Third Year B.Sc., Degree Examinations,

December 2017

(Directorate of Distance Education)

PHYSICS

Paper– IV: DSC – 211: Nuclear Physics, Solid State Physics and Electronics

Time: 3 hrs] *[Max. Marks: 75/85*

Instruction to the Candidates:

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

SECTION – A

I. ***Answer the following in a word, a phrase or a sentence:*** 10 x 1 = 10 Marks

1. Define Nuclear Magnetic moment.
2. What is meant by Resolving time of the GM – counter?
3. What is the significance of density of electronic states.
4. State the principle of equivalence.
5. What is the Relaxation time of free electrons in a solid?
6. Why is ac load line steeper than dc load line for a transistor amplifier?
7. Define primitive cell.
8. Write the Boolean equation for X – OR gate.
9. Define deflection sensitivity of CRO.
10. In which conditions the Amplifier becomes an oscillator?

SECTION – B

II. ***Answer any FIVE of the following questions:*** 5 x 3 = 15 Marks

11. Discuss the contribution of electrons to the specific heat of metals using quantum free electron theory.
12. What is Josephson effect? Mention and explain the types of it in detail.
13. Write the Merits and Demerits of shell model of a Nucleus.
14. What is Gravitational Redshift? Expalin.
15. Simplify $\overline{ABC + \overline{A}C + BC}$ and draw the logic diagram.

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16. What is East – West asymmetry? Explain.

17. In a Hartley – Oscillator $L_1 = 0.1mH$, $L_2 = 50\mu H$ and $M = 25\mu H$. Find the value of the capacitance of the oscillator circuit to obtain a frequency of 5MHz.

SECTION – C

III. Answer any FIVE of the following questions: 5 x 6 = 30 Marks

18. Derive the betatron condition for successful acceleration of electrons. Briefly describe its principle, construction and function of altering magnetic field in it?

19. Discuss the Yukawa's theory of Meson model of nuclear forces and mention the characteristics of Nuclear forces.

20. Explain the concept of free electrons. Obtain an expression for electrical conductivity based on classical free electron theory.

21. Describe with energy band diagram the construction and characteristics of n – type semiconductors and show that Fermi level lies just below the conduction band in it. Discuss the effect of variation of temperature on Fermi energy.

22. Explain briefly, the need for modulation in a communication system. With the help of block diagram describe the operation of a TV – transmitter.

23. What are synchronus Flip-Flops? Discuss the construction and working of a J – K Flip-Flop and explain how the drawbacks of a J – K Flip-Flop are overcome by M–S flip – flop.

24. Explain the origin of diamagnetism and paramagnetism on the basis of atomic structure. Explain qualitatively the variation of susceptibility of dia, para and ferromagnetic materials.

SECTION – D

IV. Answer any TWO of the following questions: 2 x 10 = 20 Marks

25. a) State and explain Thevenin's theorem.

    b) Draw the dc and ac load lines for the CE transistor amplifier circuit. Given: $R_1 = 16K\Omega$, $R_2 = 6K\Omega$, $R_C = 3K\Omega$, $R_E = 2K\Omega$, $V_{CC} = 20V$. Neglect V_{BE}.

    c) Mention the factors affecting the stability of Q – point. (4 + 4 + 2)

26. a) What is meant by Transistor biasing? Obtain the expression for V_{CE} and I_C in case of self biasing method.

Contd.....3

b) A stabilized voltage 12V across a load, whose Current varies from 5mA to 35mA with an unregulated dc supply of 18V is to be obtained with a Zener voltage 12V and $I_{Z(\max)} = 20mA$. Calculate the value of the current limiting resistance required for the same and the power dissipated in the resistance. (6 + 4)

27. a) What are the difficulties faced in explaining $\beta-$ ray Spectrum? Give the Fermi's theory of $\beta-$ decay.

b) Find the number of $\alpha-$decays that occur in 1 centigram sample of thorium – 232 in one year. If the disintegration constant 'λ' of thorium is $1.85\times10^{-18}/\text{sec}$. (7 + 3)

28. a) Explain the principle, construction, working and characteristics of a GM counter.

b) Calculate the power out put of a nuclear reactor which consumes 25gm U – 235 per day. Assume 5% reactor efficiency and energy released per fission is 200 MeV. (6 + 4)

SECTION – E

V. Answer any ONE of the following questions: 1 x 10 = 10 Marks

(Compulsory question for 85 marks scheme only)

29. a) What are elementary particles? Give the classification of elementary particles with examples.

b) Write a note on type – I and type – II super conductors. (6 + 4)

30. a) Derive an expression for number of daughter atoms of a radioactive element at a given instant of time. Discuss secular and transient equilibrium.

b) A p – type Ge has a donar density of $10^{23}/m^3$. It is used in Hall effect experiment in which a magnetic field of 0.5T is used and a current of 300 Am^{-2} is passed. If the thickness of the Ge is 4mm. Find the Hall voltage developed. (7 + 3)

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