Roll No. [redacted] Total Pages : 03

013402

May 2025

B.Tech. (Mech.) (Fourth Semester)

Material Engineering (PCC-ME-402-21)

Time : 3 Hours] [*Maximum Marks : 75*

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other. Assume suitable missing data

Part A

1. (a) Define linear and planar density. **1.5**

(b) Define twin boundary **1.5**

(c) Define CRSS. **1.5**

(d) What is the effect of grain size on the strength of a material ? **1.5**

(e) Draw S-N curve for ferrous and non-ferrous materials. **1.5**

(f) How the surface look like after ductile and brittle fracture ? **1.5**

(g) Write peritectic and eutectoid reaction. 1.5

(h) What do you mean by phase diagram ? 1.5

(i) Define Martempering. 1.5

(j) Define nano-material also write its two examples. 1.5

Part B

2. (a) Draw the following crystallographic directions and planes in : 8

(i) Cubic crystal

$[0\ 2\ 1]$, $[\bar{2}\ 1\ 2]$, $(\bar{2}\ \bar{1}\ \bar{1})$, $(1\ 3\ 2)$

(ii) Hexagonal crystal :

$[1\ 1\ \bar{2}\ 0]$, $(\bar{1}\ \bar{1}\ 2\ 0)$

(b) Differentiate between edge dislocation and screw dislocation. 7

3. (a) Discuss the mechanisms of plastic deformation. 8

(b) Derive Schmid's law. 7

4. (a) Define a crack. What are the characteristics of a crack ? 8

(b) Discuss the mechanism of ductile fracture. 7

5. (a) Discuss the Eutectic phase diagram. Also discuss the formation of microstructure for hypo-eutectic, eutectic and hyper eutectic composition. **8**

(b) Discuss Home Rothery rule. 7

6. (a) Discuss Annealing, Normalizing, Austempering and Tempering. Also mark them on TTT diagram. **8**

(b) Consider 1.0 kg of austenite containing 1.15 wt% C, cooled to below 727°C (1341°F) : 7

(i) What is the proeutectoid phase ?

(ii) How many kilograms each of total ferrite and cementite form ?

(iii) Schematically sketch and label the resulting microstructure

7. **Write short notes on the following : 15**

(i) **Composites**

(ii) **Biodegradable Polymers**

(iii) **Shape memory alloys.**

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