

Q.P. Code – 50822

Third Year B.Sc. Degree Examination

OCTOBER/NOVEMBER 2014

(Directorate of Distance Education)

Physics

**(DSC 211) Paper IV – NUCLEAR PHYSICS, SOLID STATE PHYSICS
AND ELECTRONICS**

Time : 3 Hours]

[Max. Marks : 75/85

Instructions to Candidates :

- 1) *Students who have attended **25** marks **I-A** scheme will have to answer for total of **75** marks.*
- 2) *Students who have attended **15** marks **I-A** scheme will have to answer for total of **85** marks.*
- 3) *Section-**E** is **compulsory** for **85** marks scheme **only**.*

SECTION – A

I. Answer **ALL** questions : **10 × 1 = 10**

1. What is hysteresis loss?
2. Where does the Fermi level lies in the p-type semiconductor?
3. State Norton's theorem for AC circuits.
4. Which type of modulation is used for video signal transmission?
5. Define Fermi level.
6. Why fusion reaction cannot be produced at ordinary temperature?
7. Write the significance of modulation index.
8. Why neutrons are better projectiles for producing nuclear reactions?
9. State De Morgan's theorem.
10. Define drift velocity of electrons.

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SECTION – B

- II. Answer any **FIVE** questions : **5 × 3 = 15**
11. Define nuclear cross section. Distinguish between exoergic and endoergic reactions.
 12. Describe the functions of RADAR system with a neat diagram.
 13. Explain how to nortonize a circuit.
 14. Mention the differences between nuclear fission and nuclear fusion reactions.
 15. Obtain Miller indices of a plane which intercepts at a , $b/2$ and $3c$ in a simple cubic unit cell. Draw a neat diagram showing the plane.
 16. What are the failures and success of the classical free electron theory?
 17. Calculate the critical current for a wire of lead having a diameter of 1 mm at 4.2 K. The critical temperature for lead is 7.18 K and $H_0 = 6.5 \times 10^4 \text{ Am}^{-1}$.

SECTION – C

- III. Answer any **FIVE** questions : **5 × 6 = 30**
18. Give the theory of successive disintegration of a radioactive substance and arrive at the condition for (i) secular equilibrium and (ii) transient equilibrium.
 19. (a) What are cosmic ray showers? Explain.
(b) Write a note on east-west asymmetry.
 20. What is transistor biasing? With a neat circuit diagram, describe the potential divider method of biasing.
 21. Deduce an expression for electrical conductivity of an intrinsic semiconductor in terms of its energy gap and absolute temperature.
 22. Give Debye's theory of specific heat of solids and discuss high and low temperature limits.

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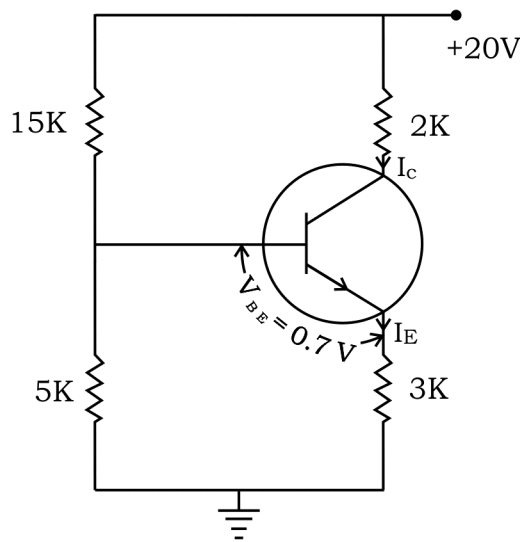
23. State Barkhausen criterion. Explain the construction and working of Hartley oscillator. Write the expression for frequency of oscillation.
24. Simplify the following Boolean expressions :
- (a) $Y = A\bar{B}C + A\bar{B}\bar{C} + \bar{A}BC + \bar{A}\bar{B}C + ABC$
- (b) $Y = (AB + C)(AB + D)$

SECTION – D

- IV. Answer any **TWO** questions : **2 × 10 = 20**
25. (a) What are particle accelerators? Describe the construction and working of a Betatron. What are the limitations of cyclotron?
- (b) In a fission reactor operating at a power level of 10^9 Watts, average time lapse between the emission of prompt neutron and its capture to induce the next generation of the chain reaction is 10^{-3} seconds. Estimate the number of free neutrons present in this reactor. **6 + 4**
26. (a) Explain the principle, construction, working and characteristics of G-M counter.
- (b) Which of the following reactions are allowed and forbidden under the conservation of strangeness, conservation of baryon number and conservation of charge.
- (i) $\pi^+ + n \rightarrow \Lambda^0 + K^+$
- (ii) $\pi^+ + n \rightarrow K^0 + K^+$ **6 + 4**
27. (a) Explain
- (i) BCS theory of superconductivity.
- (ii) Show that $\bar{E} = 3/5 E_{F0}$.
- (b) The rare earth element gadolinium is ferromagnetic below 16°C with 7.1 Bohr magneton per atom. Calculate the magnetic moment per atom. What is the value of saturation magnetization? Given : Atomic weight of gadolinium is 157.26 and its density is $7.8 \times 10^26 \text{ kg m}^{-3}$. **6 + 4**

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28. (a) With a neat circuit diagram and truth table, explain the operation of OR gate and AND gate using semiconductor diodes.
- (b) For the given circuit, draw the dc load line and determine its Q-point. Assume silicon transistor. **6 + 4**



SECTION – E

V. Answer any **ONE** question : **1 × 10 = 10**

(Compulsory question for 85 marks scheme only)

29. (a) Explain the characteristics of nuclear forces. Give the meson theory of nuclear forces.
- (b) Using the liquid drop model, find the expression for the most stable isobar for a given odd A. Find the stable atom with A = 77. **6 + 4**
30. (a) What is heterodyning? Describe the working of superheterodyne receiver with a neat block diagram.
- (b) Apply Thevenin's theorem to find current through the 12 Ω resistor of the given circuit. **6 + 4**

