Question Paper

Exam Date & Time: 24-Apr-2019 (02:00 PM - 05:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
IV SEMESTER B.Sc.(APPLIED SCIENCES) IN ENGINEERING END SEMESTER EXAMINATION-APRIL/MAY 2019
Theory of Machines [IME 241]

Marks: 100 **Duration: 180 mins.**

Answer ANY FIVE FULL questions.
Any missing data if any, may be suitably assumed.

1) What is a kinematic link? With help of neat sketches explain flexible link and fluid link. (4)

A)

B) Find the total number of degrees of freedom for the given mechanisms shown in Figure 1a and Figure 1b. (6)

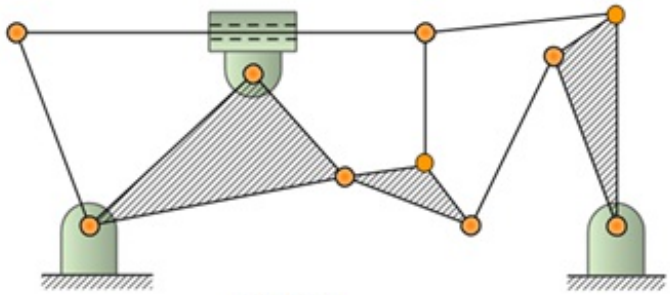

Figure 1a

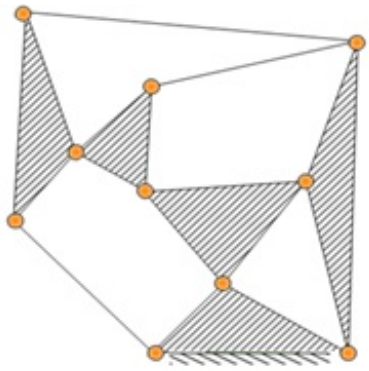

Figure 1b

C) With help of neat sketch discuss (i) Oscillating cylinder engine mechanism (ii) Scotch yoke mechanism. (10)

2) Locate all instantaneous centers for the mechanisms shown in Figure 2a, Figure 2b and Figure 2c. (10)

A)

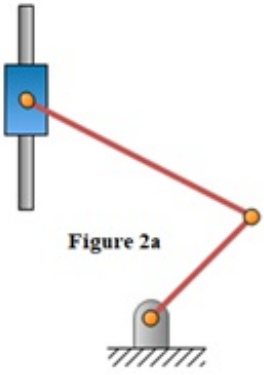

Figure 2a

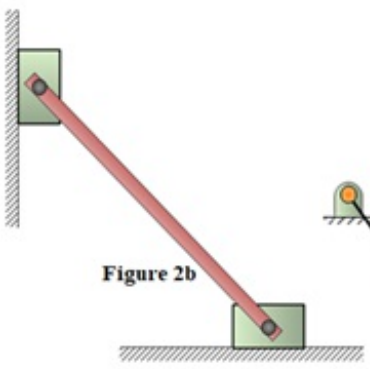

Figure 2b

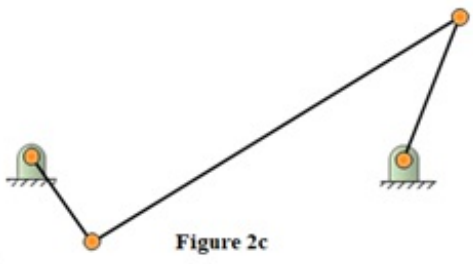

Figure 2c

B) Figure 2d shows a quick return motion mechanism. Crank AP is 5 cm (10)

long.The lever CD is 16 cm mm long and the distance between the fixed centres PC is 12 cm. Crank rotates at a uniform angular velocity of 40 rad/s. At the position shown, determine the sliding velocity of the block on link CD and the angular velocity of link CD using the method of relative velocity.

