ABES ENGINEERING COLLEGE, GHAZIABAD
Department of Mechanical Engineering Session 2023-24
Fundamentals of Mechanical Engineering (BME 101)

Assignment-1
Unit 1
Topic: Introduction to Mechanics

Type (A)

1. State and prove the Varignon's theorem.
2. Define the Principle of Transmissibility.
3. What do you understand by Free Body Diagram? Explain with suitable example.
4. Define the Followings terms:
   (i) Young modulus
   (ii) modulus of rigidity
   (iii) bulk modulus
   (iv) Poisson's ratio
5. State Hook's law. Also define the term factor of safety and its importance.
6. Discuss about superposition Theorem.
7. Establish the relationship between Young's modulus (E) and Bulk Modulus (K). Also derive the relation between modulus of Elasticity (E) and Modulus of Rigidity (G).

Type (B)

1. Define the different Types of Load.
2. Write down the condition of Equilibrium for concurrent and non-concurrent force system.
3. Define the Followings terms:
   (i) Coplanar Force
   (ii) Concurrent Force
   (iii) Collinear Force
   (iv) Types of Support
4. Define the Moment of Forces. Differentiate between Moment and couple.
5. What is Force System? Also classified the Force System.
6. Draw stress-strain diagram for mild steel and cast iron and describe their salient features. (UPTU-2022-23 Odd SEM.)

Type (C)

1. Determine the changes in length and thickness of a steel bar which is 4 m long, 30 mm wide and 20 mm thick and is subjected to an axial pull of 30 KN in the direction of its length. Take E = 2 x 10^5 N/mm^2 and Poisson's ratio = 0.3
2. In an experiment, a bar of 30 mm diameter is subjected to a pull of 60 KN. The measured extension on gauge length of 200 mm is 0.09 mm and the change in Diameter is 0.0039 mm. Calculate the Poisson's ratio and the values of the three Moduli.

   [Ans. 0.289, E = 188.9 GPa, G = 149.2GPa, K = 149.2GPa]

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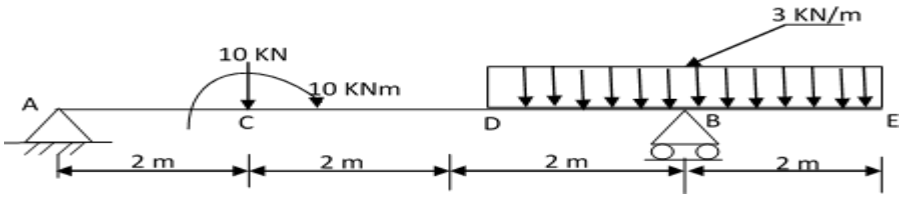
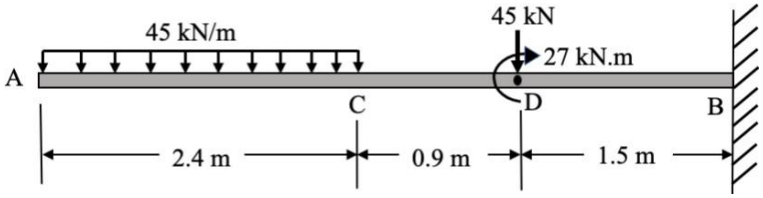
3. A beam is loaded and supported as shown in figure. Determine the support reaction at end A and B.

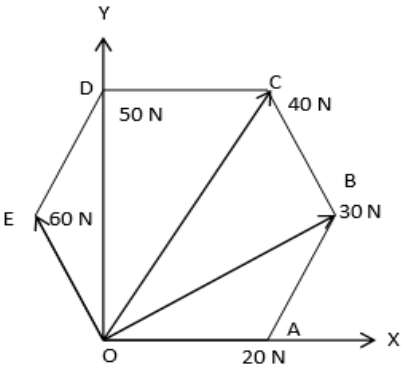


4. Find out the support reactions at the fixed end B of cantilever beam



5. A metallic rectangular rod 1.5 m long, 40 mm wide and 25 mm thick is subjected to an axial tensile load of 120 KN. Elongation of the rod is measured as 0.9 mm. Calculate stress, strain and modulus of elasticity.

6. Five forces are acting on a regular hexagon at an angular point as shown in Fig.. Calculate their resultant in magnitude and direction.



7. A square ABCD is subjected to forces equal to P, 2P, 3P and 4P along the sides AB, BC, CD and DA. Determine the magnitude, direction and line of action of the resultant.

8. A cylindrical roller of weight 600 N is resting on a smooth inclined plane having incline of 30^0. The roller is held by a rope OB as shown in Fig.1.1. Find the tension in the rope and reaction at the point of contact (End A) between roller and plane.

