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Question Paper Code : 50875

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Third/Fourth Semester

Mechanical Engineering

ME 8492 — KINEMATICS OF MACHINERY

(Common to Mechanical Engineering (Sandwich)/Mechatronics Engineering)

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Write the Kutzbach criterion for a planar mechanism.
2. Determine the maximum transmission angle in a slider crank mechanism having a crank radius of 40 mm and connecting rod of length 70 mm.
3. Locate the instantaneous center of a thin disc rolling inside a curved rigid surface.
4. What is called as Coriolis component of acceleration?
5. State the importance of pressure angle of cam-follower mechanism.
6. Write different types of followers used in cam-follower mechanism.
7. State the law of gearing.
8. Compare the Involute and cycloidal gear tooth profiles in terms of pressure angle and ease of manufacture.
9. If the pitch of a screw thread is 2 mm and mean pitch circle diameter of the screw is 16 mm, determine the helix angle of the thread.
10. Reason out why the possibility of slip of flat belt on the smaller pulley is more.

PART B — (5 × 13 = 65 marks)

11. (a) With a neat sketch, explain the working of any two kinematic inversions of four-bar chain.

Or

- (b) With a neat sketch, explain the working of any two kinematic inversions of single-slider chain.
12. (a) In a four bar mechanism with link PS fixed as shown in Fig.Q12(a), the lengths of the links are PQ = 65 mm, QR = 120 mm, RS = 90 mm, and PS = 200 mm. The crank PQ rotates at a constant speed of 20 rad/s clockwise. Determine the relative velocity of 'R' with respect to 'Q' and relative acceleration of link QR and absolute acceleration of point 'R' in the link RS.

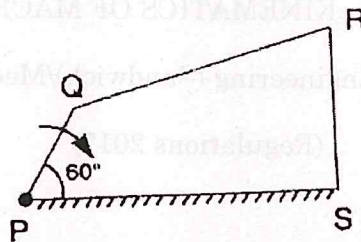


Figure – Q.12 (a)

Or

- (b) A slider crank mechanism has a crank of 30 mm length and connecting rod of 60 mm length. The angular velocity of crank is 10 rad/sec (clockwise). The angular acceleration of the crank is 1200 rad/sec². The crank makes an angle of 60° with the line of stroke from inner dead centre. Determine the acceleration of slider and angular acceleration of connecting rod.
13. (a) A knife-edged follower is operated by a uniformly rotating plate cam. The follower is raised to a distance of 30 mm with cycloidal motion in 120° rotation of the cam, remains at rest for the next 60° and lowered with uniform velocity during further 180° rotation of the cam. The least radius of the cam is 30 mm which rotates at 320 rpm. The follower is offset at 10 mm from the cam axis. Draw the cam profile and determine the maximum velocity and acceleration during rising and falling of the follower.

Or

- (b) The following data related to a plate cam profile with a radial roller follower. Minimum radius of cam = 30 mm; lift = 40 mm; radius of roller = 15 mm, angle of ascent with uniform velocity = 120°; dwell = 60°; angle of descent with uniform acceleration and retardation = 120°; dwell for remaining cam angle; speed of the cam = 180 rpm. Draw the cam profile and find the maximum velocity and acceleration during ascent and descent.

14. (a) Two spur gear wheels mesh externally and are to give a velocity ratio of 3. The teeth are of involute form; module = 6 mm, addendum = one module, pressure angle = 20° . The pinion rotates at 90 rpm. Find (i) number of teeth on pinion to avoid interference and the corresponding number of teeth on the wheel (ii) the length of path and arc of contact (iii) the contact ratio and (iv) maximum sliding velocity.

Or

- (b) In Fig.Q14(b), an internal wheel 'B' with 80 teeth is keyed to shaft 'F'. A fixed internal wheel 'C' with 82 teeth is concentric with 'B'. A compound wheel 'D-E' gears with the two internal wheels; 'D' has 28 teeth and gears with 'C' while 'E' gears with 'B'. The compound wheels revolve freely on a pin which projects from a disc keyed to a shaft 'A' co-axial with 'F'. If the wheels have the same pitch and the shaft 'A' makes 800 rpm, what is the speed of the shaft 'F'? Also, determine the speed of gear 'E'.

