KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

Marks Scored:

Level : B.E.
Year : II

Course : MEEG 206
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : 02 JUL 2023

SECTION "A"
[20 Q. × 1 = 20 marks]

Mark [X] in the most appropriate option.

1. In a slider crank mechanism, the velocity of piston becomes maximum when
   [ ] the crank is at an angle of 120° with the line of stroke
   [ ] the crank is perpendicular to the line of stroke of the piston
   [ ] the crank and the connecting rod are mutually perpendicular
   [ ] the crank and the connecting rod are in line with each other

2. If the rotational speed of a crank of radius 50 cm is 100 rpm and the angular acceleration is 50 rad/s$^2$, then the tangential acceleration of the crank will be
   [ ] 2.5 m/s$^2$ [ ] 25 m/s$^2$ [ ] 0.25 m/s$^2$ [ ] 50 m/s$^2$

3. The mechanism has 7 links with all binary pairs except one which is ternary pair. The number of instantaneous centres of rotation will be
   [ ] 14 [ ] 42 [ ] 21 [ ] 13

4. A mechanism has 11 links with 1 binary joint, 4 ternary joints and 2 quaternary joints, the degree of freedom of the mechanism will be
   [ ] 1 [ ] 2 [ ] -1 [ ] 0

5. For the same lift of the follower and for same angle of action for ascent of the follower in the cams, smaller base circle diameter will give
   [ ] same pressure angle [ ] smaller pressure angle
   [ ] larger pressure angle [ ] depends upon other data

6. The centrifugal tension in the belts
   [ ] increases power transmission
   [ ] decreases power transmission
   [ ] increases the wrap angle
   [ ] increases the belt tension without increasing power transmission

7. For same pulley diameters, centre distance, belt speed and, belt and pulley materials,
   [ ] open belt drive transmits more power than crossed belt drive
   [ ] crossed belt drive transmits more power than open belt drive
   [ ] open and crossed belt drives transmit same power
   [ ] power transmission does not depend upon open and crossed types of constructions

8. Which of the following is **TRUE** for centrifugal force causing unbalance?
[ ] direction changes with rotation
[ ] magnitude changes with rotation
[ ] direction and magnitude both change with rotation
[ ] direction and magnitude both remain unchanged with rotation

9. An imaginary circle which by pure rolling action, gives the same motion as the actual gear, is called
[ ] addendum circle [ ] dedendum circle [ ] clearance circle [ ] pitch circle

10. An unbalanced couple of magnitude 300 N-m is noticed on a shaft of length 200 cm. The dynamic reactions at the bearings are
[ ] 300 N and 300 N [ ] 300 N and – 300 N
[ ] 150 N and 150 N [ ] 150 N and – 150 N

11. A mass of 9 kg is attached to a shaft at radius of 50 cm, the balance masses $B_1$ and $B_2$ are attached on the either side at 50 cm and 100 cm respectively at a radius 50 cm. the plane of rotation of three masses are parallel. If the shaft is rotating at 100 rpm, the balance mass $B_1$ is
[ ] 3 kg [ ] 6 kg [ ] 9 kg [ ] 12 kg

12. 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 cos$\phi$ multiplied by [ ] does not depend upon

13. Cylindrical Cams are also known as
[ ] Spiral Cam [ ] Conjugate Cam [ ] Drum Cam [ ] Special Cam

14. A cosine curve depicts simple harmonic motion of a cam follower
[ ] normal stress diagram [ ] acceleration diagram
[ ] displacement diagram [ ] velocity diagram

15. The pressure angle of cam is the angle between the direction of the follower motion and a normal to the
[ ] pitch circle [ ] base circle [ ] pitch curve [ ] prime circle

16. In a circular cam with roller follower, the acceleration in any position of the lift will depend only upon
[ ] total lift, total angle of lift, minimum radius of cam and cam speed
[ ] cam speed, radius of circular arc, diameter of roller and total lift
[ ] total lift, cam speed, radius of cam and radius of roller
[ ] total lift, cam speed and total angle of lift

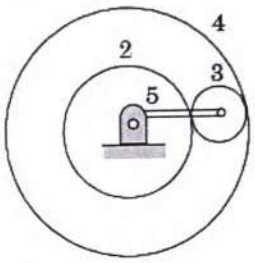
17. Which one of the following is used to convert a rotational motion into a translational motion?
[ ] bevel gears [ ] double helical gears
[ ] worm gears [ ] rack and pinion gears

18. Planar closed kinematic chain is formed with rigid links PQ = 2 m, QR = 3 m, RS = 2.5 m and SP = 2.7 m with all revolute joints. The link to be fixed to obtain a double crank mechanism is

[ ] PQ [ ] QR [ ] RS [ ] SP

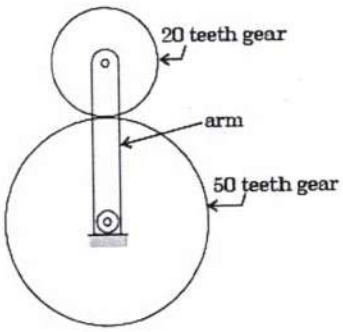
19. In the gear train shown gear 3 is carried on arm 5, gear 3 meshes with gear 2 and gear 4. The number of teeth in gear 2, 3 and 4 are 60, 20 and 100 respectively. If gear 2 is fixed and gear 4 rotates with an angular velocity of 100 rpm in the counterclockwise direction, the angular speed of arm 5 in rpm is

