



GENERAL INSTRUCTIONS TO THE CANDIDATES

1. Candidates are instructed to answer the questions as per Bloom's Taxonomy knowledge level (K_1 to K_6)
2. Candidates are strictly instructed not to write anything in the question paper other than their roll number.
3. Candidates should search their pockets, desks and benches and handover to the Hall Superintendent/ Invigilator if any paper, book or note which they may find therein as soon as they enter the examination hall.
4. Candidates are not permitted to bring electronic watches with memory, laptop computers, personal systems, walkie-talkie sets, paging devices, mobile phones, cameras, recording systems or any other gadget / device /object that would be of unfair assistance to him / her.
5. Corrective measures as per KCT examination policies will be imposed for malpractice in the hall like copying from any papers, books or notes and attempting to elicit the answer from neighbours

B.E DEGREE EXAMINATIONS: JUNE 2016

(Regulation 2015)

Second Semester

U15PHT202: MATERIALS SCIENCE

(Common to AUE/AE/ME & MCT)

COURSE OUTCOMES

- CO1:** Apply core concepts in Materials Science to solve engineering problems.
- CO2:** Determine the position of the acceptor or donor levels and the band gap of an extrinsic semiconductor.
- CO3:** Classify and differentiate the structure and physical properties of conducting materials.
- CO4:** Apply the techniques to manufacturing of modern materials and nano materials for engineering applications.
- CO5:** Recognize the basic concepts of strengthening of materials in technological applications.

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. At very high temperature, the mean free path and collision time in a conductor are proportional to CO1 [K₁]
 - a) $1/T$
 - b) Independent of T
 - c) $1/T^2$
 - d) T

a) Both A and R individually false and R is the correct explanation of A b) A is false but R is true

c) A is true and R is false. d) Both A and R are true.

9. The continuous deformation of a metal under steady load with the passage of time is called CO5 [K₁]

a) Fatigue b) Brittle fracture

c) Fracture d) Creep

10. Matching type item with multiple choice code CO2 [K₁]

List I	List II
A. N-type semiconductor	i. It provides information about the sign of the charge carriers
B. P-type semiconductor	ii. Pure semiconductor
C. Intrinsic semiconductor	iii. Arsenic doped with pure semiconductor
D. Hall effect	Iv Boron doped with pure semiconductor.

A B C D

a) 1 3 4 2

b) 4 2 1 3

c) 2 4 1 3

d) 3 4 2 1

PART B (10 x 2 = 20 Marks)

(Answer not more than 40 words)

11. How the band theory is different from classical free electron theory? CO1 [K₁]

12. Show that (mathematically) the superconductors are perfectly diamagnetic. CO1 [K₂]

13. Calculate the electronic polarisability of Ar atom whose radius is 0.384nm. CO2 [K₁]

14. Show the variation of Fermi level with temperature in N-type semiconductor (diagram only). CO2 [K₂]

15. Mention the importance of band gap in solids. CO2 [K₁]

16. What are Ferro electric materials? CO3 [K₁]

17. Mention the characteristics of nanomaterials. CO4 [K₁]

18. List out the properties of metallic glasses. CO4 [K₁]

19. What are the various strengthening mechanisms . CO5 [K₂]

20. Define Fatigue. CO5 [K₂]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

21. i) Explain Griffith theory of Brittle fracture. (7) CO4 [K₁]
- ii) Discuss the factors that will affect the mechanical properties of Grain size and heat treatment. (7)
22. i) Deduce an expression for density of energy states and carrier concentration in metals. (10) CO1 [K₂]
- ii) Calculate the intrinsic conductivity of Si at 300K, $\mu_e=0.135\text{m}^2\text{V}^{-1}\text{s}^{-1}$, (4)
 $\mu_h=0.048\text{m}^2\text{V}^{-1}\text{s}^{-1}$, $n_i= 2.4\times 10^{19}\text{m}^{-3}$.
23. i) Define Hall effect and derive an expression for Hall voltage and Hall coefficient in a semiconducting material. (10) CO3 [K₂]
- ii) The Hall coefficient and conductivity of Cu at 300K is $-0.55\times 10^{10}\text{m}^3\text{A}^{-1}\text{s}^{-1}$ and $5.9\times 10^7\ \Omega^{-1}\text{m}^{-1}$, respectively. Calculate the drift mobility of electrons in copper. (4)
24. i) Explain the Weiss theory of Ferromagnetism and obtain an expression for ferromagnetic susceptibility. (10) CO2 [K₄]
- ii) Discuss the frequency and temperature dependence of polarization. (4)
25. i) Discuss preparation, properties and applications of shape memory alloys. (10) CO1 [K₂]
- ii) The critical temperature of lead is 6.2K at zero magnetic field and it has a critical field of $0.064\ \text{MAm}^{-1}$ at 0K. Determine the critical field at 4K. (4)
26. i) Explain the manufacturing of Carbon nano tubes by CVD and DC arc discharge methods. (10) CO5 [K₁]
- ii) Explain the properties of nano materials. (4)
27. Discuss the Cryotron, Magnetic levitation and SQUIDS in a superconductor with suitable diagrams. CO1 [K₁]