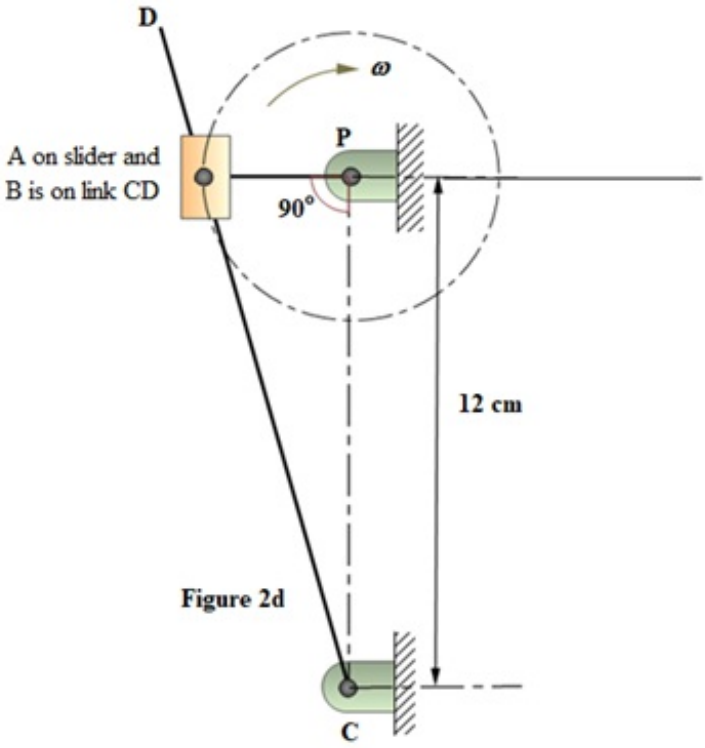

Figure 2d

3) What is Coriolis acceleration component? Write a brief note on the magnitude and the direction of Coriolis acceleration. (5)

A)

B) A slider crank mechanism is undergoing the motion as shown in the figure 3a. The angular velocity of link AB is 5.3 rad/s in clockwise. Find the magnitude and the direction of the centripetal acceleration of link BC (acceleration of point B with respect to C). (5)

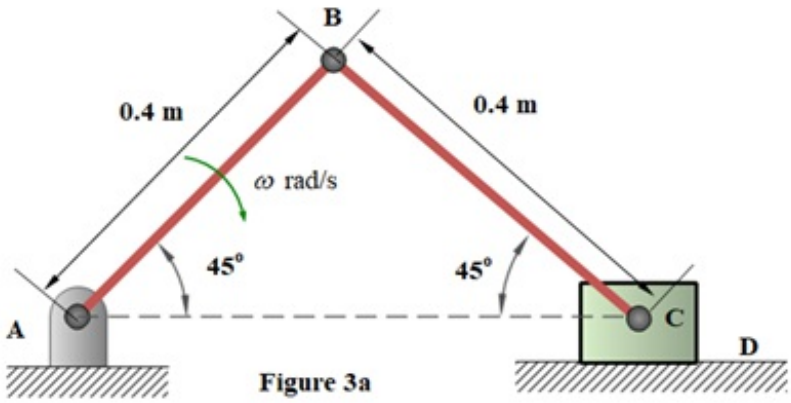

Figure 3a

C) Figure 3b shows the configuration diagram of four-bar linkage. The link AB has an instantaneous angular velocity of ω rad/s and angular acceleration α m/s^2 in the counter clockwise direction. For this given configuration draw the acceleration diagram. Also find the magnitude and the direction of the (10)

angular acceleration of link BC and CD.

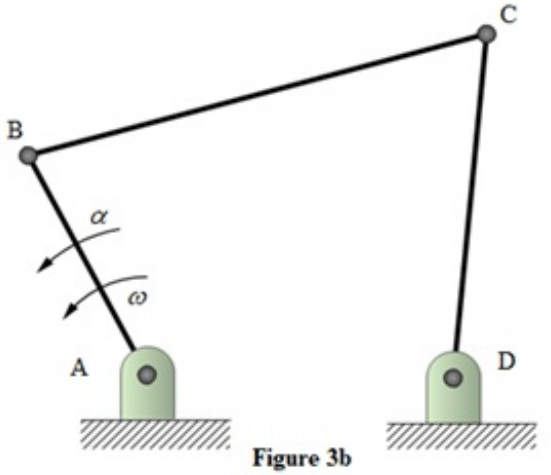

Figure 3b

4) Draw the profile of cam for a knife edged follower with the following data. (15)

A) (i) Cam lift =40 mm during 90^o of cam rotation with simple harmonic motion
(ii) Dwell for the next 30^o
(iii) During next 60^o of cam rotation, the follower returns to its original position with simple harmonic motion
(iv) Dwell during remaining 180^o.
The radius of the base circle is 40 mm,