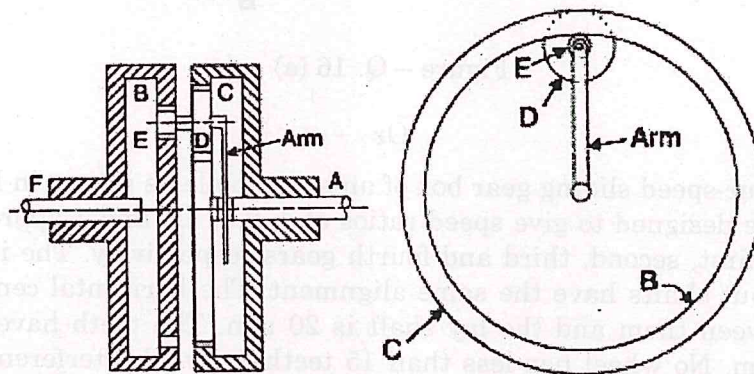


Figure Q. 14 (b)

15. (a) Two parallel shafts, whose center lines are 4.8 m apart, are connected by an open flat belt drive. The diameter of the larger pulley is 1.5 m and that of the smaller pulley is 1 m. The initial tension in the belt when stationary is 3 kN. The mass of the belt is 1.5 kg/m length. The co-efficient of friction between the belt and pulley is 0.3. Taking centrifugal tension into account, calculate the power transmitted, when the smaller pulley rotates at 400 rpm. Also determine the maximum power transmitted.

Or

- (b) The spindle of a screw jack has single start square threads with an outside diameter of 50 mm and a pitch of 10 mm. The spindle moves in a fixed nut. The load is carried on a swivel head but is not free to rotate. The bearing surface of the swivel head has a mean diameter of 60 mm. The coefficient of friction between the nut and the screw is 0.12 and that between the swivel head and the spindle is 0.10. calculate the load which can be raised by efforts of 125 N each applied at the end of two levers each of effective length 400 mm. Also, find the efficiency of the lifting system.

PART C — (1 × 15 = 15 marks)

16. (a) An application requires a sliding action at 'S' as shown in Fig.Q. 16 (a) in which 'O' and 'Q' are the fixed centers. Determine the velocity and acceleration of the slider S and the angular accelerations of the links 'BQ' and 'AS' for the given configuration. The dimensions are in 'mm'.

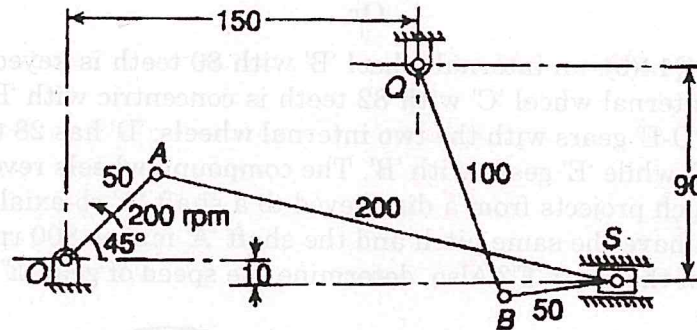


Figure – Q. 16 (a)

Or

- (b) A four-speed sliding gear box of an automobile as shown in Fig.Q16 (b) is to be designed to give speed ratios of 4, 2.5, 1.5 and 1 approximately for the first, second, third and fourth gears respectively. The input and the output shafts have the same alignment. The horizontal central distance between them and the lay shaft is 20 mm. The teeth have a module of 4 mm. No wheel has less than 15 teeth to avoid interference. Calculate the number of teeth on each wheel and find the actual speed ratios attained.

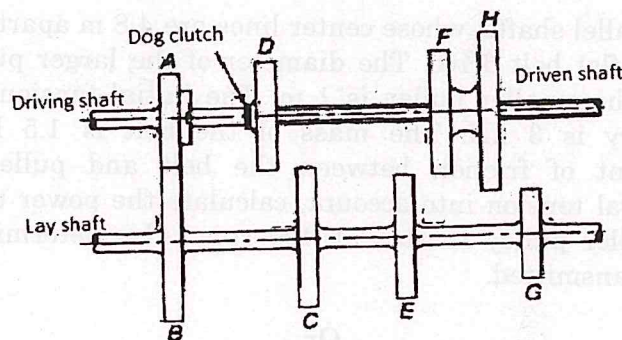


Figure – Q.16 (b)