KATHMANDU UNIVERSITY
End Semester Examination
January/February 2024

Marks Scored:

Level : B.E.
Year : II

28 JAN 2024

Course : MEEG 206
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date :

SECTION "A"
[20 Q. × 1 = 20 marks]

Encircle the most appropriate option.

1. A cam operating roller follower has the following dimensions, the radius of the base and nose circle is 15 mm and 10 mm respectively, and the distance between them is 8 mm. Determine the lift made by the follower
   a. 5 mm b. 12.5 mm c. 3 mm d. 17 mm

2. A combination of kinematic pairs joined in such a way that relative motion between them is completely constrained, is called
   a. Mechanism b. Kinematic chain c. Structure d. Inversion

3. A distributing mass m1 attached to a rotating shaft may be balanced by a single mass m2 attached in the same plane of rotation as that of m1 such that
   a. $m1.r2 = m2.r1$ b. $m1.r1 = m2.r2$ c. $m1.m2 = r1.r2$ d. none of these

4. 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 the arm about the center of the bigger gear is
   a. 2 b. 3 c. 4 d. 5

5. A shaft has a single rotating mass of 50 kg at a 50 mm radius and makes an angle of 30 degrees with the shaft axis, the balancing mass has a 20 mm radius. Determine the mass and angle of the balancing mass.
   a. 10 kg at 210° b. 125 kg at 210° c. 10 kg at 150° d. 125 kg at 150°

6. A shaft revolving in a bearing is a
   a. Rolling pair b. Sliding pair c. Higher pair d. Lower pair

7. An imaginary circle which by pure rolling action, gives the same motion as the actual gear, is called
   a. addendum circle b. dedendum circle c. pitch circle d. clearance circle

8. An involute pinion and gear are in mesh. If both have the same size of addendum, then there will be an interference between the
   a. tip of the gear tooth and flank of pinion b. tip of the pinion and flank of gear
   c. flanks of both gear and pinion d. tip of both gear and pinion

9. For S.H.M. cam, the acceleration of the follower at the ends of the stroke and midstroke respectively, is
   a. maximum and zero
   b. zero and maximum
   c. minimum and maximum
   d. zero and minimum

10. An open belt running over two pulleys 240 mm and 600 mm diameter connects two parallel shafts 3 meters apart, the length of the belt required is,
   a. 3.84 m
   b. 6.35 m
   c. 7.33 m
   d. 8.21 m

11. If the annular wheel of an epicyclic gear train has 100 teeth and the planet wheel has 20 teeth, the number of teeth on the sun wheel is
   a. 80
   b. 60
   c. 40
   d. 20

12. When there is a reduction in amplitude over every cycle of vibration, then the body is said to have
   a. Free vibration
   b. Damped vibration
   c. Forced vibration
   d. Transverse Vibration

13. In involute gears, the pressure angle is
   a. dependent on the size of teeth
   b. dependent on the size of the gears
   c. always constant
   d. always variable

14. The centrifugal tension in belts
   a. Increases power transmitted
   b. Decreases power transmitted
   c. Do not affect the power transmitted
   d. Increases power transmitted up to a certain speed and then decreases

15. Static balancing involves the balancing of
   a. Couples
   b. Forces
   c. Masses
   d. Radii

16. The advantages of the involute profile over cycloidal are given below. Which of these is **NOT** correct?
   a. The interference is inherently absent in the involute system
   b. In the involute system, the pressure angle is constant from commencement to end of engagement
   c. The straight teeth of the basic rack for the involute profile admits of simple tools
   d. The profile for the flank and face is a single curve in the involute system

17. The gear train usually employed in clocks is a
   a. simple gear train
   b. reverted gear train
   c. sun and planet gear
   d. differential gear

18. The type of coupling used to connect two shafts whose distance between axes is small and misaligned is
   a. Universal coupling
   b. Flexible coupling
   c. Oldham's coupling
   d. Knuckle joint

19. Slip in belt drive is due to
    a. Material of pulley
    b. Size of pulley
    c. Insufficient friction between pulley and belt
    d. Uneven extension and contraction due to varying tension

20. Determine natural frequency of a system, which has equivalent spring stiffness of 30000 N/m and mass of 20 kg?
    a. 12.32 Hz b. 4.10 Hz c. 6.16 Hz d. None of these