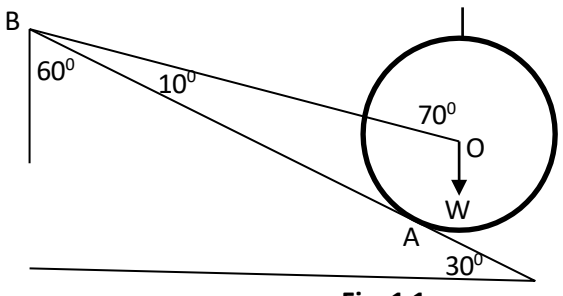


Fig. 1.1

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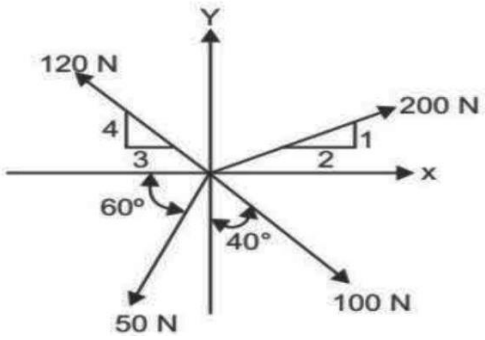
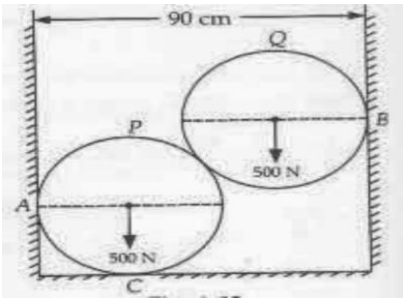
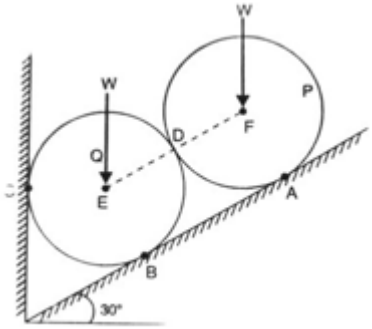
9 A system of four forces acting on a body is as shown in figure. Determine the magnitude resultant and its inclination with positive X-axis. (UPTU-2022-23 Odd SEM.)



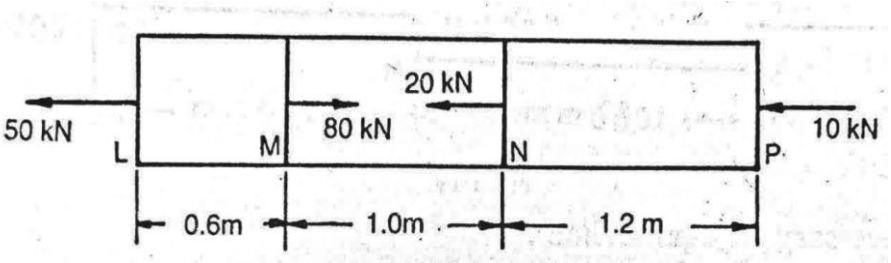
10. Two smooth spheres P and Q each of radius 25 cm and weighing 500 N, rest in a horizontal channel having vertical walls. If the distance between the walls is 90 cm, make calculations for the reactions on all the points of contact.



11. Two identical rollers P and Q, each of weight 100 N, are supported by an inclined plane and a vertical wall as shown in figure. Draw FBD of both sphere assuming all surfaces to be smooth. Also, find the reactions at points A, B, C and D.



12. A brass bar having cross sectional area of 1000 mm^2 is subjected to axial forces as shown in the figure. Find the total elongation of the bar and stress in individual components. Take Modulus of elasticity of Brass = 100 GPa



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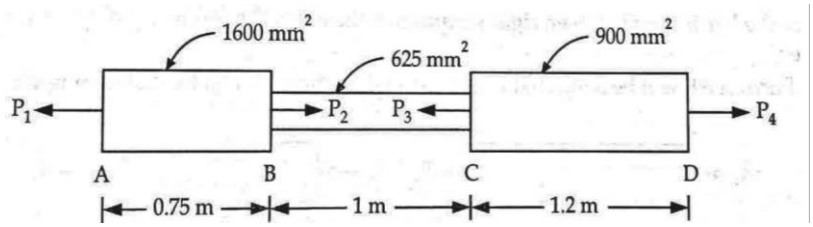
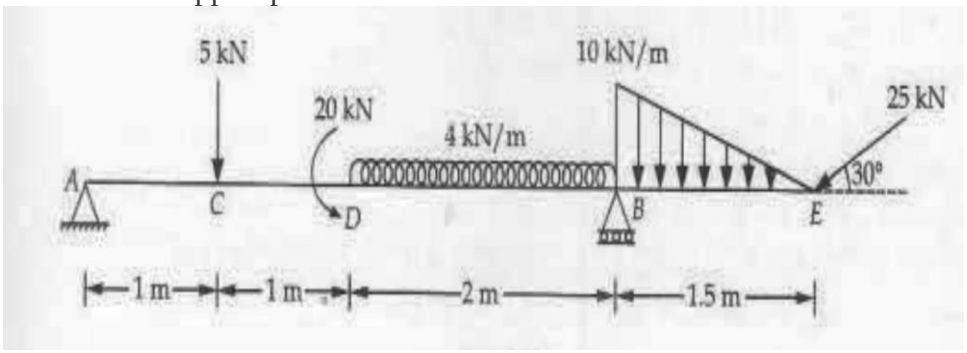
13. A member ABCD is subjected to point loads P_1, P_2, P_3 and P_4 as shown in figure given below:



Calculate the force P_3 necessary for equilibrium if P_1 = 120 kN, P_2=220 kN and P_4=160 kN. Determine change in length of the member. Take modulus of elasticity 200 GN/m^2.

14. A beam has been loaded and supported as shown in figure given below. Determine the reactions at the support points A and B.



15. A square bar 50 mm x 50 mm is subjected to a compressive load of 500 KN. The contraction over 200 mm length is 0.5 mm and increase in thickness is 0.04 mm. Calculate the value of the four elastic constants of the material.

16. A steel bar of square cross-section 35 mm x 35 mm, 500 mm long stretches 0.2 mmunder a pull of 100 kN. The same bar in single shear test under a force of 122.5 kN Shows a distortion of original right-angle corners by 0.00125 radian. Determine thevalues of the four elastic constants of the material.

17. At an axial load of 22 kN, a 45-mm-wide by 15-mm thick polyimide polymer bar Elongates 3.0 mm while the bar width contracts 0.25 mm. The bar is 200 mm long. At The 22-kN load, the stress in the polymer bar is less than its proportional limit.Determine, the modulus of elasticity, Poisson's ratio and the change in the bar thickness. (UPTU-2022-23 Odd SEM.)