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Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019

Theory of Machines

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

- 1 a. Define the following: (i) Inversion (ii) Higher pair (iii) Lower pair (iv) Mobility. (04 Marks)
 b. Determine the mobility of the mechanism given below. (06 Marks)

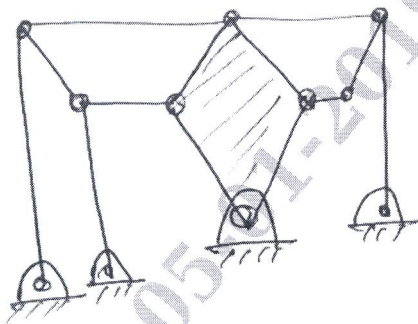


Fig. Q1 (b) – (i)

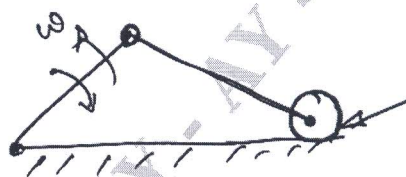


Fig. Q1 (b) – (ii)

- c. With neat sketch explain the following mechanism: (i) Coupled wheel of a locomotive (double crank mechanism). (ii) Bean engine (Crank and lever mechanism) (06 Marks)

OR

- 2 a. State and explain Aronhold Kennedy or three centers inline theorem. (02 Marks)
 b. Locate the instantaneous centers in the following mechanisms:
 (i) Four bar mechanism (ii) Slider crank mechanism. (06 Marks)
 c. PQRS is four bar chain with link PS fixed. The length of the links are $PQ = 62.5$ mm, $QR = 175$ mm, $RS = 112.5$ mm and $PS = 200$ mm. The crank 'PQ' rotates at 10 rad/sec clockwise. Draw the velocity diagram when angle $QPS = 60^\circ$ and Q and R lie on the same side of PS. Find the angular velocity of the link QR and RS. (08 Marks)

Module-2

- 3 a. State law of gearing. (02 Marks)
 b. Derive an expression for LPC, LAC and CR for a pair of involutes gears in mesh. (08 Marks)
 c. Two mating gears with module 6 mm have 20 and 50 teeth of pressure angle 20° and addendum 6 mm. Determine (i) LPC (ii) LAC (iii) C.R. (06 Marks)

OR

- 4 a. An epicyclic gear train is composed of fixed annular wheel A having 150 teeth meshing with A is wheel B, which drives wheel D through an Idler wheel C. D being concentric with A, wheel B and C are carried on an arm which rotates clockwise at 100 rpm about the axis of A and D. If the wheel B and D have 25 and 40 teeth respectively, find the number of teeth on C and the speed and sense of rotation of C.
 Refer Fig. Q4 (a)

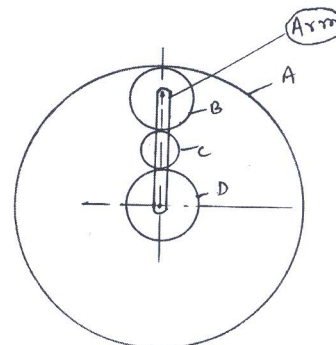


Fig. Q4 (a)

- b. Explain the following gear trains: (i) Simple gear train. (12 Marks)
 (ii) Compound gear train. (04 Marks)

Module-3

- 5 A cam rotates a uniform speed of 300 rpm clockwise and gives an oscillating follower 75 mm long, an angular displacement of 30° in each stroke. The follower is fitted with a roller of 20 mm dia which makes contact with the cam. The outward and inward displacements of the follower each occupying 120° cam rotation and there is no dwell in the lifted position. The follower moves throughout with SHM. The axis of fulcrum is 80 mm from the axis of cam and the least distance of roller axis from cam is 40 mm. (16 Marks)

OR

- 6 Draw the CAM profile for cam with roller reciprocating follower. The axis of the follower passes through the axis of cam. Particulars of the cam and follower are the following: Roller dia = 20 mm, Minimum radius of cam 25 mm, Total lift = 30 mm. The cam has to lift the follower with SHM during 180° of cam rotations, then allow the follower to drop suddenly halfway and further return with uniform velocity during the remaining 180° of cam rotation. The cam rotates in clockwise direction. (16 Marks)

Module-4

- 7 a. Explain balancing of single revolving mass in two different planes for both the masses are on the same side. (06 Marks)
 b. Five masses M_1, M_2, M_3 revolve in the same plane, magnitudes of M_1, M_2, M_3 are 5, 2.5 and 4 kg respectively. Angular positions of M_2, M_3, M_4 and M_5 are $60^\circ, 135^\circ, 210^\circ$ and 270° from M_1 . Determine the masses M_4 and M_5 . (10 Marks)

OR

- 8 a. Prove that $T = 3T_C$ and $V = \sqrt{\frac{T}{3}} m$ for maximum power condition in flat belt drive. (06 Marks)
 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 1000 kg/m^3 . Safe stress in the belt is not to exceed 2.5 N/mm^2 . Diameter of the driving pulley 250 mm where as the speed of the driven pulley 220 rpm. Two shafts are 1.25 m apart. The Co-efficient of friction is 0.25. Determine the width of the belt. (10 Marks)

Module-5

- 9 a. Each road wheel of a motor cycle has a moment of inertia of 2 kg-m^2 . The rotating parts of the engine of the motor cycle has a moment of inertia of 0.2 kg-m^2 . The speed of the engine is 5 times the speed of the wheel and is in the same sense. The mass of the motor cycle with rider is 200 kg and its CG is 500 mm above ground level. The dia of the wheel is 500 mm. The motor cycle is travelling at 15 m/sec on a curve of 30 m radius. Determine
 (i) Gyroscopic couple and its effect.
 (ii) Centrifugal couple and its effect.
 (iii) Angle of heel. (12 Marks)
 b. Derive an expression for the gyroscopic couple for plane disc. (04 Marks)

OR

- 10 a. Define the following:
 (i) Controlling force of governor (ii) Governor effort
 (iii) Governor power. (iv) Isochronous governor. (04 Marks)
 b. A porter governor has all four arms 300 mm long, the upper arms are pivoted on the axis of rotation and lower arms are attached to the sleeve at a distance 35 mm from axis. The mass of each ball is 7 kg and the load on the sleeve is 540 N. Determine the equilibrium speed for the two extreme radii 200 mm and 260 mm of rotation of governor ball. (12 Marks)
