Total No. of Questions—12] [Total No. of Printed Pages—8

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S.E. (Prod./Prod. S-W) (II Sem.) EXAMINATION, 2010

THEORY OF MACHINES

(2003 COURSE)

Time : Four Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer any *three* questions from Section.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of electronic pocket calculator is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) List inversion of single slider crank chain. Explain any *two* with neat sketches. [6]

(*b*) Explain Grubler criterion for determining degree of freedom of mechanism. [6]

(*c*) Differentiate between spatial and planer mechanism. [4]

Or

2. (*a*) Define kinematic link. Can spring, belt, liquid be treated as link ? Justify your answer. [6]

(*b*) State and explain Grashoff's criterion as applied to 4 bar chain. How is it useful in studying the inversion of 4-bar chain ? [6]

P.T.O.

(c) Define the following terms :

(i) Mechanism

(ii) Lower pair

(iii) Completely constrained motion

(iv) DOF of mechanism. [4]

3. (a) In the mechanism shown in Fig. 1, OA = 300 mm, AB = 600 mm AC = 1200 mm, BD = 1200 mm. OD is horizontal at the instant shown and OA rotates at 200 r.p.m. clockwise direction. Find : [12]

(i) Velocities of C and D

(ii) Acceleration of C

(iii) Angular velocities of link AC and BD.

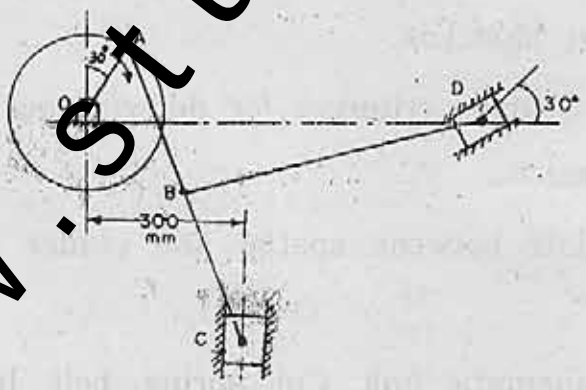

Fig. 1

(b) State and prove Kennedy theorem of 3 centres in line. [4]

Or

4. (*a*) In an IC engine mechanism, the stroke length is 40 cm and obliquity ratio is 4. The angular acceleration of connecting rod is found to be 54 rod/s^2 when the crank makes an angle of 45° with IDC while rotating at a uniform angular speed. Determine :

(*i*) The crank speed in RPM

(*ii*) Acceleration of piston

(*iii*) Velocity and acceleration of mid-point of connecting rod. Use Klein's construction method. [8]

(*b*) A small connecting rod 220 mm long between centres has a mass of 2 kg and mass moment of inertia of 0.02 kg-m^2 about its C.G. The C.G. is located at a distance of 150 mm from small end centre. Determine dynamically equivalent two mass system when one mass is located at small end centre.

If the connecting rod is replaced by two masses located at two centres, find the correction couple that must be applied for complete dynamical equivalence of the system when the angular acceleration of connecting rod is 20000 rad/sec^2 anticlockwise. [8]

5. (*a*) Explain interference in involute gears with suitable sketch. [4]

(*b*) Explain compound gear train and hence deduce the velocity ratio for each gear pair. [4]

(*c*) Two mating gears have 20 and 40 involute teeth of 10 mm module and 20° pressure angle. The addendum on each wheel is to be made of such a length that the line of contact on each side of pitch point has half the max. possible length. Determine addendum for each gear wheel and length of line of contact. If smaller wheel rotates at 250 r.p.m., find the sliding velocity at the start and end of engagement. [10]

Or

6. (*a*) Prove that the velocity of sliding is proportional to the distance of point of contact form pitch point. [6]

(*b*) In an epicyclic gear train as shown in Fig. 2 the internal wheels A & F and compound wheel C-D rotate about the axis O. The wheel B & E rotate on pins fixed to arm L. The wheels have same pitch and the no. of teeth are B and E 18, C 28, and D 26. If the arm L makes 150 r.p.m. clockwise find speed of F when :

(*i*) The wheel A is fixed and

(*ii*) The wheel A makes 15 r.p.m. counterclockwise. [12]

