(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2102 Roll No. | | | | | | | | | | |

**B.Tech.**

(SEM. V) ODD SEMESTER THEORY EXAMINATION 2013-14

**THEORY OF MACHINES—I**

*Time : 3 Hours* *Total Marks : 100*

**Note :—** (1) Answer **all** the questions.

(2) All questions carry equal marks.

(3) Assume suitable value for missing data if any.

1. Answer any **four** parts : **(5×4=20)**

(a) What is Kutzback's criterion for degree of freedom of plane mechanism ? In what way Grubler's criterion is different from it ?

(b) Fig. (1) shows four link mechanisms in which the figures indicate the dimensions in standard unit of length. Indicate the type of each mechanism whether crank rocker or double crank or double rocker.

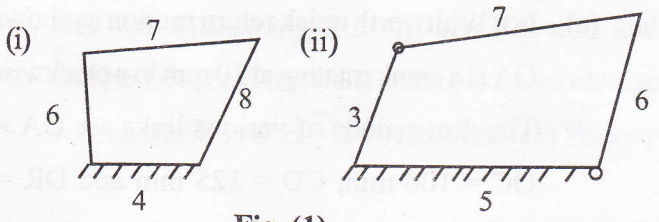


**Fig. (1)**

(c) Determine the degree of freedom for the following mechanisms in figure (2) and figure (3).

(i)

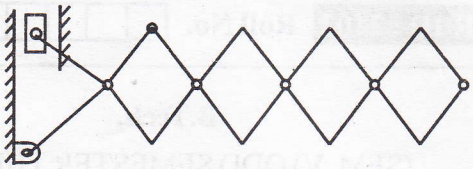

**Fig. (2)**

(ii)

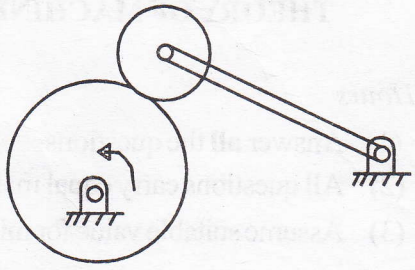

**Fig. (3)**

(d) What do you mean by inversion of a mechanism ? Show that the locus of the mid point of the link connecting the two sliders in an elliptical trammel is a circle.

(e) Describe the Klein's construction for velocity and acceleration of piston in a slider crank mechanism.

2. Answer any **one** part : **(20×1=20)**

(a) In a Whitworth quick return motion as shown in fig. (4) OA is a crank rotating at 30 rpm in a clockwise direction. The dimensions of various links are OA = 150 mm, OC = 100 mm, CD = 125 mm and DR = 500 mm.

Determine the acceleration of the sliding block 'R' and angular acceleration of the slotted lever CA.

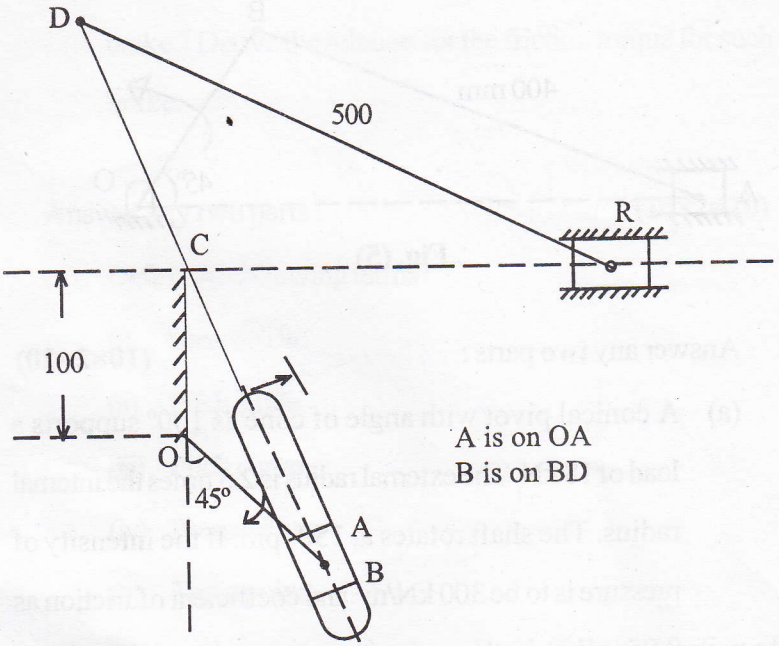


**Fig. (4)**

(b) (i) Give a neat sketch of the straight line motion 'Hart Mechanism'. Prove that it produces an exact straight line motion.

