**(b)** Synthesize a function generator to generate a function  $y = \sin x$  in the region **10**

$0 \leq x \leq \frac{\pi}{2}$ , using Chebyshev spacing taking three precession points. Assume initial crank angle,  $\theta_i = 30^\circ$ , initial rocker angle,  $\phi_i = 60^\circ$ ,  $\Delta\theta = 60^\circ$  and  $\Delta\phi = 90^\circ$ . Take fixed link length 50 mm. Also draw the mechanism.

- Q.2 (a)** Using Bloch's method, synthesize and draw a four bar linkage to meet the following specifications of angular positions. Velocities and accelerations at one of its positions are **07**

$\omega_2 = 21 \text{ rad/sec}$ ,  $\omega_3 = -6 \text{ rad/sec}$ ,  $\omega_4 = 12 \text{ rad/sec}$ ,

$\alpha_2 = -280 \text{ rad/sec}^2$ ,  $\alpha_3 = 200 \text{ rad/sec}^2$  and  $\alpha_4 = 100 \text{ rad/sec}^2$ .

- (b)** Define (i) Hunting (ii) Sensitiveness (iii) Sleeve lift and (iv) Isochronisms for governor. **07**

**OR**

- (b)** A porter governor has all the four arms of 300 mm each. All the upper arms as well as the sleeve arms are pivoted on the axis of rotation. The mass of each governor ball is 1 kg. The mass of the sleeve is 20 kg. Find the speed of rotation, when the balls rotate at a radius of 150 mm. **07**

- Q.3 (a)** Derive an equation for gyro-couple with usual notations. **05**

- (b)** The turbine rotor of a ship has mass of 2000 kg and rotates at 25 rev./sec clockwise when viewed from the stern. The radius of gyration of rotor is 0.30 meter. Determine gyroscopic couple and its effect when **09**

- (i) The ship turns right at a radius of 250 m with a speed of 25 km/hr.
- (ii) The ship rolls at an angular velocity of 0.1 rad/sec.

**OR**

- Q.3 (a)** Explain dynamically equivalent two mass system. **05**

- (b)** A Hartnell governor having a central sleeve spring and two right angles bell crank levers operates between 290 rpm and 310 rpm for a sleeve lift of 15 mm. The sleeve arms and the ball arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from the governor axis and the mass of each ball is 2.5 kg. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine: (i) loads on the spring at the lowest and highest equilibrium speeds and (ii) stiffness of the spring. **09**

- Q.4 (a)** Distinguish between brakes and dynamometer. **07**  
**(b)** Describe the construction and operation of a rope brake absorption dynamometer. **07**
- OR** **[P.T.O.]**
- Q.4 (a)** Differentiate between Flywheel and Governor. **04**  
**(b)** A simple band brake is operated by a lever of length 500 mm. The brake drum has a diameter of 500 mm and the brake band embraces  $\frac{5}{8}$  of the circumference. One end of the band is attached to the fulcrum of the lever while the other end is attached to a pin on the lever 100 mm from the fulcrum. If the effort applied to the end of the lever is 2 kN and the coefficient of friction is 0.25, find the maximum braking torque on the drum. **10**
- Q.5 (a)** State and explain D'Alembert's principle. **07**  
**(b)** Draw and explain Klien's construction for determining the velocity and acceleration of the piston in a slider crank mechanism. **07**
- OR**
- Q.5 (a)** Define the flywheel and state its importance. What are the functions of a flywheel? **07**  
**(b)** In Internal combustion engine the crank radius is 400 mm and connecting rod is 950 mm long. The diameter of piston is 100 mm and net gas pressure acting on the piston is 15 MPa. Find: **07**
1. Thrust in connecting rod
  2. Piston side exhaust
  3. Torque acting on the crank shaft
  4. Radial load on main bearings when the crank has made 450 from TDC.
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