KATHMANDU UNIVERSITY
End Semester Examination [C]
June/July 2024

Marks Scored:

Level : B.E.
Year : II
Course : MEEG 206
Semester : II

Exam Roll No. :
Time: 30 mins.
F. M. : 20

Registration No.:
Date : 05 JUL 2024

SECTION "A"
[20 Q. × 1 = 20 marks]

Choose and the mark [X] in the most appropriate option.

1. In a reciprocating steam engine, which of the following forms a kinematic link?
   [ ] Cylinder and piston
   [ ] Piston and connecting rod
   [ ] Crankshaft and flywheel
   [ ] Flywheel and engine frame

2. When the elements of the pair are kept in contact by the action of external forces, the pair is said to be
   [ ] Lower pair
   [ ] Higher pair
   [ ] Self closed pair
   [ ] Force closed pair

3. When a slider moves on a fixed link having curved surface, their instantaneous centre lies
   [ ] On their point of contact
   [ ] At the centre of curvature
   [ ] At the centre of circle
   [ ] At the joint

4. A mechanism has 7 links with all binary pairs having 2 higher pairs and 5 lower pairs. The number of instantaneous centre of rotation will be
   [ ] 14 [ ] 15 [ ] 21 [ ] 35

5. A point Q on a rigid link PQ moves with respect to P with angular velocity ω rad/sec. The total acceleration of Q with respect to P will be equal to
   [ ] Vector sum of radial component and coriolis component
   [ ] Vector sum of tangential component and coriolis component
   [ ] Vector sum of radial component and tangential component
   [ ] Vector difference of radial component and tangential component

6. In a cone pulley, if the sum of radii of the pulley on the driving and driven shafts is constant, then
   [ ] Open belt drive is recommended
   [ ] Cross belt drive is recommended
   [ ] Both open belt drive and cross belt drive are recommended
   [ ] The drive is recommended depending upon the torque transmitted.

7. The power transmitted by a belt is maximum when the maximum tension in the belt (T) is equal to
   [ ] T_C [ ] $2T_C$ [ ] $3T_C$ [ ] $1/3\ T_C$
   where, T_C = centrifugal tension

8. When a belt is stationary, it is subjected to some tension, known as initial tension. The value of this tension is equal to the
[ ] Tension in the tight side of the belt
[ ] Tension in the slack side of the belt
[ ] Sum of the tensions in the tight and slack side of the belt
[ ] Average tension of the tight side and slack side of the belt.

9. The radial distance of a tooth from the pitch circle to the bottom of the tooth, is called
[ ] Dedendum [ ] Addendum [ ] Total clearance [ ] Working depth

10. Interference can be avoided in involute gears with 20° pressure angle by
[ ] Cutting involutes correctly
[ ] Using as small number of teeth as possible
[ ] Using more than 20 teeth
[ ] Using more than 8 teeth.

11. For a speed ratio of 100, smallest gear box is obtained by using
[ ] A pair of spur gears
[ ] A pair of helical and a pair of spur gear compounded
[ ] A pair of bevel and a pair of worm gear compounded
[ ] A pair of helical and a pair of worm gear compounded.

12. For high speed engines, the cam follower should move with
[ ] Uniform velocity [ ] Simple harmonic motion
[ ] Uniform acceleration and retardation [ ] Cyloidal motion

13. The whirling speed of a rotating shaft depends on its
[ ] Mass and stiffness [ ] Mass, stiffness and eccentricity
[ ] Mass and eccentricity [ ] Stiffness and eccentricity

14. The pressure angle of a cam is the angle between the direction of the follower motion and a normal to the
[ ] Pitch circle [ ] Pitch curve [ ] Base circle [ ] Prime circle

15. In a system of revolving masses, complete dynamic balance can be achieved when
[ ] The combined mass center lies on the axis of rotation
[ ] All the masses lie on a single plane
[ ] Centrifugal forces for each mass equate to zero
[ ] The system's potential energy is minimized

16. The unbalanced force due to revolving masses
[ ] Varies in direction but constant in magnitude
[ ] Varies in magnitude but constant in direction
[ ] Varies in direction and magnitude both
[ ] Constant in direction and magnitude both

17. The number of degrees of freedom of an epicyclic gear train is
[ ] Zero [ ] One [ ] Two [ ] Three

18. A fixed gear having 200 teeth is in mesh with another gear having 50 teeth. The two gears are connected by an arm. The number of turns made by the smaller gear for one revolution of arm about the centre of bigger gear is
[ ] 2 [ ] 3 [ ] 4 [ ] 5

19. The velocity of sliding _____ the distance of the point of contact from the pitch point
[ ] is directly proportional to [ ] is inversely proportional to
[ ] is equal to cosϕ multiplied by [ ] does not depend upon

20. A sun gear with 20 teeth in a planetary gear train is surrounded by three identical planet gears. If the planet gears each have 40 teeth, how many teeth does the ring gear have?
[ ] 80 [ ] 100 [ ] 120 [ ] 140

