

The cam rotating clockwise at a uniform speed of 500 rpm. The maximum radius of the cam is 40 mm and the line of stroke of the follower is offset 15mm from the axis of the cam and the displacement of the follower is to take place with uniform and equal acceleration and retardation on both the outward and the return strokes. Determine the maximum velocity and acceleration of the follower during outward and return strokes.

5. a) Explain the Gyroscopic couple. **rgpvonline.com**  
 b) Explain the terms spin and precession.  
 c) Drive an expression for Gyroscopic torque in terms of angular velocity of spin, angular velocity of precession and polar mass moment of inertia of a disc.  
 d) An air craft consists of a propeller. It also consists of engine and propeller of mass moment of inertia  $150 \text{ kgm}^2$ . The engine rotates at 3600 rpm in a sense clockwise looking from rear. The air craft completes half circle of radius 100 m towards left when flying at 360 km/hr. Determine the gyroscopic couple on the air-craft.

OR

A four wheel car weighs 30kN. Each axle with its two wheels and gears has a total mass moment of inertia of  $35 \text{ kg-m}^2$ . Each wheel is 500mm radius. The centre distance between two wheels on an axle is 1.4m. Each axle is driven by a motor with a speed ratio of 1:3. Each motor along with its gear has a mass moment of inertia of  $15 \text{ kg-m}^2$  and rotates in the opposite direction to that axle. The centre of gravity of the car is located at 1m above the rails. Determine the limiting speed of the car while negotiating a curve of 200m radius without the wheels leaving the rails.

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## AU/IP/IEM/PR/ME-403

### B.E. IV Semester

Examination, December 2015

### Theory of Machines and Mechanisms

*Time : Three Hours*

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*Maximum Marks : 70*

- Note:* i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.  
 ii) All parts of each questions are to be attempted at one place.  
 iii) All questions carry equal marks, out of which part A and B (Max.50 words) carry 2 marks, part C (Max.100 words) carry 3 marks, part D (Max.400 words) carry 7 marks.  
 iv) Except numericals, Derivation, Design and Drawing etc.

1. a) Distinguish between mechanism and machine.  
 b) Write and explain Gruebler's and Kutzbach criterion.  
 c) How are the kinematic pairs classified? Explain with examples.  
 d) Determine the maximum permissible angle between the shaft axes of a universal joint if the driving shaft rotates at 800 rpm and the total fluctuation of speed does not exceed 60 rpm. Also find the maximum and minimum speeds of the driven shaft.

OR

The length of the fixed link of a crank and slotted-lever mechanism is 250 mm and that of the crank is 100mm. Determine the inclination of the slotted lever with the vertical in the extreme position. ratio of the time of

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cutting stroke to the time of return stroke, and the length of stroke, if the length of the slotted lever is 450 mm and the line of stroke passes through the extreme positions of the free end of the lever.

2. a) State and explain the Kennedy's Theorem.
- b) Explain the Rubbing velocity at a pin joint.
- c) What is a velocity image? State why it is known as a helpful device in the velocity analysis of complicated linkage.
- d) What do you mean by coriolis component of acceleration? When will it exist? Prove that this component of acceleration is equal to:  $2 \times V \times \omega$

Where:  $\omega$  - Angular velocity of the rotating link

$V$  - Linear velocity of the slider along the link

OR

A link AB of a four bar mechanism ABCD revolves uniformly at 120 rpm in a clockwise direction. Find the angular acceleration of links BC, CD and point E (lie in the link BC). Given: AB=7.5 cm, BC=17.5 cm, EC=5 cm, CD=15cm, DA=10 cm and  $\angle BAD = 90^\circ$

3. a) State the law of Gearing.
- b) What do you mean by pitch point, module, addendum and dedendum of a gear? **rgpvonline.com**
- c) Explain what is interference and how it is prevented.
- d) Two  $20^\circ$  involute spur gear mesh externally and give a velocity ratio of 3. The module is 3mm and the addendum is equal to 1.1 module. If the pinion rotates at 120 rpm, determine contact ratio and the minimum number of teeth on each wheel to avoid interference.

OR

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Two left-handed helical gears connect two shafts  $60^\circ$  apart. The normal module is 6 mm. The larger gear has 70 teeth and the velocity ratio is  $\frac{1}{2}$ . The center distance is 370 mm. Find the helix angles of the two gears.

4. a) List the different motions that a follower can have.
- b) Explain pitch circle, prime circle and base circle.
- c) Draw the displacement, velocity and acceleration diagrams for a follower when it moves with simple harmonic motion.
- d) Draw the profile of a cam operating a roller reciprocating follower and with the following data:
  - i) Minimum radius of cam is 25 mm
  - ii) Lift of follower is 30mm **rgpvonline.com**
  - iii) Roller diameter is 15mm.

The cam lifts the follower for  $120^\circ$  with simple harmonic motion followed by a dwell period of  $30^\circ$ . Then the followers lower down during  $150^\circ$  of the cam rotation with uniform acceleration and deceleration followed by a dwell period. If the cam rotates at a uniform speed of 150 rpm, determine the maximum velocity and acceleration of the follower during the descent period.

OR

Draw the profile of a cam operating a knife-edge follower from the following data:

- i) Follower to move outward through a distance of 20mm during  $120^\circ$  of cam rotation.
- ii) Follower to dwell for the next  $60^\circ$  of cam rotation.
- iii) Follower to return to its initial position during  $90^\circ$  of cam rotation.
- iv) Follower to dwell for the remaining  $90^\circ$  of cam rotation.