

KATHMANDU UNIVERSITY  
End Semester Examination  
June/July, 2023

Marks Scored:

Level : B.Arch.

Year : II

Exam Roll No. :

Time: 30 mins.

Course : CIEG 231

Semester : I

F. M. : 10

Registration No.:

Date

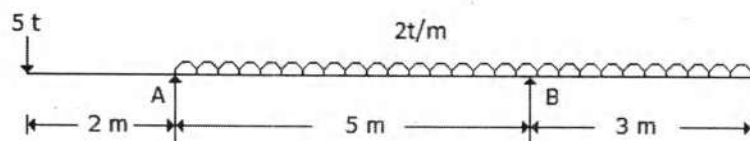
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SECTION "A"  
[20 Q. × 0.5 = 10 marks]

Encircle the most appropriate answer.

- If the resultant of two forces 'P' and 'Q' acting at an angle 'θ', is R
  - $R = \sqrt{P^2 + Q^2 - 2PQ \cos \theta}$
  - $R = \sqrt{P^2 + Q^2 + 2PQ \sin \theta}$
  - $R = \sqrt{P^2 + Q^2 + 2PQ \cos \theta}$
  - $R = \sqrt{P^2 + Q^2 - 2PQ \sin \theta}$
- Free body diagram is an
  - Isolated joint with only body forces acting on it
  - Isolated joint with internal forces acting on it
  - Isolated joint with all forces, internal as well as external acting on it
  - Unisolated joint with all forces, internal as well as external acting on it
- Which of the following principle states that the moment of resultant of two forces about a point lying in plane of forces is equal to algebraic sum of moments of those forces about that point?
  - De' Alembert Principle
  - Varignon's Principle
  - Principle of Transmissibility
  - Lami's Principle
- When forces do not lie in same plane and the line of action pass through single point, forces are called
  - Coplanar Concurrent Force
  - Coplanar Non Concurrent force
  - Non Coplanar Concurrent Force
  - Collinear Non Concurrent Force
- Two like parallel forces of 50 N and 100 N act at the ends of a rod 5m long, the resultant force is
  - 150 N
  - 100 N
  - 50 N
  - 200 N
- ..... support allows rotation and do not allow lateral or vertical movement.
  - Fixed
  - Roller
  - Pin
  - Free
- The shear force diagram for a uniformly varying load is ..... in nature.
  - Constant
  - Linear
  - Parabolic
  - Cubic
- First moment of area has unit of
  - $m^4$
  - $m^3$
  - $m^2$
  - $m$
- The slope of bending moment curve is equal to
  - Tension force
  - Compression force
  - Axial force
  - Shear force

10. The centroid of a semi-circle lies ..... above its base ( $r$  is the radius of the semi-circle)
- exact at its base
  - $4r/3\pi$
  - $2r/3\pi$
  - $r/3\pi$
11. Parallel Axis theorem states the following
- $I_{AB} = I_G + Ah^2$
  - $I_G = I_{AB} + Ah^2$
  - $I_{AB} = I_G + Ah^3$
  - $I_{AB} = I_G - Ah^2$
- where,  $I_{AB}$  is MOI about axis AB,  $I_G$  is MOI about Centroidal axis,  $A$  is area of lamina and  $h$  is perpendicular distance between centroid and AB.
12. The moment of inertia of a triangular section of base 'b' and height 'h' about its cg is given by the relation
- $\frac{bh^3}{48}$
  - $\frac{bh^3}{12}$
  - $\frac{bh^3}{36}$
  - $\frac{bh^3}{24}$
13. Time of flight of a projectile on a horizontal plane, is
- $2u \sin \alpha/g$
  - $2u \cos \alpha/g$
  - $2u \sec \alpha/g$
  - $2u \tan \alpha/g$
14. A lever AB = 2 m long is inclined at  $35^\circ$  with horizontal. A forces of 180 N is acting at B vertically downwards. The moment about 'A' is
- $2u \tan \alpha/g$
  - 295 Nm
  - 2950 Nm
  - 2.95 Nm
15. What is the maximum moment generated for a simply supported beam of length 'l' m loaded with uniform load of 'w' kN/m?
- wl
  - wl/2
  - wl<sup>2</sup>
  - wl<sup>2</sup>/4
16. For triangle ABC the side AB represents magnitude of force and altitude of triangle represents moment arm from moment center C then moment about C is
- Area of triangle ABC
  - $\frac{1}{2}$  area of triangle
  - 2 area of triangle ABC
  - 3 area of triangle ABC
17. The motion of particle is defined by relation  $x = t^2 - 10t + 20$ , where x is in m and t is sec. Find time when velocity is zero.
- 4 sec
  - 5 sec
  - 6 sec
  - 7 sec
18. The point where maximum bending moment occurs is called
- Point of Zero Shear
  - Point of Inflexion
  - Point of Contra flexure
  - Point of Virtual Hinge
19. The beam shown in below figure is supported by a hinge at 'A' and a roller at 'B'. The reaction  $R_A$  of the hinged support 'A' of the beam, is



- 10.8 t
  - 10.6 t
  - 10.4 t
  - 10.2 t
20. If  $r$  is number of reactions,  $n$  is number of members, for a statically determinate structure
- $r < 3n$
  - $r > 3n$
  - $r = 3n$
  - $r \leq 3n$

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SECTION "B"

Attempt *ALL* questions.

