[4]

Prove that the maximum acceleration during outstroke of the follower, when it moves in simple harmonic motion is given by

$$f_{max} = \frac{S}{2} \times \left(\frac{\pi \times \omega}{\theta_o} \right)^2$$

where S = Stroke of the follower

θ_o = Angle turned by the cam during out stroke, and

ω = Angular velocity of the cam.

5. a) Explain the terms spin and precession.

   b) What do you mean by gyroscopic couple?

   c) Explain the gyroscopic effect on two wheel vehicles.

   d) A four wheeled trolley car has a total mass of 3000kg. Each axle with its two wheels and gears has a total moment of inertia of 32kg.m². Each wheel is of 450mm radius. The centre distance between two wheels on a 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 moment of inertia of 16 kg.m² and rotates in the opposite direction to that of the axle. The centre of mass of the car is 1m above the rails. Calculate the limiting speed of the car when it has to travel around a curve of 250m radius without the wheels leaving the rails.

OR

A small high speed ship is driven by a turbine, rotor of which has a moment of inertia of 20kg.m² and is running at 3000rpm in clockwise direction when viewed from the bow. The ship is speeding at 72km/hr taking a right turn round a curve of 600m radius. Determine the gyroscopic couple applied to the ship and its effects.

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Total No. of Questions :5]   [Total No. of Printed Pages : 4

Roll No ....

AU/IP/IEM/PR/ME-403
B.E. IV Semester
Examination, December 2016
Theory of Machines and Mechanisms

Time : Three Hours

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 question 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.

v) Assume suitable data or dimensions, if necessary, Use graph paper is permitted.

1. a) Explain the difference between mechanism and machine.

   b) What do you mean by 'Steering mechanisms'?

   c) What do you understand by degree of freedom? For a plane mechanism, derive an expression for Grubler's equation.

   d) Explain with the help of neat sketch any one mathematically correct straight line mechanism and prove the result.

OR

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

2. a) What is the instantaneous center of rotation?

   b) What do you mean by Coriolis component of acceleration?

   c) State and explain 'angular velocity ratio' theorem.

   d) In a slider crank mechanism, the crank is 480mm long and rotates at 40 rad/s in the counter-clockwise direction. The length of the connecting rod is 1.6m. When the crank turns 60° from the inner dead centre, determine the velocity of the slider, angular velocity of connecting rod and velocity of a point P located at a distance 450mm on the connecting rod extended.

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=7.5cm, BC=17.5cm, EC=5cm, CD=15cm, DA=10cm and ∠BAD = 90°.

3. a) Explain interference in gear.

   b) State the Law of Gearing.

   c) Define and explain the gear terminology with neat sketch.

   d) A pinion and gear wheel in mesh have 20 and 40 involute teeth respectively. If the pressure angle is 20° and tooth module is 10mm, discuss the state whether interference takes place.

OR

A 20 teeth pinion has circular pitch of 1.25cm. It is generated by rack cutter. The addenda for the pinion and rack are 3.4mm each. Determine the least pressure angle which may be used while generating the pinion to avoid under cutting. Determine contact ratio for such pinion and rack pair.

4. a) Explain Prime circle and pressure angle for cam.

   b) Classify the different types of followers.

   c) Explain with the help of neat sketch a reverted gear train and give its applications.

   d) An epicyclic gear train consists of an arm and two gears A and B having 60 and 80 teeth respectively. The arm rotates about the centre of gear A at a speed of 80 rpm clockwise. Determine the speed of the gear B if

   i) The gear A is fixed, and

   ii) The gear A revolves at 240 rpm clockwise instead of being fixed.

OR