National Institute of Technology Hamirpur (H.P)
B. Tech First Year

End Semester Examination:2022-23

## CE -101 Applied Mechanics

Max marks: 50
Instructions:

- Answer all questions, each question carries 5 marks
- Missing data, if any, may be assumed and stated suitably.
- Calculator is allowed.

1. Obtain the resultant of the concurrent coplanar forces acting in the Fig. 1.


Fig. 1


Fig. 2
2. Determine the distance $s$ to which the 90 kg painter can climb without causing the 4 m ladder to slip at its lower end A . The top of the 15 kg ladder has a small roller, and at the ground the coefficient of static friction is 0.25 . The mass centre of the painter is distributed directly above her feet. (Fig. 2)
3. Find out the centroid of the shaded area shown in Fig. 3. Determine the area moment of inertia of the shaded area about centroidal axis parallel to $X$ axis.



Fig. 4
4. The scissors linkage is subjected to a force of $P=150 \mathrm{~N}$. Determine the angle $\theta$ for equilibrium. The spring is unstretched at $\theta=0^{\circ}$ (see Fig. 4). Neglect the mass of the links.
5. Determine the forces in each member of truss as shown in Fig 5. Mention the nature of forces in each

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case.


Fig. 5


Fig. 6
6. A brass bar of 5 mm thickness is subjected to axial forces as shown in Fig. 6. Find the total elongation of the bar. Take $\mathrm{E}=1.05 \times 10^{5} \mathrm{~N} / \mathrm{mm}^{2}$
7. Draw shear force and bending moment diagram for the given loading on a beam as shown in Fig. 7 .


Fig. 7


Fig. 8
8. Draw the shear force, axial force and bending moment diagrams for the frame as shown in Fig. 8.
9. A simply supported steel beam of rectangular section having length of 10 m is carrying a uniformly distributed load of $9 \mathrm{KN} / \mathrm{m}$ upto a distance of 7 m from the left end of support. If the width of beam is half its depth, find the suitable dimension of the section. Also discuss the applicability of theory of simple bending to this condition.
10. Two solid shafts $A C$ and $B C$ of aluminium and steel are rigidly fastened together at $C$ and attached to rigid supports at A and B . A torque of 200 Nm is applied at junction C . Compute the maximum shearing stress in each material. What is the angle of twist at the junction? Take modulus of rigidity of aluminium as $3 \times 10^{4} \mathrm{~N} / \mathrm{mm}^{2}$ and steel as $9 \times 10^{4} \mathrm{~N} / \mathrm{mm}^{2}$.


Fig. 9

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