1. Explain Principle of Transmissibility with an example. What do you understand by Free Body diagram? Explain with sketch. [2]
2. State De' Alembert Principle. Show that rate of change of angular momentum at any instant of time is equal to the moment of force about that point. [2]
3. A uniform lamina shown in Figure 1 consists of a rectangle, a semi-circle and a triangle. Determine the center of gravity of lamina. All dimensions are in mm. [5]

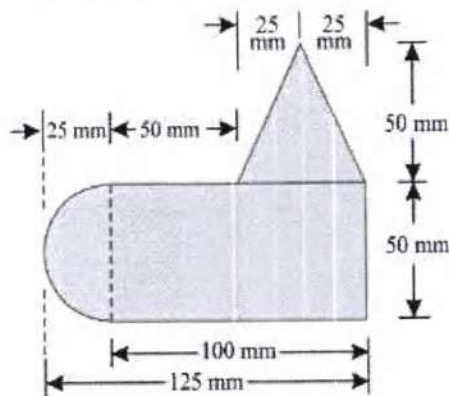


Figure 1

4. An angle section is shown in Figure 2. Find the moment of inertia about the Centroidal X-X and Y-Y axes of the angle section. All dimensions are in mm. [7]

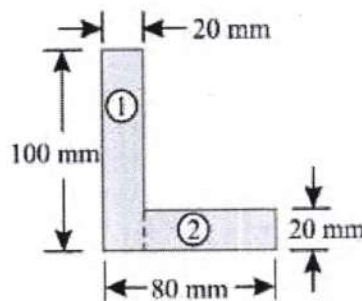


Figure 2

5. An electric light fixture weighting 15 N hangs from a point C, by two strings AC and BC as shown in Figure 3. The string AC is inclined at  $60^\circ$  to the horizontal and BC at  $45^\circ$  to the horizontal. Using Lami's theorem, or otherwise, determine the forces in the strings AC and BC. [5]

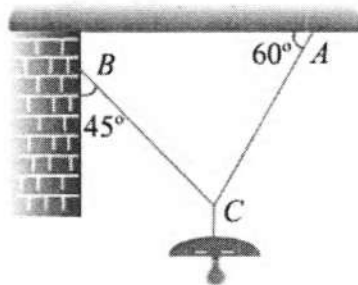


Figure 3

OR

A system of forces are acting at the corners of a rectangular block as shown in Figure 4. Determine the magnitude and direction of resultant force. Also find the resultant moment with direction about A and B. [5]

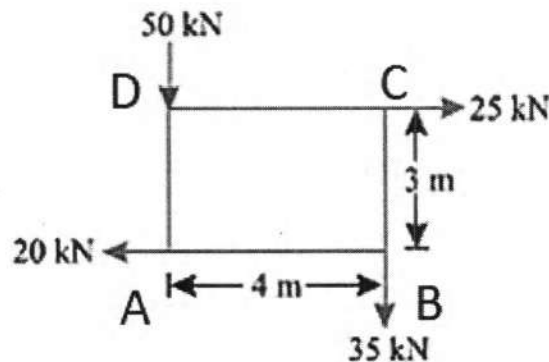


Figure 4

6. State and derive the Parallel axis theorem. [3]
7. A motorist is travelling at 4 km/hr. when he observes that a traffic light is 250m ahead of him turns red. The traffic light is timed to stay red for 24 sec. If the motorist wishes to pass the light without stopping just as it turns green again. Determine. [4]
- The required uniform acceleration of the car.
  - The speed of the car as it passes the light.

OR

A rectilinearly moving particle has an acceleration  $a = -8x^{-2} \text{ m/s}^2$ , where  $x$  is in meter. It is known that at time  $t=1$  sec,  $x=4\text{m}$  and  $v=2 \text{ m/s}$ . Determine its acceleration when  $t=2$  sec. [4]

8. The connection of block A, B and C with pulley is shown in Figure 5. If the block B has velocity  $2\text{m/s}$  (up) and its acceleration  $3\text{m/s}^2$  (down) while block C has a velocity and acceleration of  $2\text{m/s}$  (up) and  $4\text{m/s}^2$  (down) respectively. Find the velocity and acceleration of block A. [5]

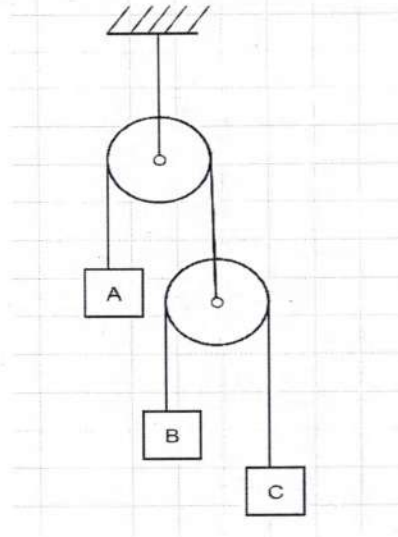


Figure 5

9. Draw the Shear Force Diagram and Bending Moment Diagram for the beam in Figure 6. 'A' is pinned and 'B' is roller support. Also determine the point of contraflexure and the point of zero shear if present. [7]

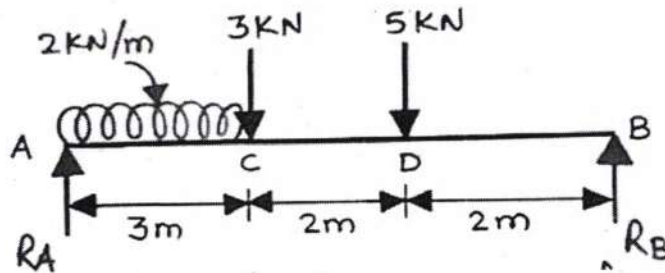


Figure 6