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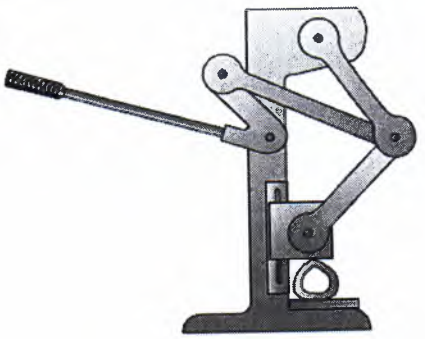
SECTION "B"

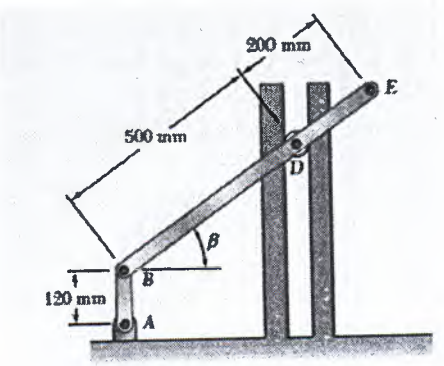
Attempt *ALL* questions. Assume any missing data with proper reason.

1.

a. A mechanical press as shown is used to exert large forces for example to insert a smaller part into a larger one. Draw a kinematic diagram indicating the joints and linkages and compute the degree of freedom. [3+3]



b. Rod BDE is partially guided by a roller at D that moves in a vertical track. Knowing that at the instant shown the angular velocity of crank AB is 5 rad/s clockwise and that $\beta = 25°$, Locate the instantaneous center and determine (i) the angular velocity of the rod, and (ii) the velocity of point E. [2+2+2]



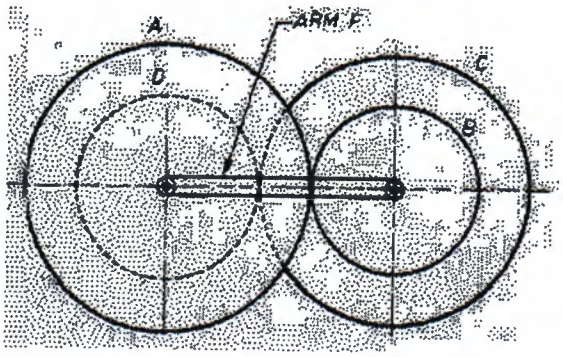
2. Draw the cam profile for the following conditions:
A Knife edge follower with a 10mm offset to the right is used to raise a product in the production Line. During the process, the follower rises by 24 mm for the first 1/4 rotation in SHM, Dwells for 1/8 rotation, and raises again by 24 mm for 1/3 rotation with Uniform Velocity and dwells for 1/16 rotation and returns for the remaining rotation with SHM. Base circle radius = 30mm. Also, find the Maximum velocity and acceleration during the return stroke if the Angular velocity of CAM is 600 rpm. [3+3+2]

3. A shaft carries four masses in parallel planes A, B, C, and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively, and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine:

   i. The magnitude of the masses at A and D; [2]
   ii. the distance between planes A and D; and [2]
   iii. the angular position of the mass at D. [2]

4. Find the width of the belt, necessary to transmit 7.5 kW to a pulley 300 mm diameter, if the pulley makes 1600 r.p.m and the coefficient of friction between the belt and the pulley is 0.22. Assume the angle of contact as 210° and the maximum tension in the belt is not to exceed 8 N/mm width. [7]

5. In a reverted Epicyclic train shown in the figure below, arm F carries two wheels A and D, and a compound wheel B - C. Wheel A meshes with wheel B and wheel D meshes with wheel C. Number of teeth on A = 40, Number of teeth on D = 24 and number of teeth on C = 36. Determine the angular speed of wheel D when wheel A is fixed and arm F rotates at 300 rpm counterclockwise. [8]



6. A 20° involute pinion with 30 teeth drives a gear having 50 teeth and a module of 4 mm.
   a. State whether interference occurs or not. Give reasons. [6]
   b. Find the length of the arc of contact and contact ratio. [2]

7. A shaft of 3.2 mm in diameter and 1 meter long is fixed at one end and supported at the other end. Taking Young's modulus for the shaft material as 2×10^6 kg/cm^2 and the density of the shaft material as 0.0078 kg/cm^3 find the natural frequency of transverse vibrations and the critical speed of the shaft. [3+3]