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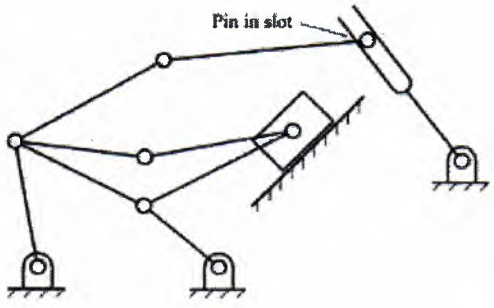
SECTION "B"

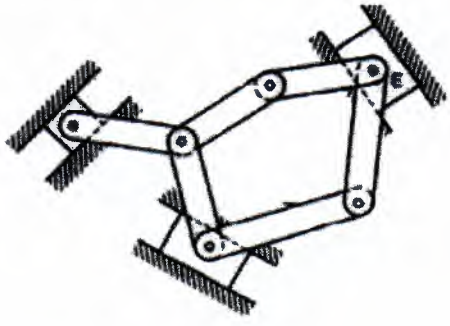
Attempt *ALL* questions. Assume any missing data with proper reason.

1.

a. Determine the degrees of freedom of the linkages shown in the figures below. [4]

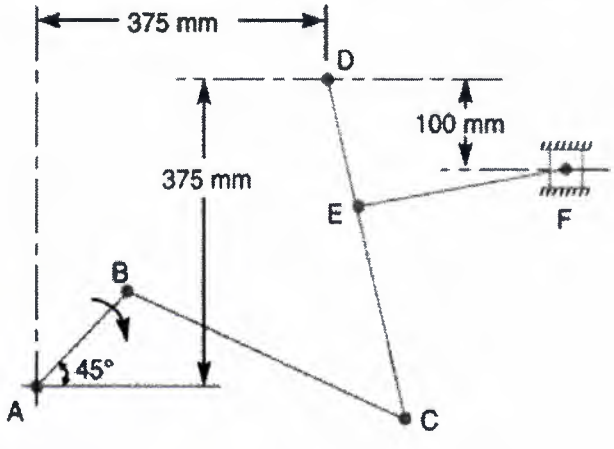


(i)



(ii)

b. The mechanism, as shown in the figure below has the dimensions of various links as follows: AB = DE = 150 mm; BC = CD = 450 mm; EF = 375 mm. The crank AB makes an angle of 45° with the horizontal and rotates about A in the clockwise direction at a uniform speed of 120 rpm. The lever DC oscillates about the fixed point D, which is connected to AB by the coupler BC. The block F moves in the horizontal guides, being driven by the link EF. Determine: 1) Velocity of the block F, 2) Angular velocity of DC, and 3) rubbing speed at the pin C which is 50 mm in diameter. [8]



c. What is Instantaneous centre method of determining velocity of a link in a mechanism? Explain the way of finding instantaneous centre in mechanism having 'n' number of links. [3]

P.T.O.

2. A cam rotating clockwise at a uniform speed of 1000 rpm is required to give a knife edge follower motion defined as follows:
   a. follower to move outward through 2.5 cm during 120° of cam rotation.
   b. follower to dwell for next 60° of cam rotation
   c. follower to return to its starting position during the next 90° of cam rotation
   d. follower to dwell for the rest of the cam rotation

   The minimum radius of the cam is 5 cm and the line of stroke of the follower is offset by 2 cm from the axis of the cam shaft. If the displacement of the follower takes place with simple harmonic motion during outward stroke and uniform motion during the return stroke, draw profile of the cam and find the maximum velocity and acceleration during outward stroke. [11]

3.
   a. State and proof the law of gearing for an involute profile gear in mesh having a pressure angle of 20°. [3]

   b. Two mating gear wheels 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 the pitch point has half the maximum possible length. Determine the addendum height for each wheel and the length of the line of contact. If the smaller wheel rotates at 250 rpm, find the velocity of point of contact along the surface of each tooth at the instant when the tip of a tooth on a smaller wheel is in contact. [6]

4. A shaft rotating at 200 rpm drives another shaft at 300 rpm and transmits 6 kW through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4 m. The smaller pulley is 0.5 m in diameter. Calculate the stress in the belt, if it is (a) an open belt drive, and (b) a cross belt drive. The coefficient of friction between the belt and pulley is 0.3. [6]

5. A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in two planes. The distance between the planes A and the first balancing plane is 100 mm, between the balancing planes is 400 mm and between the second balancing plane and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions. [7]

6. The figure below shows an epicyclic speed reduction gear train with the following details:
   Gear A has 40 teeth external which is a fixed gear; B is internal wheel meshes with gear C. Gear C-D is a compound wheel having 20 and 50 external teeth respectively. Gear E-F is another compound wheel having 20 and 40 external teeth respectively. Gear G has 90 external teeth which mesh with gear F.
   If the arm runs at 100 rpm in clockwise direction, determine the speeds of gears C, E and B. [7]