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

Roll No. .....

AU/IP/ME–403

B. E. (Fourth Semester) EXAMINATION, June, 2012

(Grading/Non-Grading)

(Common for AU, IP & ME Engg. Branch)

THEORY OF MACHINES AND MECHANISMS

Time : Three Hours

Maximum Marks : $\begin{cases} GS : 70 \\ NGS : 100 \end{cases}$

Note : Attempt all questions. All questions carry equal marks. Assume suitably data not given.

1. (a) What is kinematic pair ? Classify them using different methods of classification. Draw diagram to support your answer.

   (b) What is meant by inversion of a mechanism ? Describe with the help of suitable sketches the inversions of a slider crank chain.

   (c) Prove that Peaucellier mechanism traces an exact straight line. How is it different from Hart mechanism ?

   Or

   (a) Sketch a mini-drafter and find :

   (i) No. of links

   (ii) No. of kinematic pairs

   (iii) Degree of freedom

   (b) Explain different kinds of kinematic pair with the help of suitable sketches.

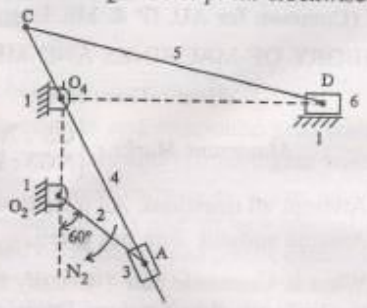
P. T. O.

(c) A Hooke's joint connects two shafts whose axes intersect at 25°. What will be the angle turned by the driving shaft when velocity ratio is :

(i) Maximum (ii) Minimum

(iii) Unity

2. A Whitworth quick-return motion mechanism is shown in Fig. Determine the velocity and acceleration of the slider D. $O_2A = 80$ mm, $O_4C = 60$ mm, $O_2O_4 = 40$ mm, CD = 200 mm and $N_2 = 30$ r. p. m. clockwise.



Or

The following data relate to a horizontal reciprocating engine :

Crank length = 90 mm; length of connecting rod = 450 mm and engine speed = 600 r. p. m.

Determine :

(i) Velocity and acceleration of piston.

(ii) Angular velocity and acceleration of the connecting rod when the crank has turned 30° from the inner dead centre.

3. (a) Distinguish between the laws of friction for dry surfaces and for film-lubricated surfaces. What conditions must be satisfied in order that film-lubrication may be obtained ?

(b) A cone clutch with a semi-cone angle α of 15°, transmits 12 kW at 500 r. p. m. The normal pressure between the surfaces of contact is not to exceed 100 kPa. The axial width of the friction surfaces is half the mean diameter. Assuming coefficient of friction as 0·25, determine :

(i) dimensions of the friction plate

(ii) axial force

(c) Sketch and describe one form of transmission dynamometer. State clearly what dimensions and measurements would have to be taken and explain how the power transmitted may be calculated.

Or

(a) Distinguish between a band brake and a 'band and block' brake. Compare the expressions for ratio of tensions on two sides.

(b) Derive necessary relations to determine the actuating force and braking capacity of an internally expanding shoe brake.

(c) What are the problems associated with the pivoted shoe of an externally contracting shoe brake ? How are these eliminated ? Derive necessary equation(s) to prove your point.

4. (a) Define the term 'pitch point'.

(b) Prove that pitch point must be a fixed point for two gear wheels to transmit power at a fixed ratio of angular velocities.

(c) A pair of spur wheels with 14 and 21 teeth are of involute profile and pressure angle of 14°. Find the maximum addenda on the pinion and gear wheel to avoid interference if the module is 6 mm. Also find the maximum velocity of sliding of teeth on either side of the pitch point if the pinion runs at 300 rev/min.

Or

(a) Derive the expression for the minimum number of teeth on pinion having involute teeth profile to avoid interference.

(b) The 20° involute gears in mesh have a gear ratio of 2. There are 20 teeth on the pinion. The module is 5 mm and the pitch line speed is 1·5 m/s. Assuming addendum to be equal to one module, find :

(i) angle turned through the pinion when one pair of teeth is in mesh.

(ii) maximum velocity of sliding

5. (a) Differentiate between the following :

(i) simple gear train and compound gear train.

(ii) reverted gear train and epicyclic gear train.

(b) An Epicyclic gear train consists of a sun wheel S, a stationary internal gear E and three identical planet wheels P carried on a star shaped planet carrier C. The size of different toothed wheels are such that the planet C rotates at 1/5th of the speed of the sun wheel S. The minimum number of teeth on any wheel is 16. The driving torque on the sun wheel is 100 Nm.

Determine :

(i) number of teeth on different wheels of the train.

(ii) torque necessary to keep the internal gear stationary.

Or

(a) Enumerate different types of cams and followers commonly used. State their relative merits and demerits.

(b) Derive expressions for displacements, velocity and acceleration of a follower during ascent and descent assuming that the follower moves with SHM. Illustrate your answer by suitable graphs showing displacement, velocity and acceleration versus cam angle.