National Institute of Technology, Hamirpur (H.P.)

M. Tech. Mechanical Engineering (Design)

End-Semester Examination (Session 2020-21)

Branch: M.tec (Design Engineering) **Semester:** Ist

Course Name: Adv. Mech. of Solids **Course Code:** ME-631

Time Allowed: 2 hours **Maximum Marks:** 50

Date: 14-12-2020 **Time Slot: 15:00-17:00 Hrs**

Instruction to candidates:

- **Attempt all the questions in the order as appear in the question paper.**
- **Marks are indicated against each question.**
- **Assume if there is any missing data with little explanation**
- **Keep your web-cameras on for invigilation purpose**

Q1. Write short notes on: **(5x2=10)**

(a)State of stress at a point (b)Airyôs Stress Function (c) Compatibility Conditions (d) Torsion of Prismatics shafts (e) Fictitious Load method

Q2. The known stress components at a point in a body, relative to the (x, y, z) axes, are $\mathring{u}_{xx}$, = 20 MPa, $\mathring{u}_{yy}$ =10 MPa, $\mathring{u}_{xy}$ = 30 MPa, $\mathring{u}_{xz}$, = -10 MPa, and $\mathring{u}_{yz}$ = 80 MPa. Also, the second stress invariant is I_2 = -7800 $(MPa)^2$

(a) Determine the stress component $\mathring{u}_{zz}$. Then determine the stress invariants I_1, and I_3, and the three principal stresses.

(b) Show that I_1, I_2 and I_3, are the same relative to (x, y, z) axes and relative to principal axes (1, 2, 3). **(10)**

Q3. The rectangular components of small strain at a point is given by the following matrix. Determine the principal strain and the direction of the maximum unit strain. **(10)**

$$\left[\varepsilon_{ij}\right] = p\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & -4 \\ 0 & -4 & 3 \end{bmatrix} \text{ where } p = 10^{-4}$$

Q4. (a) Explain the yield surfaces of Tresca and Von-mises. **(5)**

(b) Determine the diameter of a ductile steel bar if the tensile load F is 35,000 N and the torsional moment T is 1800 Nm. Use a factor of safety of 1.5. Take E= 207 $x10^6$ kPa and $\mathring{u}_{yp}$ = 207,000 kPa. Use suitable theory of Failure. **(5)**

Q5. A thin walled circular ring is loaded as shown in the figure. Determine the vertical displacement of Point A, only considering the bending energy. (10)