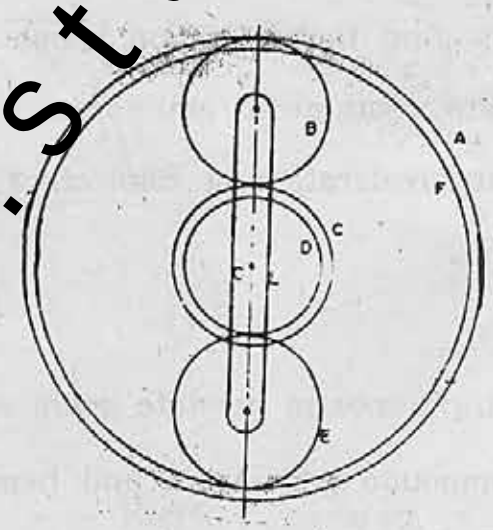

Fig. 2

SECTION II

7. (*a*) Define the following terms as applied to cam with neat sketches : [6]

(*i*) Pitch circle

(*ii*) Pitch curve

(*iii*) Base circle.

(*b*) Draw the profile of a cam with oscillating roller follower for the following motion : [10]

(*i*) Follower to move outward through an angular displacement of 20° during 120° of cam rotation with SHM.

(*ii*) Follower to dwell for 50° of cam rotation.

(*iii*) Follower to return to its initial position in 90° of cam rotation with uniform acceleration and retardation.

(*iv*) Follower to dwell for the remaining period of cam rotation.

The distance between the pivot centre and roller centre is 130 mm and the distance between the pivot centre and cam axis is 150 mm. The minimum radius of cam is 80 mm and roller diameter is 50 mm. Assume cam rotates clockwise direction.

Or

8. (*a*) Explain the following with neat sketches : [4]

(*i*) Positive cam

(*ii*) Tangent cam.

(*b*) Explain why constant velocity of cam is not practicable at high speed unless it is modified. How is it modified ? [4]

(c) A cam rotating clockwise with uniform speed is to give the roller follower of 20 mm diameter with the following motion :

(*i*) Follower more outward through distances of 30 mm during 120° of cam rotation

(*ii*) Follower to dwell for 60° of cam rotation

(*iii*) Follower to return to its initial position during 90° of cam rotation and

(*iv*) Follower to dwell for the remaining 90° of cam rotation.

Minimum cam radius is 45 mm. Line of stroke of the follower is offset 15 mm from cam axis. Outstroke and return stroke of follower with SHM. Draw cam profile. [8]

9. (*a*) Write a short note on direct and rivers crank method. [6]

(*b*) Four masses A, B, C, D as shown below are to be completely balanced :

	Mass (kg)	**Radius** (mm)
A	–	180
B	30	240
C	50	120
D	40	150

The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90°. B and C makes angles of 210° and 120° respectively with D in same sense. Find :

(1) Magnitude and angular position of mass A

(2) Position of planes A and D. [10]

Or

10. (*a*) Explain in brief partial primary balancing of reciprocating masses in engine. [6]

(*b*) The three cranks of a three cylinder locomotive are all on the same axle and are set at 120°. The pitch of the cylinders is 1 meter and stroke of each piston is 0.6 m. The reciprocating masses are 300 kg for inside cylinders and 260 kg for each outside cylinder and the planes of rotation of the balance masses are 0.8 m from the inside crank.

If 40% of the reciprocating parts are to be balanced, find :

(*i*) Magnitude and position of balancing masses required at a radius of 0.6 m.

(*ii*) The hammer blow per wheel when the axle makes 360 r.p.m. [10]

11. (*a*) What are the causes and effects of vibration ? [5]

(*b*) Define the following terms :

(*i*) Undamped free vibration

(*ii*) Longitudinal vibration

(*iii*) Amplitude of vibration

(*iv*) Resonance

(*v*) Damping ratio. [5]

(c) Determine the natural frequency of vibration for the system shown in Fig. 3 below. [8]

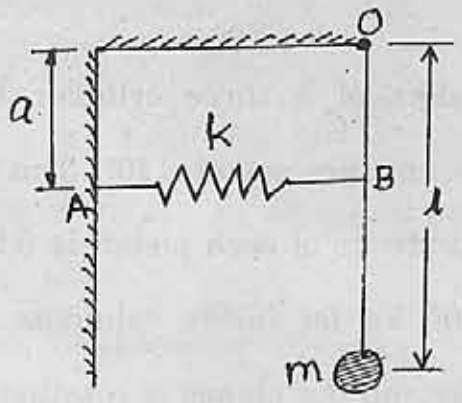

Fig. 3

Or

12. (a) Explain significance of vibration isolation. What are vibration isolation materials ? [5]

(b) Explain the terms underdamping, critical damping and over-damping. [5]

(c) Derive an expression for logarithmic decrement in terms of damping ratio. [8]