**Q.P. Code – 50822**

**Third Year B.Sc. Degree Examination**

**SEPTEMBER/OCTOBER 2013**

**(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. Define nuclear reaction cross-section.

2. State Geiger-Nuttal law.

3. What are the components of secondary cosmic rays?

4. Which quark combination make up the antiproton?

5. What is lattice point group?

6. State superposition theorem.

7. What are phonons?

8. State Barkhausen criterion.

9. What are class-B amplifiers?

10. Define modulation index.

SECTION – B

II. Answer any **FIVE** questions : **5 × 3 = 15**

11. Explain Meson theory of nuclear forces.

12. What are the similarities between a liquid drop model and a nucleus?

13. Discuss the contribution of electron to the specific heat of metals using quantum free electron theory.

14. Debye temperature of a solid is 3000 K. Calculate the specific heat at room temperature.

15. Describe the construction and working of a phase shift oscillator with a neat circuit diagram.

16. Draw the logic circuit for the Boolean expression $Y = \overline{A} \cdot B + A \cdot \overline{B}$, using basic logic gates.

17. Explain the principles of T.V. transmission and reception using block diagrams.

SECTION – C

III. Answer any **FIVE** questions : **5 × 6 = 30**

18. Explain the construction and working of a cyclotron with theory.

19. Explain :

    (a) Production of cosmic ray showers

    (b) C-N nuclear fusion reaction.

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

21. Obtain an expression for concentration of charge carriers and discuss the position of Fermi level in p-type semiconductor.

22. Explain :

    (a) Meissner effect exhibited by superconductors

    (b) Type-I and Type-II superconductors

23. What are AC and DC loadlines? Explain the working of zener diode as voltage regulator.

24. Explain the principle and working of superheterodyne receiver. What are its advantages?

SECTION – D

IV. Answer any **TWO** questions : **2 × 10 = 20**

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

(b) The Q-value of $Na^{23}(n_1\alpha)F^{20}$ reaction is $-5.4$ MeV. Determine the threshold energy of the neutrons for this reaction. Given mass of neutron = 1.00866 amu and Mass of $Na^{23}$ = 22.99097 amu. **7 + 3**

26. (a) Explain the principle, construction, working and characteristics of a G-M counter.

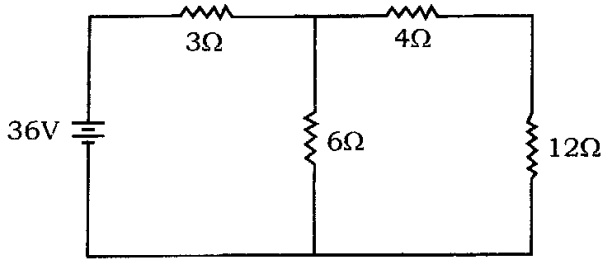
(b) In a nuclear reactor, the reactor is developing energy at the rate of 1500 kW. How many atoms of $U^{235}$ undergo fission per second? How many kgm of $U^{235}$ would be used in 1000 hours of operation. Assuming that on an average energy of 200 MeV is released per fission. **6 + 4**

27. (a) Explain the origin of dia, para and ferro magnetism on the basis of electronic structure of atoms and their characteristic features.

(b) Give the theory of Hall effect and its applications. **5 + 5**

28. (a) What are flipflops? Explain the operation of R-S flip flop using logic diagram and truth table. What are its demerits?

(b) Find the current through the $12-\Omega$ resistor of the circuit by applying Thevenin's theorem. **6 + 4**



SECTION – E

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

(**Compulsory** question for **85** marks scheme **only**)

29. (a) Derive four factor formula.

(b) A quantity of ore is found to contain 1 kg of uranium–238, the half life of $U^{238}$ is $4.5 \times 10^9$ years and that of radium of amu 226 is 1620 years. Find the mass of the radium in the ore considering them in radioactive equilibrium. **6 + 4**

30. (a) Obtain an expression for Fermi energy and average energy at absolute zero temperature.

(b) Find the Miller indices of a plane which is parallel to the *Y*-axis and cuts intercepts of 2 and 1/3, respectively along *x* and *z* axes. **8 + 2**