(ii) State and prove the Arnnold Kennedy theorem. Locate all the instantaneous centres of the slider crank mechanism as shown in fig. 5. The lengths of crank OB and connecting rod AB are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s find : (1) Velocity

of the slider 'A' and (2) Angular velocity of the connecting rod AB.

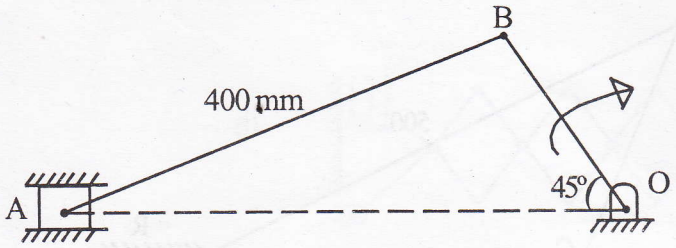


**Fig. (5)**

3. Answer any **two** parts : **(10×2=20)**

(a) A conical pivot with angle of cone as 100° supports a load of 18 kN. The external radius is 2.5 times the internal radius. The shaft rotates at 150 rpm. If the intensity of pressure is to be 300 kN/m$^2$ and coefficient of friction as 0.05, what is the power lost in working against the friction ?

(b) A belt drive is required to transmit 10 kW from a motor running at 600 rpm. The belt is 12 mm thick and has a mass density of 0.001 gm/mm$^3$. Safe stress in the belt is not to exceed 2.5 N/mm$^2$. Diameter of the driving pulley is 250 mm, whereas the speed of driven pulley is 220 rpm. The two shafts are 1.25 m apart. The coefficient of friction is 0.25. Determine the width of the belt.

(c) What is meant by a self-locking and a self-energised brake ? What is the advantage of self-expanding shoe brake ? Derive the relation for the friction torque for such brake.

4. Answer any **two** parts : **(10×2=20)**

(a) Define the following terms :

(i) Base circle

(ii) Pitch circle

(iii) Pitch curve

(iv) Pressure angle

(v) Trace point.

(b) Deduce expressions for the velocity and acceleration of the follower when it moves with simple harmonic motion.

(c) Draw the profile of the Cam when the roller follower moves with cycloidal motion during outstroke and return stroke as given below :

(i) Outstroke with maximum displacement of 31.4 mm during 180° of Cam rotation.

(ii) Return stroke for the next 150° of Cam rotation.

(iii) Dwell for the remaining 30° of Cam rotation.

The minimum radius of the Cam is 15 mm and the roller diameter of the follower is 10 mm. The axis of the roller follower is offset by 10 mm towards right from the axis of Cam shaft.

5. Answer any **two** parts : **(10×2=20)**

(a) A pair of involute spur gears with 16° pressure angle and pitch of module 6 mm in mesh. The number of teeth on pinion is 16 and its rotational speed is 240 rpm. When the gear ratio is 1.75 find in order that interference is just avoided :

(i) The addenda on pinion and gear wheel

(ii) The length of path of contact

(iii) The maximum velocity of sliding of teeth on either side of the pitch point.

(b) Derive an expression for minimum number of teeth required on a pinion to avoid interference when it gears with a rack.

(c) In a reverted epicyclic gear train, the arm 'A' carries two gears B and C and a compound gear D-E. The gear B

meshes with gear E and gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed and the arm 'A' makes 100 rpm clockwise.

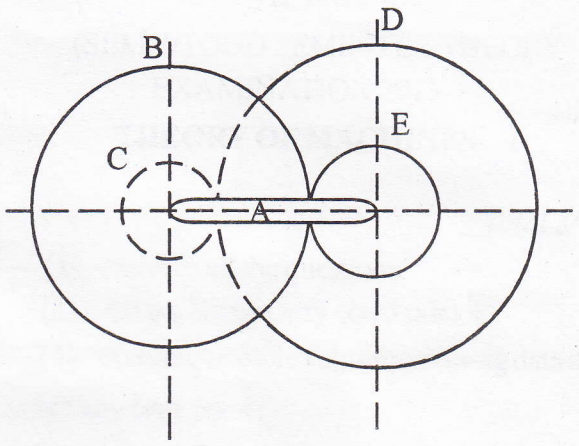


**Fig. (6)**