DSC – 211

III Year B.Sc. Degree Examination, Sept./Oct. 2012
(Directorate of Distance Education)
PHYSICS
Paper – IV : Nuclear Physics, Solid State Physics and Electronics

Time : 3 Hours Max. Marks : 75/85

Instructions *: 1) Students who have attended **25** marks **IA scheme** will have to answer for total of **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 **all** questions. **(10×1=10)**

1) When a radioactive nucleus emits a β-particle, what will happen to the neutron/proton ratio ?

2) What do you mean by enriched uranium ?

3) Why does fusion reaction take place only at high temperature ?

4) Why neutrons are moderated to thermal speeds in nuclear reactors ?

5) What are gluons ?

6) What is unit cell of a crystal ?

7) What will happen to the position of fermi level when the number of impurity atom is increased in a n-type semiconductor ?

8) Define Hall coefficient.

9) Which mode of operation enable a transistor to be used as a closed switch ?

10) Why is the Astable multivibrator called a free-running oscillator ?

P.T.O.

SECTION – B

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

11) What are the similarities between a liquid drop and a nucleus ?

12) Explain why a neutron is having negative magnetic moment.

13) Explain any three basic interactions in nature.

14) Explain the procedure to find the Miller indices of a crystal.

15) Describe briefly the formation of domains and explain the characteristic features of a ferromagnetic substance.

16) Describe the experimental observation which establish the diamagnetic property of a super conductor.

17) Distinguish different types of multivibrators.

SECTION – C

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

18) Derive an expression for transient and permanent equilibrium using the theory of successive disintegration.

19) Describe with neat diagram the construction and working of a cyclotron. Arrive at the expression for final energy interms of frequency of the ion.

20) What are hard and soft components of cosmic rays ? Explain the production of cosmic ray showers.

21) Using quantum free electron theory discuss.

a) the contribution of electron to the specific heat capacity of metals and
b) the development of contact potential difference between the two metals.

22) Using Band theory of solids obtain the expression for concentration of charge carriers and discuss the position of Fermi level in an n-type semiconductor.

23) What is transistor biasing ? Explain with the help of circuit diagram the working of voltage divider method of biasing a transistor.

24) Explain with the help of Block diagram the principle and working of superheterodyne radio receiver. What are its advantages ?

SECTION – D

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

25) a) Mention the characteristics of nuclear forces and explain qualitatively the Meson theory of nuclear forces. **6**

b) The nuclear reaction is given by

$$_{7}N^{14} + {}_{0}n^{1} \rightarrow {}_{6}C^{14} + {}_{1}H^{1} + 0.55\,MeV$$

Find the mass of C^{14} in amu

Given $m(N^{14}) = 14.007520$ amu

$m(_{1}H^{1}) = 1.008145$ amu

$m(_{0}n^{1}) = 1.008986$ amu **4**

26) a) Explain with neat diagram the principle, construction and working of a scintillation counter. **6**

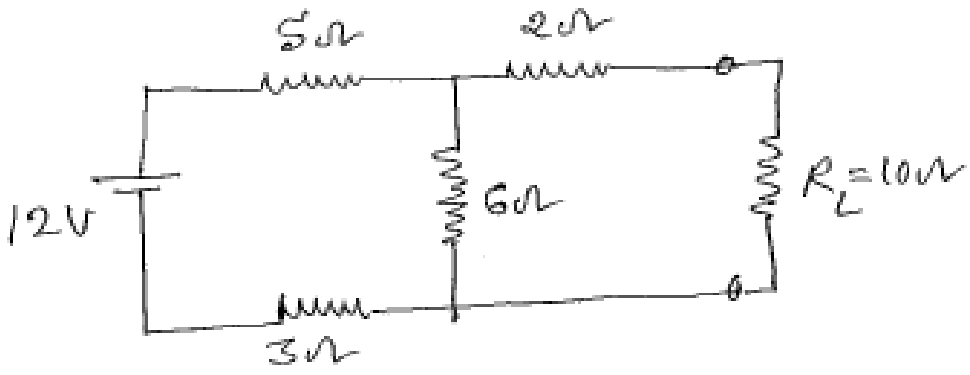
b) A G.M. counter will collect 10^8 electrons per discharge when the counting rate is 500 counts/min. What will be the average current in the circuit ? **4**

27) a) Give the classical free electron theory of metals and obtain the expression for specific resistance. **6**

b) Find the Fermi energy in copper on the assumption that each copper atom contribute one free electron to the electron gas. The density of copper is 8.94×10^3 Kgm^{-3} and its atomic mass is 63.5u. **4**

28) a) What are oscillators ? With the help of circuit diagram explain the principle and operation of a phase shift oscillator. **6**

b) Using Thevenin's theorem find the current through the load resistance R_L in the circuit shown below. **4**



SECTION – E

V. Answer **any ONE** of the following questions. **(1×10=10)**

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

29) a) Derive Fermi four factor formula. **6**

b) A nuclear reactor using $_{92}U^{235}$ is to operate at a power level of 250 megawatts. If the energy released per fission of $_{92}U^{235}$ is 200 mev. Calculate the rate of consumption of $_{92}U^{235}$ per year. Assuming that there are no losses and that the mass of atom equal to the sum of the masses of nucleus where each nucleon has a mass equal to 1 amu. **4**

30) a) What are Flip-Flops ? With the help of logic circuit diagram and Truth table explain the operation of RS flip-flop. Mention its demerits. **6**

b) The electron and hole mobilities in a silicon sample are 0.135 and 0.048 $m^2/V - S$ respectively. Determine the conductivity of intrinsic silicon at 300 K if the intrinsic carrier concentration is $1.5x10^{16}$ atoms/m^3. The sample is then doped with 10^{23} phosphorus atom/m^3. Find the equilibrium hole concentration and conductivity. Assume that all the donor atoms are ionized. **4**