Total No. of Questions : 5]

Roll No .....



# AU/IP/ME-403

## B.E. IV Semester

Examination, June 2013

## Theory of Machines & Mechanisms

*Time : Three Hours*

*Maximum Marks : 70/100*

*Note:* i) Attempt any five questions in selecting one question from each unit.

ii) All questions carry equal marks.

### Unit - I

1. a) State and explain Grashof's criterion? Distinguish between exact and approximate straight line motions. Sketch peaucellier straight line motion and prove that the tracing point describes a straight line path.

b) What do you meant by constrained motion? What are the different types of constrained motion? Explain each type with examples and neat sketches?

**OR**

a) What do you mean by inversion of a mechanism? Explain with sketches all the inversions of single slider crank mechanism? Where these inversions are used?

b) The driving shaft of a Hooke's joint runs at a uniform speed of 260 rpm and angle $\alpha$ between the shafts is 20°. The driven shaft has a attached mass of weight 55kg at a radius of gyration of 20cm. Find

i) If a steady torque of 25kg-m resists rotation of the driven shaft, find the torque required at the driving shaft where $\theta = 45°$.

PTO



ii) At what value of $\alpha$ will be total fluctuation of speed of the driven shaft be limited to 30rpm.

### Unit - II

2. a) Discuss the two different types of steering gear mechanism? What are their merits and demerits?

b) In a double Hooke's joint, the angle of the driving and driven shaft with the intermediate shaft is 18°. The driving shaft is rotating at 420 rpm. If the forks of the intermediate shaft lie in plane perpendicular to each other, find the maximum and minimum speed of the driven shaft.

**OR**

In a simple steam engine, the length of the crank and the connecting rod are 100mm and 400mm respectively. The weight of the connecting rod is 45kg and its centre of mass is 220mm from the cross head centre. The radius of gyration about the centre of mass is 120mm. If the engine speed is 300 rpm, determine for the position when the crank has turned 45° form the inner-dead centre.

i) The velocity and acceleration of the centre of mass of the connecting rod.

ii) The angular velocity and acceleration of the rod.

iii) The kinetic energy of the rod.

### Unit - III

3. Two 20° involutes spur gears have module 8mm. Gear ratio 2.5, speed of gear wheel 120rpm, number of teeth on gear wheel 80. The addendum is such that the path of approach and path of racers on each side are 40% of maximum possible length each. Determine the addendum for pinion and the wheel. Also determine the length of arc of contact. Does the interference occur?

**OR**

Two gear wheel mesh externally and give a velocity ratio of 3. The teeth are of involutes form of module 6. The standard

addendum of one module being used. If the pressure angle is 20° and pinion rotates at 90 rpm. Find

i) Number of teeth on each wheel so that interference is just avoided.

ii) The length of path of contact

iii) Contact ratio

iv) Maximum velocity of sliding between the meshing teeth.



**Unit - IV**

4. a) For a simple harmonic motion of the follower, prove that the maximum velocity and maximum acceleration during out stroke is given by

$$V_{max} = \frac{S}{2} \times \frac{\pi \times \omega}{\theta_2} \text{ and } f_{max} = \frac{S}{2} \times \left( \frac{\pi \times \omega}{\theta_0} \right)^2$$

Where, S = stroke of the follower

$\theta_0$ = Angle turned by cam during outstroke, and

$\omega$ = Angular velocity of the cam.

b) Fig.1 shows an epicyclic gear train in which gear a drives the internal gear Δ through compound gears B and C. The number of teeth on gear A is 20 and centre distance between the centre of gears A and B is 300mm. If the module of all gears is 10mm and gear C has 30 teeth, find the speed of gear D. The arm rotates at 600 rpm in counter clockwise direction and gear A is fixed.

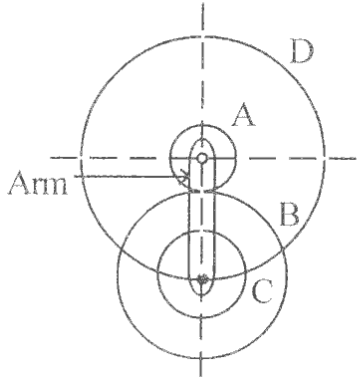


Fig. 1





**OR**

a) A symmetrical cam has a base circle 60mm radius, arc of action 110°, straight flanks and tip is a circular arc. The line of action of the follower passes through the centre line of the cam shaft. The follower which has 40mm diameter roller has a lift of 26mm. Calculate the velocity and acceleration of the follower when moving onward and contact is just reaching the end of the straight flank. The cam rotates at 500rpm.

b) What do you mean by reverted gear train? Explain with suitable sketch?

**Unit - V**

5. a) Explain the gyroscopic effect on four wheeled vehicles?

b) A ship has a propeller of mass moment of inertia 2000kgm². The propeller rotates at a speed of 360 rpm in clockwise sense looking from starter. Determine

i) Gyroscopic couple and its effect when ship moves at 30km/r and steers to the left at a radius of 200m

ii) Maximum gyroscopic couple and its effect when ship pitches and moving up having amplitude 10° and time period 20 seconds. The motion occurs with 5 HM.

**OR**

a) Explain the gyroscopic effect on two wheeled vehicles?

b) A four wheeled trolley car has total mass 2000kg. The car runs on rails of 1.4m gauge and rounds a curve of 30m radius at 36km/hr on a track of embankment slope of 10°. The external diameter of wheels is 0.6m and the each pair of angle has a mass of 200kg with radius of gyration of 250mm. The height of the centre of gravity of the car above the wheel base is 1m. Determine the pressure on each rail allowing for centrifugal force any gyroscopic couple action.