B) Derive the expression for the minimum number of teeth on the pinion to avoid the interference with the rack. (5)

5) Derive the expression for the arc of contact and the contact ratio for the pair of involute teeth gears in mesh. (8)

A)

B) Two gear wheels mesh externally, and give a velocity ratio of 3:1. The teeth are of involute form, module= 6 mm, addendum=1 module, pressure angle 20^o. The pinion rotates 250 rpm. Determine (12)
i) Number of teeth on the gear wheel to avoid interference on it and the corresponding number teeth on the pinion.
ii) Length of path and arc of contact.
iii) Number of pairs of teeth in contact.
iv) Maximum velocity of sliding.

6) With the help of neat sketches discuss the type of gear trains. (8)

A)

B) As shown in Figure 6, the internal gear B has 92 teeth. The wheels C and D have (12)
25 and 15 teeth respectively. The wheel E has 52 teeth. The arm A is the input which rotates at 260 rpm and transmits 0.4 kW power. Calculate
(i) Speed of gear wheel E
(ii) The resisting torque on output wheel E
(iii) The holding torque on B

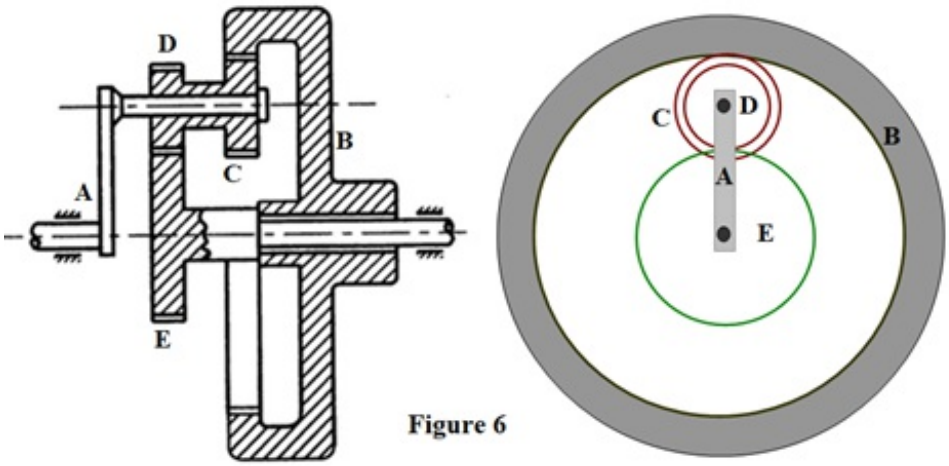

Figure 6

7) Discuss the different cases of dynamic balancing of a single rotating mass using two masses rotating in different planes. (8)

A)

B) A shaft carries four masses in parallel planes A, B, C, and D in this order, along it. The masses at B and C are 18 Kg and 12.5 Kg respectively, and each has an eccentricity of 6 cm. The masses at A and D have an eccentricity of 8 cm. The angle between the masses at B and C is 100^o, and that between masses at B and A is 190^o (both angles being measured in same direction). The axial distance between the planes A and B is 10 cm and that between B, and C is 20 cm. If the shaft is in complete dynamic balance, determine (12)
(i) The masses at A and D
(ii) The distance between the planes C and D
(iii) The angular position of mass at D

8) Derive an expression to find the centrifugal tension in belt drive and briefly discuss its effect on the power transmission. (7)

A)

B) An open belt drive connects two parallel shafts 1.2 m apart. The driving and driven shafts rotate at 375 rpm and 150 rpm respectively. The diameter of the driven pulley is 45 cm. The belt is 5 mm thick and 8 cm wide. The coefficient of friction between the belt and pulley is 0.3 mm, and the maximum tension in the belting is 137 N/cm^2. Determine, (7)
(i) The diameter of the driving pulley
(ii) The maximum power that may be transmitted by the belting (neglect centrifugal tension)

C) A circular disc attached to the shaft carries three attached masses 4 kg, 3 kg and 2.5 kg at distances 75 cm, 85 cm and 50 mm and at angular positions 45^o, 135^o and 240^o respectively. The angular positions are measured counter clockwise from the reference line along x axis. Determine the amount of counter mass required at a radial distance of 75 mm to achieve static balance. (6)

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