[ ] 166.7 counterclockwise
[ ] 166.7 clockwise
[ ] 62.5 counterclockwise
[ ] 62.5 clockwise




20. The number of degree of freedom of the planetary gear train as shown in the figure is

[ ] 0 [ ] 1 [ ] 2 [ ] 3



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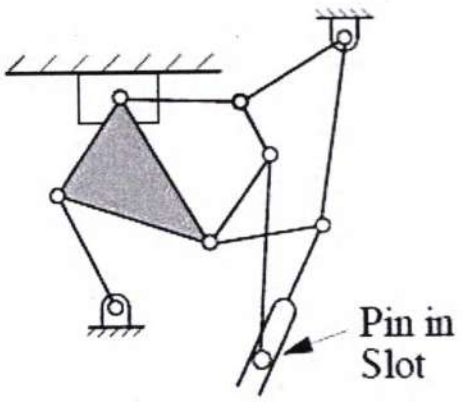
F. M. : 55

SECTION "B"

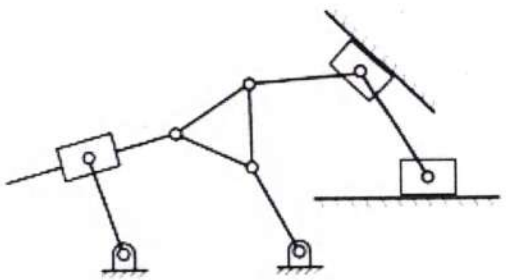
Attempt *ALL* questions. Assume suitable data if necessary.

1.

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



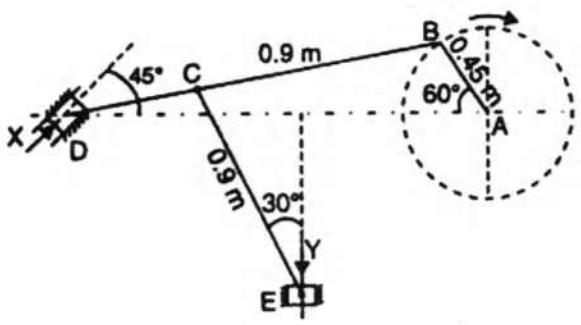

(i)



(ii)

b. A mechanism in which the crank AB is rotating uniformly at 180 rpm in the clockwise direction is shown in the figure below. The blocks at D and E are working in frictionless guides. The dimensions of the mechanism are: AB = 450 mm; BD = 1500 mm; BC = 900 mm and CE = 900 mm. [8]

i. Draw the velocity diagram
ii. Determine the velocities of blocks D and E in their guides.
iii. Determine the angular velocity of point C
iv. Find the turning moment at A if a force of 1000 N acts on D in the direction of arrow X and a force of 1500 N acts on E in the direction of arrow Y.




c. Explain four bar chain mechanism with all of its inversion [3]

2. Construct a follower performance diagram and draw the cam profile for the cam rotating in anticlockwise direction for the following conditions.

Type of follower used is knife edge follower with in line cam, Follower rises by 24 mm with simple harmonic motion in 1/4 rotation of the cam, dwells for 1/8 rotation of the cam and then raises again by 24 mm with uniform velocity in 1/4 rotation of the cam, dwells for 1/16 rotation of the cam and finally return to the initial position for the remaining period of the cam rotation with simple harmonic motion. Take base circle radius of 30 mm. Also calculate the maximum velocity and acceleration of the follower during the return stroke. [11]

3.

a. State law of gearing. A spur gear has a module of 2 mm and its pitch line velocity is 0.6283 m/sec. If the number of teeth of this spur gear is 30, find the speed of the gear. Also determine its circular pitch and diametral pitch. The gear is in mesh with other spur gear of same number of teeth having 20 degree involute profile, determine the height of addendum if the length of path of contact is 1.8 times the circular pitch. [6]

b. What is the interference in gears? Explain the method to avoid or reduce the interference in an external involute spur gear pair. [3]

4. A motor shaft connected to a pulley 120 cm diameter running at 200 rpm is required to drive a machine shaft at 800 rpm in the opposite direction. The belt drive is required to transmit 9 kW from motor shaft to machine shaft with a leather belt of length 3 m and thickness 10 mm. If the safe working stress for the leather belt is 140 $N/cm^2$, the mass density of leather is 1 $gm/cm^3$ and the coefficient of friction between leather belt and pulley is 0.3, determine the width of the belt. [6]

5. A rotating shaft carries four rotating masses A, B, C and D in the order D C B and A from the left end along its axis. The mass A may be assumed concentrated at a radius of 12 cm, B at 15 cm, C at 14 cm and D at 18 cm. The masses A, C and D are 15 kg, 10 kg and 8 kg respectively. The planes of rotation of A and B are 15 cm apart and of B and C are 18 cm apart. The angle between the radii of A and C is 90 degree. If the shaft is in complete dynamic balance, determine [7]

a. the angular position of B and D with respect to A
b. the distance between the planes of revolution of C and D, and
c. the mass B.

6. The gears A, D and E in a compound epicyclic gear train as shown in the figure, are free to rotate on the axis P. The compound gear B and C rotate together on the axis Q at the end of arm F. All the gears have equal module. The number of external teeth on the gears A, B and C are 18, 45 and 21 respectively. The gears D and E are annular gears. The gear A rotates at 90 rpm in the anti-clockwise direction and the gear D rotates at 450 rpm clockwise. Find the speed and direction of the arm F and gear E. [7]