GATE - 2019 - CE

EE1030 : Matrix Theory
Indian Institute of Technology Hyderabad

Satyanarayana Gajjarapu
AI24BTECH11009

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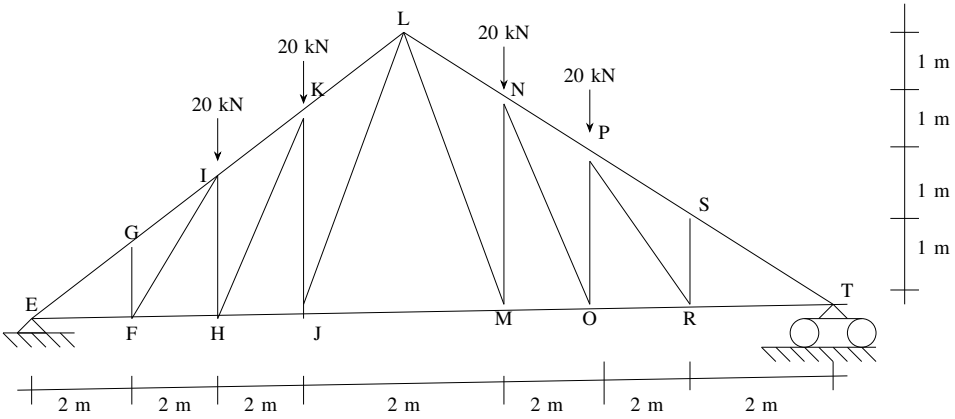
1) For a small value of h, the Taylor series expansion for $f(x+h)$ is
   a) $f(x) + hf'(x) + \frac{h^2}{2!}f''(x) + \frac{h^3}{3!}f'''(x) + \cdots + \infty$
   b) $f(x) - hf'(x) + \frac{h^2}{2!}f''(x) - \frac{h^3}{3!}f'''(x) + \cdots + \infty$
   c) $f(x) + hf'(x) + \frac{h^2}{2}f''(x) + \frac{h^3}{3}f'''(x) + \cdots + \infty$
   d) $f(x) - hf'(x) + \frac{h^2}{2}f''(x) - \frac{h^3}{3}f'''(x) + \cdots + \infty$

2) A plane truss is shown in the figure (*not drawn to scale*).

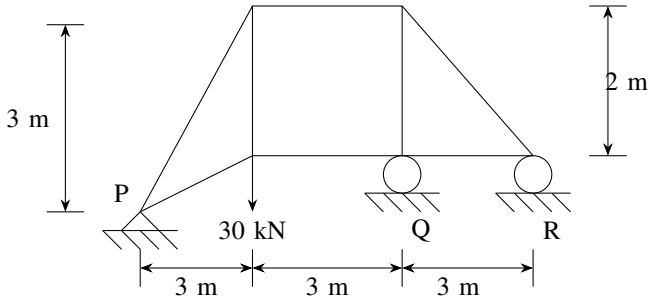


Which one of the options contains ONLY zero force members in the truss ?
   a) FG, FI, HI, RS
   b) FG, FH, HI, RS
   c) FI, HI, PR, RS
   d) FI, FG, RS, PR

3) An element is subjected to biaxial normal tensile strains of 0.0030 and 0.0020. The normal strain in the plane of maximum shear strain is
   a) Zero

b) 0.0010
c) 0.0025
d) 0.0050

4) Consider the pin-jointed plane truss shown in the figure (*not drawn to scale*). Let R_P, R_Q, and R_R denote the vertical reactions (upward positive) applied by the supports at P, Q, and R, respectively, on the truss. The correct combination of (R_P, R_Q, R_R) is represented by

