KATHMANDU UNIVERSITY
End Semester Examination
May/June, 2022

Marks Scored:

Level : B.E.
Year : II
Course : MEEG 206
Semester : II
Exam Roll No. :
Time: 30 mins.
F. M. : 10
Registration No.:
Date :

SECTION "A"
[20Q × 0.5 = 10 marks]

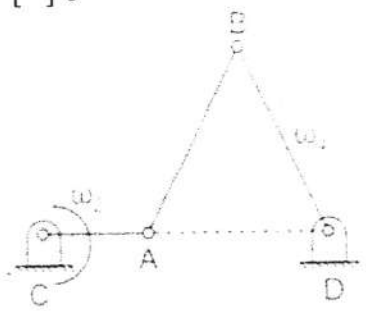
Mark [×] in the appropriate box.

1. Which of the following is an inversion of a single slider crank chain?
[ ] Beam Engine
[ ] Elliptical trammels
[ ] Watt's Indicator mechanism
[ ] Whitworth quick return motion mechanism

2. 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 rocker mechanism is
[ ] PQ [ ] QR [ ] RS [ ] SP

3. How many degrees of rotational freedom exists in a free body in space?
[ ] 3 [ ] 4 [ ] 5 [ ] 6

4. In the mechanism shown below, points C, A and D are in same straight line. If CA = 20 mm, CD = 40 mm and $\omega_2 = 4$ rad/s (ccw), then the value of ω_4 in rad/s is
[ ] 4 (ccw)
[ ] 3.5 (cw)
[ ] 4 (cw)
[ ] 3.5 (ccw)



5. Angular velocity of a car turning of 100 m radius is 0.1 rad/sec, the linear velocity of the car is
[ ] 360 kmph [ ] 36 kmph [ ] 3.6 kmph [ ] 0.26 kmph

6. The pressure angle and the base circle in a cam should be
[ ] Both as big as possible
[ ] Respectively as low as possible and as big as possible
[ ] Respectively as big as possible and as low as possible
[ ] Both as low as possible

7. The circle passing through the pitch point and concentric with the base circle of cam profile is known as
[ ] Prime circle [ ] Base circle [ ] Pitch circle [ ] Trace point circle

8. For a follower moving with cycloidal motion, the velocity of the follower is maximum at the
[ ] Beginning of the outstroke
[ ] Middle of the outstroke
[ ] End of outstroke
[ ] None of the above

9. A rotor weighing 2 kN is supported on bearings A and B which are 1 m apart. The center of mass of the rotor is at a distance 0.4 m from bearing A. It is observed that there is an unbalanced couple of magnitude 300 N-m which leaves the shaft balanced statically. The dynamic reactions at the supports will be

[ ] 800 N and 800 N [ ] 300 N and 800 N
[ ] 800 N and -300 N [ ] 300 N and -300 N

10. What is the balancing mass required to balance a mass of 5 kg, at a distance of 2 cm from the axis of rotation? Assume that balancing mass is placed opposite to the unbalanced mass and 1 cm away from the axis of rotation.

[ ] 5 kg [ ] 10 kg [ ] 15 kg [ ] 0.2 kg

11. A spur gear has a module of 3.5 mm, length of path of contact of $11\sqrt{3}$ mm and pressure angle 30°. The contact ratio of the gear will be

[ ] 1.7 [ ] 3 [ ] 2 [ ] 1

12. Tooth interference in an external involute spur gear pair can be reduced by

[ ] Decreasing center distance between gear pair
[ ] Decreasing module
[ ] Decreasing pressure angle
[ ] Increasing number of gear teeth

13. A pair of spur gear consists of a 20 teeth pinion meshing with a 120 teeth gear. The module is 4 mm. Calculate the center distance in mm.

[ ] 240 [ ] 280 [ ] 360 [ ] 480

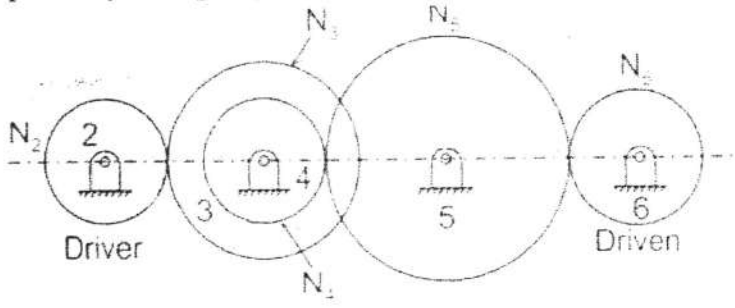
14. The gear train usually employed in clocks is

[ ] Reverted gear train [ ] simple gear train
[ ] sun and planet great train [ ] Compound gear train

15. In a simple epicyclic gear train with two gears A and B having 40 and 50 teeth respectively. The speed of revolution of gear B if the arm C rotates at 200 rpm and gear A fixed is

[ ] 160 [ ] 250 [ ] 360 [ ] 450

16. A gear train is made up of five spur gears as shown in the figure. Gear 2 is driver and gear 6 is driven member. N_2, N_3, N_4, N_5 and N_6 represent number of teeth on gears 2, 3, 4, 5 and 6 respectively. The gear(s) which act(s) as idler(s) is/are



