Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–IV EXAMINATION – WINTER 2015**

**Subject Code: 142001** **Date:30/12/2015**

**Subject Name: Kinematics and Dynamics of Machines**

**Time: 02:30pm to 05:00pm** **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 kinematic pair and with neat sketch classify kinematic pairs. **05**

**(b)** With suitable example explain inversions of four bar chain mechanism. **05**

**(c)** Define the terms: Mechanism, Machine, Degrees of freedom, Kinematics. **04**

**Q.2** **(a)** An engine mechanism is shown in Fig.1. The crank CB = 100 mm and the connecting rod BA = 300 mm with centre of gravity G, 100 mm from B. In the position shown, the crankshaft has a speed of 75 rad/s and an angular acceleration of 1200 rad/s$^2$. Find velocity of G and angular velocity of AB. **07**

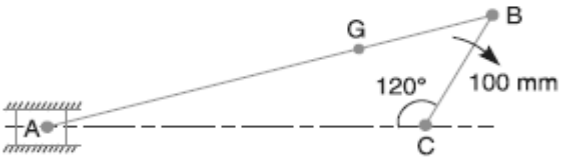


Fig.1

**(b)** For the above mentioned data in Q.2 (a) find acceleration of G and angular acceleration of AB. **07**

**OR**

**(b)** A mechanism, as shown in Fig.2 has the following dimensions: OA = 200 mm; AB = 1.5 m; BC = 600 mm; CD = 500 mm and BE = 400 mm. Locate all the instantaneous centres. If crank OA rotates uniformly at 120 r.p.m. clockwise, find **1.** the velocity of B, C and D, **2.** the angular velocity of the links AB, BC and CD. **07**

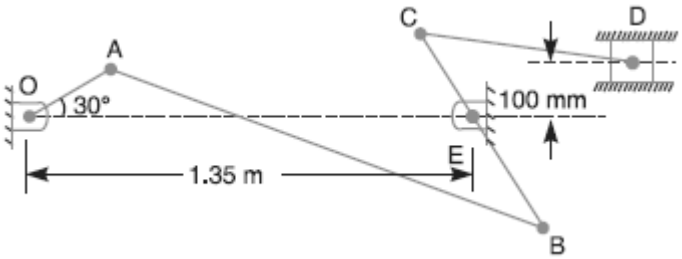


Fig.2

**Q.3** **(a)** Derive the expression for the exact and approximate lengths of belt in an open belt drive. **07**

**(b)** Two pulleys, one 450 mm diameter and the other 200 mm diameter are on parallel shafts 1.95 m apart and are connected by a crossed belt. Find the length of the belt required and the angle of contact between the belt and each pulley. What power can be transmitted by the belt when the larger pulley rotates at 200 rev/min, if the maximum permissible tension in the belt is 1 kN, and the coefficient of friction between the belt and pulley is 0.25 ? **07**

**OR**

**Q.3** **(a)** Derive the relation for ratio of friction tensions for flat belt and v-belt. **07**

**(b)** A ship propelled by a turbine rotor which has a mass of 5 tonnes and a speed of 2100 r.p.m. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions: **07**

**1.** The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.

**2.** The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.

**3.** The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern.

Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case.

**Q.4 (a)** State the law of gearing and derive law of gearing and velocity of sliding for gear drive. **07**

**(b)** A cam rotating clockwise at a uniform speed of 1000 r.p.m. is required to give a roller follower the motion defined below : **07**

**1.** Follower to move outwards through 50 mm during 120° of cam rotation,

**2.** Follower to dwell for next 60° of cam rotation,

**3.** Follower to return to its starting position during next 90° of cam rotation,

**4.** Follower to dwell for the rest of the cam rotation.

The minimum radius of the cam is 50 mm and the diameter of roller is 10 mm. The line of stroke of the follower is off-set by 20 mm from the axis of the cam shaft. If the displacement of the follower takes place with uniform and equal acceleration and retardation on both the outward and return strokes, draw profile of the cam.

**OR**

**Q.4 (a)** How are the cams classified? Describe in detail. **07**

**(b)** Two involute gears of 20° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module, find : **1.** The angle turned through by pinion when one pair of teeth is in mesh ; and **2.** The maximum velocity of sliding. **07**

**Q.5 (a)** Define terms: free vibrations, damped vibrations, forced vibrations, frequency, resonance. **07**

**(b)** A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. **07**

**OR**

**Q.5 (a)** Explain basic features of vibrating systems. **07**

**(b)** A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions. **07**

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