# B.MET. ENGG., 3$^{RD}$ YEAR, 1$^{ST}$ SEMESTER SUPPLEMENTARY EXAMINATION, 2017

## Subject: DEFORMATION AND FRACTURE BEHAVIOUR OF MATERIALS

Time: 3 hrs.

Full Marks: 100

_____(All parts of any question should be answered chronologically in one place)_____

Answer any five questions from the following:

**1. (a)** Distinguish between Slip and Twin.

5

**(b)** What is the condition for cross slip to occur in metals and alloys? Discuss the mechanism for formation of Lomer-Cottrell barriers during deformation of metals and alloys.

2 + 8 = 10

**(c)** What are the two reasons that make metals having HCP crystal structure comparatively brittle than metals having FCC crystal structure.

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**2. (a)** Explain the underlying reason for better strength-toughness combination in case of fine grained metals and alloys as compared to coarse grained ones.

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**(b)** Derive the Hall-Petch relationship. What is the limitation of Hall-Petch relationship? Can Hall-Petch relationship justify the strength of metals and alloys at temperatures above recrystallisation temperature? Justify in support of your answer.

5 + 2 + 3 = 10

**(c)** Give reason for directional dependence of elastic modulus in case of single crystal.

5

**3.(a)** Define the term – "Dislocation density". Derive the necessary expression correlating dislocation density with rate of plastic deformation.

2 + 6 = 8

**(b)** What is known as geometrically necessary dislocations and what is the reason for evolution of such dislocations?

6

**(c)** Discuss Bauschinger phenomenon. Between FCC and HCP single crystals which one would you choose for studying the Bauschinger phenomenon and why?

6

**4.** Give an account for different types of defects present in real crystalline materials. Elucidate the role of such defects in the plastic deformation process of metals and alloys.

12 + 8 = 20

**5. (a)** Write notes on: (i) Yield point phenomenon, (ii) Strain ageing) (ii) ductile fracture under tensile loading.

7 + 5 + 8 = 20

**6. (a)** State and explain Griffith's theory for brittle fracture. What is the limitation of this theory and how this limitation is taken into account for application of this theory?

3 + 4 = 7

**(b)** State the difference between stress concentration factor and stress intensity factor? After giving all the relationships for stress distribution ahead of crack in case of loading of a thin plate below the yield strength of the material find the approximate size of the plastic zone formed for such loading condition. Why plane strain fracture toughness is called a material property?

3 + 7 + 3 = 13

**7.** What is meant by strain energy release rate? Graphically show that strain energy release rate in case of fixed grip and fixed load conditions are same. In case of material that shows TYPE-I load-displacement behavior describe all the necessary steps to obtain the valid plane strain fracture toughness of the material.

4 + 6 + 10 = 20