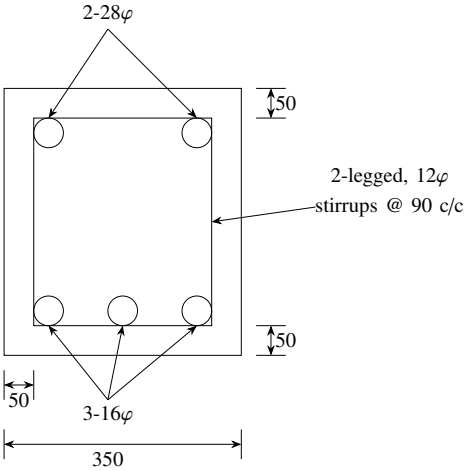


a) $(30, -30, 30)$kN
b) $(20, 0, 10)$kN
c) $(10, 30, -10)$kN
d) $(0, 60, -30)$kN

5) Assuming that there is no possibility of shear buckling in the web, the maximum reduction permitted by IS 800-2007 in the (low-shear) design bending strength of a semi-compact steel section due to high shear is

a) zero
b) 25%
c) 50%
d) governed by the area of the flange

6) In the reinforced beam section shown in the figure (*not drawn to scale*), the nominal cover provided at the bottom of the beam as per IS 456-2000, is



All dimensions are in mm

a) 30 mm
b) 36 mm
c) 42 mm
d) 50 mm

7) The interior angles of four triangles are given below:

Triangle	Interior Angles
P	85°, 50°, 45°
Q	100°, 55°, 25°
R	100°, 45°, 35°
S	130°, 30°, 20°

Which of the triangles are ill-conditioned and should be avoided in Triangulation surveys ?

a) Both P and R
b) Both Q and R
c) Both P and S
d) Both Q and S

8) The coefficient of average rolling friction of a road is f_r and its grade is $+G\%$. If the grade of this road is doubled, what will be the percentage change in the braking distance (for the design vehicle to come to a stop) measured along the horizontal (assume all other parameters are kept unchanged) ?

a) $\frac{0.01G}{f_r+0.02G} \times 100$
b) $\frac{f_r}{f_r+0.02G} \times 100$

c) $\frac{0.02G}{f_r+0.01G} \times 100$
d) $\frac{2f_r}{f_r+0.01G} \times 100$

9) An isolated concrete pavement slab of length L is resting on a frictionless base. The temperature of the top and bottom fibre of the slab are T_t and T_b, respectively. Given: the coefficient of thermal expansion = α and the elastic modulus = E. Assuming $T_t > T_b$ and the unit weight of concrete as zero, the maximum thermal stress is calculated as
a) $L\alpha\,(T_t - T_b)$
b) $E\alpha\,(T_t - T_b)$
c) $\frac{E\alpha(T_t-T_b)}{2}$
d) zero

10) In a rectangular channel, the ratio of the velocity head to the flow depth for critical flow condition, is
a) $\frac{1}{2}$
b) $\frac{2}{3}$
c) $\frac{3}{2}$
d) 2

11) If the path of an irrigation canal is below the bed level of a natural stream, the type of cross-drainage structure provided is
a) Aqueduct
b) Level crossing
c) Sluice gate
d) Super passage

12) A catchment may be idealised as a rectangle. There are three rain gauges located inside the catchment at arbitrary locations. The average precipitation over the catchment is estimated by two methods: (i) Arithmetic mean (P_A), and (ii) Thiessen polygon (P_T). Which one of the following statements is correct ?
a) P_A is always smaller than P_T
b) P_A is always greater than P_T
c) P_A is always equal to P_T
d) There is no definite relationship between P_A and P_T

13) A retaining wall of height H with smooth vertical backface supports a backfill inclined at an angle β with the horizontal. The backfill consists of cohesionless soil having angle of internal friction ϕ. If the active lateral thrust acting on the wall is P_a, which one of the following statements is TRUE ?
a) P_a acts at a height $\frac{H}{2}$ from the base of the wall and at an angle β with the horizontal
b) P_a acts at a height $\frac{H}{2}$ from the base of the wall and at an angle ϕ with the horizontal
c) P_a acts at a height $\frac{H}{3}$ from the base of the wall and at an angle β with the horizontal

d) P_a acts at a height $\frac{H}{3}$ from the base of the wall and at an angle ϕ with the horizontal