Assignment 06

1] The following expressions provide the relation between stress and strain using Lame's constant: [4 marks]

$$\sigma_{xx} = (2G+\lambda)\varepsilon_{xx} + \lambda(\varepsilon_{yy}+\varepsilon_{zz})$$
$$\sigma_{yy} = (2G+\lambda)\varepsilon_{yy} + \lambda(\varepsilon_{xx}+\varepsilon_{zz})$$
$$\sigma_{zz} = (2G+\lambda)\varepsilon_{zz} + \lambda(\varepsilon_{xx}+\varepsilon_{yy})$$
$$\sigma_{xy} = 2G\varepsilon_{xy}$$
$$\sigma_{xz} = 2G\varepsilon_{xz}$$
$$\sigma_{yz} = 2G\varepsilon_{yz}$$

and the force balance along x-direction is given by:

$$\rho \frac{\partial^2 u}{\partial t^2} = \frac{\partial \sigma_{xx}}{\partial x} + \frac{\partial \sigma_{xy}}{\partial y} + \frac{\partial \sigma_{xz}}{\partial z}$$

Solve the above force balance equation along x-direction in terms of displacement.(*Hint: Solve force balance equation in terms of strain and resolve the strain components in terms of displacement*). For the resultant wave equation given, fill the spaces in order for the choices mentioned.

$$\boxed{1}\frac{\partial^2 u}{\partial t^2} = \boxed{2}\frac{\partial^2 u}{\partial x^2} + \boxed{3}\left[\frac{\partial^2 v}{\partial y^2} + \frac{\partial^2 w}{\partial z^2}\right] + \boxed{4}\left[\frac{\partial^2 v}{\partial x \partial y} + \frac{\partial^2 w}{\partial x \partial z}\right]$$

$$A = 2G+\lambda \qquad C = \rho$$
$$B = G \qquad D = G+\lambda$$

a) C, B, A, D

b) C, A, B, D

c) C, D, A, B

d) The resulting equation doesn't match with the format equation provided

2] Mention the correct choice(s) regarding dislocations in a polycrystalline material.

a) A dislocation cannot end within the material

b) Presence of screw dislocation enhances the growth rate of crystal

c) Dislocation loops can be in any shape but should be closed

d) Point defects agglomerate on a plane during quenching forming prismatic loops

3] Mention the correct choice(s) regarding Peierls barrier for a crystalline material.

a) It denotes the lattice friction stress

b) Wide core for a dislocation ensures higher mobility

c) Peierls barrier is same for screw and edge dislocation for Aluminium

d) All of the above

4] The ideal way to define a burgers circuit around a dislocation is by:

a) Left hand screw

b) Not relevant to the screw direction

c) Right hand screw

d) Loop along the dislocation line

5] Identify the correct choice(s) regarding the factors that lead to the concept of dislocations in crystalline materials.

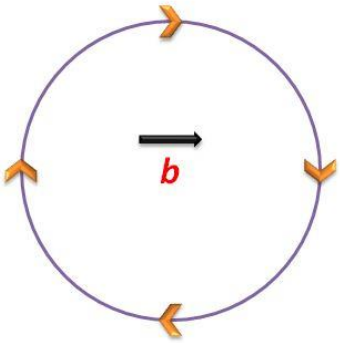
a) Actual yield stress is significantly higher than the theoretical shear modulus of the material

b) Faster growth of crystals than expected even at 1% super saturation

c) High peak intensity observed at Bragg angles for single crystals than predicted theoretically

d) None of the above

6] Identify all the correct answers regarding the dislocation loop shown below (arrows on dislocation indicate line direction and black arrow inside the Burgers vector of dislocation)



a) Slip occurs by expansion of the loop

b) Slip can occur in a direction perpendicular to the lane of the loop.

c) Expansion always occurs in a direction parallel to the burgers vector on application of stress

d) The motion of the dislocation is conservative

7] Identify all the wrong answers regarding the slip plane.

a) Conservative motion of prismatic loop in fcc is by climb perpendicular to slip plane.

b) Slip plane and climb plane are always normal to each other

c) When a dislocations meet at a junction, the sum of the line direction vectors should be zero

d) The cross product of Burgers vector and the line direction, gives the plane normal to the slip plane