BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
SEMESTER – II, 2022-23, COMPREHENSIVE EXAMINATION
ME F218, Advanced Mechanics of Solids
OPEN BOOK (TEXT BOOK ONLY)

Weightage: 40% Marks 80 Time: 180 minutes

- *Work out all parts of a numerical problem in one place and in continuous sequence*

Q1) A truncated cone is hanging vertically with the smaller radius (R) downward as shown in figure Q1, the radius r varies with length (L) as $r(x) = \frac{R}{L}(5L - 4x)$.

Determine the extension of the truncated cone due to its own weight in terms of E, L, R and specific gravity γ [10]

Q2) A thin rectangular plate (a = 30 mm , b = 15 mm) as shown in figure Q2 is acted upon by a stress distribution resulting in uniform strain $\varepsilon_{yy} = 200\ \mu$ and $\gamma_{xy} = -300\ \mu$. Determine the changes in length of diagonals AC and BD. Assume plain strain condition [10]

Q3) A box section cantilever beam of length 2m is subjected to a bending moment M at the free end as shown in figure Q3. Find

a) The orientation of the neutral axis with respect to x axis in degree.
b) Magnitude and location (show in sketch) of the maximum positive flexural stress. Given, for the material, E=200GPa. [5+10=15]

Q4) An aluminum structural section shown in figure Q4 has three prominent vertical sections of varying length and 6 mm thickness. Dimensions are as shown in figure. The vertical sections are connected with webs of negligible thickness. Compute the dimension h1 when the shear center of the section is located at e = 10 mm. [15]

Q5) A curved beam with an elliptical cross section shown in figure Q5 is used in a machine and can carry satisfactorily a bending moment of 2 Nm. Due to over usage the inner side is worn out and has become rough, therefore, it was decided to machine off 10 mm from the inside. You are required to find what maximum moment the modified part can carry without exceeding the peak stress in the original installation. Explain your observation. [13+2=15]

Q6) A compound shell is fabricated by shrink fitting a steel jacket of 300 mm diameter on a steel tube of 100 mm inside diameter and 200 mm outside diameter. The radial interference was 0.1 mm.

For the steel, assumed E = 210 GPa and ν = 0.3. Find

a) Contact pressure
b) Maximum tensile stress in the compound cylinder and where it occurs
c) Draw radial and hoop stress distribution along with values at salient points [5x3=15]

[figures overleaf]

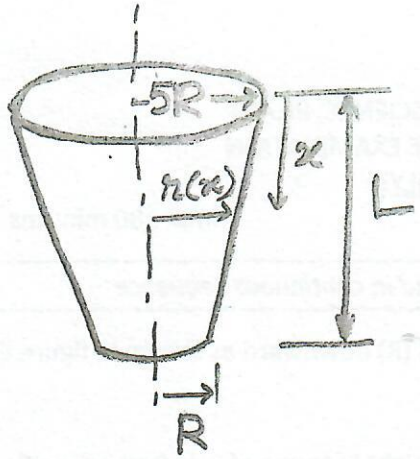


Figure Q1.

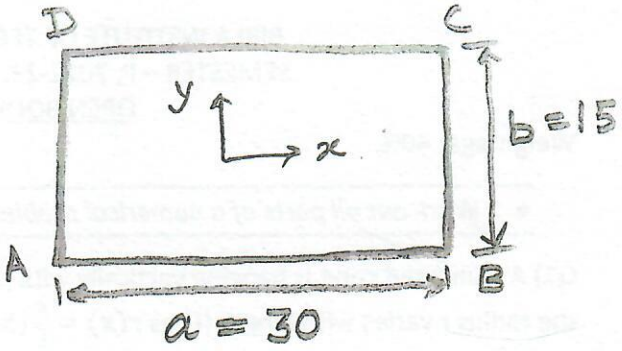
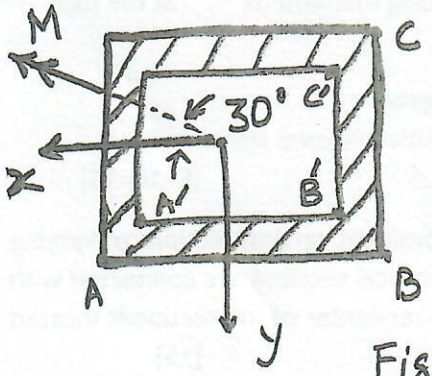
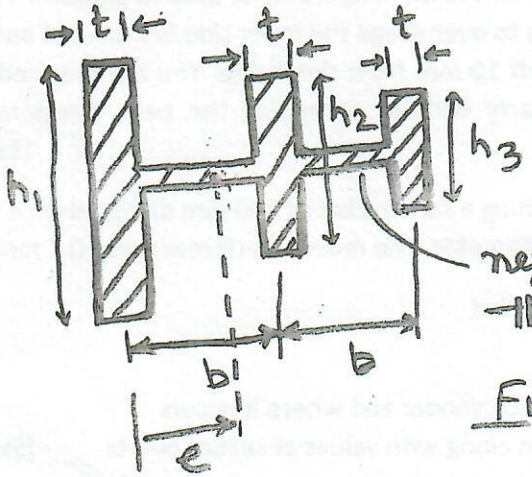


Figure Q2



AB = 80 mm
A'B' = 40 mm
BC = 200 mm
B'C' = 100 mm

Figure Q3



t = 6 mm
h_3 = 40 mm
h_2 = 60 mm
b = 20 mm
e = 10 mm

Figure Q4