Total number of printed pages: **4** **D/4th/DME405**

2021

STRENGTH OF MATERIALS

Full Marks: 60

Time: Two hours

The figures in the margin indicate full marks for the questions.

1. Answer the following Questions: **1x15=15**

a) Convert 5 MPa into N/mm^2

b) What is the SI unit of strain?

c) Define Factor of Safety.

d) What is the relation between Poisson's ratio, lateral strain and longitudinal strain?

e) what is the value of shear stress in principal planes

f) What is the value of shear force at the free end of a cantilever beam

g) What will be the unit of polar moment of inertia in terms of mm?

h) Radius of Mohr's circle indicates what value of shear stress?

i) Write down the mathematical expression for Resultant stress for stresses on an oblique plane.

j) What is the relation between shear strain, shear stress on the outer most layer of the shaft and modulus of rigidity

k) Define Hook's Law.

l) Define shear force and bending moment

m) State principle of complementary shear stress.

n) Define modulus of rigidity or shear modulus

o) State principle of superposition.

2. State the following statements in True or False: **1x5=5**

a) Lateral strain = - (Poisson's ratio) x Longitudinal strain

b) Volumetric Strain = Longitudinal strain x (1-3μ)

c) Radius of Mohr's circle indicates zero value of shear stress.

d) For a stress system on an oblique plane there are always two principal planes having the extreme values of the normal stress.

e) Bending moment diagram for a cantilever beam loaded with uniformly distributed load is parabolic in nature

3. Answer the following questions in brief: 2x6=12

a) Define tensile and compressive stress

b) Find the minimum diameter of a steel wire which is used to raise a load of 4000 N, if the stress in the rod is not to exceed 95 MN/m^2

c) Define principal plane and principal stress

d) Write down the expressions for normal stress and shear stress for stresses on an oblique section of a body subjected to a direct stress in one plane.

e) Explain sign conventions for SFD and BMD

f) A circular shaft of 60 mm diameter is running at 150 rpm. If the shear stress is not to exceed 50 MPa, find the power which can be transmitted by the shaft.

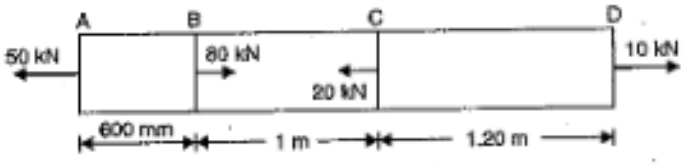
4. Answer any SEVEN questions from the following: 7X4=28

a) Show that elongation of a bar due to its own weight, $\delta L=WL/2E$

Where,

W=Total weight, L=Length of the bar, E= Young's Modulus

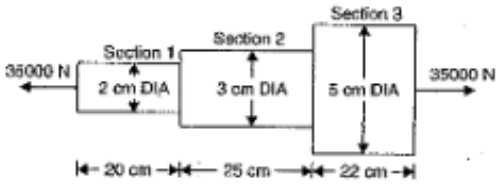
b) A brass bar, having cross-sectional area of 1000 mm^2 is subjected to axial forces as shown in the figure below.



Find the total elongation of the bar. Take E= 1.05 x 10^5 $N.mm^{-2}$

c) Define Bulk Modulus. Show that the relation between Bulk modulus (K) and Young's modulus (E) as $E=3K(1-2\mu)$ Where μ= Poisson's ratio

d) An axial pull of 35000 N is acting on a bar consisting of three lengths as shown in the figure below. If the Young's modulus is equal to $2.1x10^5$ N/mm^2, Determine



(i) Stresses in each section

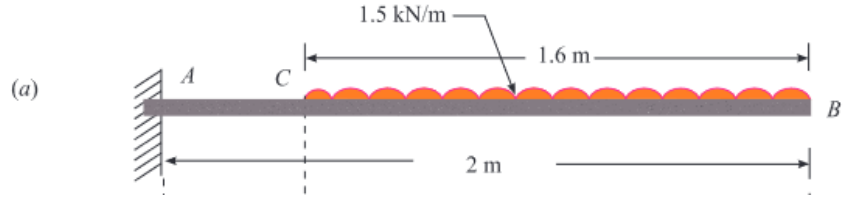
(ii) Total extension of the bar.

e) A plane element in a body is subjected to a tensile stress of 100 MPa accompanied by a shear stress of 25 MPa. Find by using analytical or Mohr's circle method

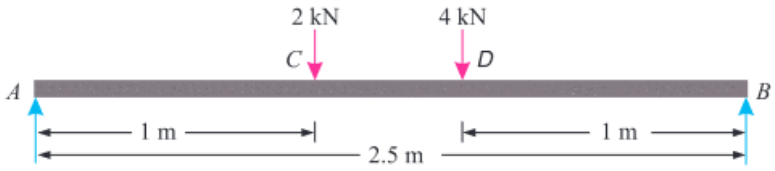
(i)The normal and shear stress on a plane inclined at an angle of 20° with the tensile stress.

(ii) The maximum shear stress on the plane.

f) A cantilever beam AB 2m long carries a uniformly distributed load of 1.5 KN/m over a length of 1.6m from the free end. Draw the shear force and bending moment diagrams for the beam.



g) A simply supported beam AB of span 2.5m is carrying two point loads as shown in the figure below.



Draw SFD and BMD for the beam.

h) For a circular shaft of radius 'R' and length 'l' show that

$\tau/R = C\theta/l$

Where,

τ =shear stress on the outer most layer, C = modulus of rigidity, θ =

angular deflection on the circular end of the shaft.

i) A hollow sphere is to transmit 200 KW at 80 rpm. If the shear stress is not to exceed 60 MPa and internal diameter is 0.6 of the external diameter. Find the diameter of the shaft.

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