H.T.No. $\square$
Code No: ME1901
GEC-R14

## M. Tech I Semester Regular/Suppl. Examinations, January 2017 ADVANCED MECHANICS OF SOLIDS (Machine Design)

## Time: 3 Hours

Max. Marks: 60
Note: Answer any FIVE questions. All Questions carry equal Marks.

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5 \times 12=60 \mathrm{M}
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1. The stress component at a point in a plate is given by $\sigma_{x x}=80 \mathrm{MPa}, \sigma_{y y}=60$ $\mathrm{MPa}, \sigma_{z z}=20 \mathrm{MPa}, \sigma_{x y}=20 \mathrm{MPa}, \sigma_{y z}=10 \mathrm{MPa}$, and $\sigma_{z x}=40 \mathrm{MPa}$.
i. Determine the principal stress $\sigma_{1} \geq \sigma_{2} \geq \sigma_{3}$
ii. Determine the max. shear stress
iii. Determine the stress vector on a plane normal to the vector $\mathrm{i}+2 \mathrm{j}+\mathrm{k}$
2. A square plate in the side of a ship with 800 mm sides parallel to the x and y axes has a uniform thickness $\mathrm{h}=10 \mathrm{~mm}$ and is made of an isotropic steel . The plate is subjected to a uniform state of stress. If $\sigma_{z z}=\sigma_{z x}=\sigma_{z y}=0, \sigma_{x x}=$ $500 M P a$ and $\epsilon_{y y}=0$ for the plate, Take $\mathrm{E}=200 \mathrm{GPa}$ and $\mu=0.29$.
i. Determine $\sigma_{y y}=\sigma_{2}$
ii. Determine the final dimensions of the plate, assuming linearly elastic conditions.
3. Locate the shear center for the beam cross section shown in Figure 1. The walls of the cross section have constant thickness $t=2.00 \mathrm{~mm}$.


Figure 1
4. Define Airy's Stress function and derive an equation for bending of cantilever beam loaded at the end.
5. Derive Winkler Bach formula for bending of curved beams.
6. A cast iron disk has an inner radius $a=150 \mathrm{~mm}$ and an outer radius $\mathrm{b}=300 \mathrm{~mm}$, with material properties $\mathrm{p}=7200 \mathrm{~kg} / \mathrm{m}^{3}, \mathrm{E}=70 \mathrm{GPa}, \mathrm{v}=0.25$ and ultimate strength $\sigma_{u}=170 \mathrm{MPa}$. Determine the speed of revolution (in rpm) of the disk at which the maximum stress is equal to the ultimate strength.
7. a) Derive an expression for the twist and shear stress in a narrow rectangular shaft subjected to torsion.
b) Also explain the membrane analogy for torsion non circular shaft.
8. a) Define the condition of compatibility equation.
b) Derive the compatibility equation in a two dimensional problem having three stress components $\sigma_{x}, \sigma_{y}$ and $\tau_{x y}$.