[ ] Only 3 [ ] Only 4 [ ] Only 5 [ ] Both 3 and 5

17. What is the addendum of a cycloidal gear tooth

[ ] Cycloid [ ] Involute

[ ] Epicycloid [ ] Hypocycloid

18. The centrifugal tension in belts

[ ] Increases power transmitted

[ ] Decreases power transmitted

[ ] Have no effect on power transmitted

[ ] Increases power transmitted up to a certain speed and then decrease

19. The condition for maximum power transmission is that the maximum tension in the flat belt should be equal to, where P_c = tension in belt due to centrifugal force

[ ] $3 P_c$ [ ] P_c [ ] $P_c/3$ [ ] $2 P_c$

20. The creep in the belt is due to

[ ] Effect of temperature on belt

[ ] Material of belt

[ ] Unequal extensions in the belt due to tight and slack side tensions

[ ] Stresses beyond elastic limit of belt material

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SECTION "B"

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

1. Define Grashoff's law taking an example of four bar chain mechanism and explain all inversions of four bar chain mechanism. [5]

2. In the mechanism shown in the figure below find all the instantaneous centers. If the link A rotates clockwise at 10 rad/sec, find the angular velocity of link E. The lengths of various links are as follows:
   Lin A = 25 mm, link B = Link C = 100 mm; Link D = Link E = 50 mm. The link D is hinged to link B at 25 mm from the left hand end of link B. [8]

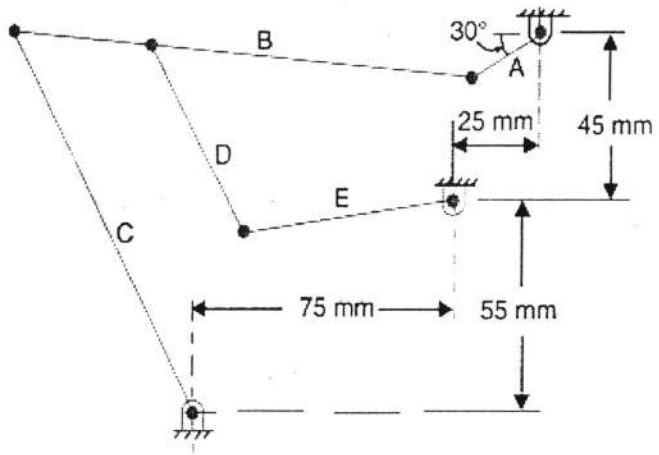

Figure 1

3. A cam rotating counter clockwise at a uniform speed of 1000rpm 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 passes through the axis of the cam shaft. If the displacement of the follower takes place with uniform acceleration and retardation on both the outward and return strokes, draw profile of the cam and find the maximum velocity and acceleration during outstroke and return stroke. [10]

4. A shaft has three eccentrics, each 75 mm diameter and 25 mm thick, machined in one piece with the shaft. The central plains of the eccentric are 60 mm apart. The distance of the centres from the axis of rotation are 12 mm, 18 mm and 12 mm and their angular positions are 120° apart. The density of metal is 7000 kg/m^3. Find the amount of out-of-balance force and couple at 600 rpm. If the shaft is balanced by adding two masses at a radius 75 mm and at distances of 100 mm from the central plane of the middle eccentric, find the amount of the masses and their angular positions. [7]

5. The following data relate to a pair of 20° involute gears in mesh: module =6 mm, number of teeth on pinion = 17, number of teeth on gear = 49, addendum on pinion and gear wheel = 1 module. [7]

Find:

a. The number of pairs of teeth in contact
b. The angle turned through by the pinion and the gear wheel when one pair of teeth is in contact
c. The ration of sliding to rolling motion when the tip of the tooth on the larger wheel
    i. is just making contact
    ii. is just leaving contact with its mating tooth
    iii. is at pitch point

6. Two shafts 'A' and 'B' are co-axial. A gear 'C' (50 teeth) is rigidly mounted on shaft 'A'. A compound gear 'D-E' gears with 'C' and an internal gear 'G'. 'D' has 20 teeth and gears with 'C' and 'E' has 35 teeth and gears with an internal gear 'G'. The gear 'G' is fixed and is concentric with the shaft axis. The compound gear 'D-E' is mounted on a pin which projects from an arm keyed to the shaft 'B'. Sketch the arrangement and find the number of teeth on internal gear 'G' assuming that all gears have the same module. If the shaft 'A' rotates at 110 rpm find the speed of the shaft 'B' and the speed of the gear 'D'. [7]

7. Determine the width of a 9.75 mm thick leather belt required to transmit 15 kW from a motor running at 900 rpm. The diameter of the driving pulley of the motor is 300 mm. The driven pulley runs at 300 rpm and the distance between the center of two pulleys is 3 meters. The density of the leather is 1000 kg/m^3. The maximum allowable stress in the leather is 2.5 MPa. The coefficient of friction between the leather and pulley is 0.3. Assume open belt drive and neglect the slag and slip of the belt. [6]