C 23328   (Pages : 3)   Name.....................................

Reg. No.............................

FOURTH SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2017

(CUCBCSS–UG)

Complementary Course

PHY 4C 04—ELECTRICITY MAGNETISM AND NUCLEAR PHYSICS

Time : Three Hours   Maximum : 64 Marks

Section A (One Word)

Answer **all** *questions.*
Each question carries 1 *mark.*

1. A set of n identical resistors, each of resistance R ohm when connected in series have an effective resistance of X ohm and when the resistors are connected in parallel, the effective resistance is Y ohm. The relation between R, X and Y is ————

2. Relative permittivity of a medium is also called ———— constant.

3. Superconductivity was discovered by ————

4. Steel or alloy like alnico are preferred for making permanent magnets because they have large ————

5. The value of intensity of magnetization is small positive fora specimen. Then it is a ———— substance.

6. Range of nuclear force is of the order of ————

7. The exchange particle in weak interaction is ————

8. The binding energy per nucleons for most of the nuclei is constant and is equal to ————

9. In the decay scheme $_zP^A \rightarrow {}_{z-1}D^A + ... + ...$

10. The energy of gamma radiations produced due to electron positron annihilation is ———— each.

$(10 \times 1 = 10 \text{ marks})$

Section B (Short Answer Questions)

Answer **all** *questions.*
Each question carries 2 *marks.*

11. Explain the properties of electric lines of force.

12. Using Gauss' theorem, find the value of field inside a uniformly charged spherical shell. Use this to gather information on electric potential inside it.

13. State two applications of super conductors.

14. In superconductivity what are called Critical Temperature T_c, and Critical Magnetic Field H_c? Is H_c related to T_c ?

Turn over

15. Draw the graph showing the variation of binding Energy per nucleon with mass number. Write two inferences drawn from the graph.

16. What is cosmic background radiation (CMB) ?

17. What are Mesons? Which one is the lightest Meson ?

<div align="right">(7 × 2 = 14 marks)</div>

Section C (Paragraph Questions)

Answer any two questions.
Each question carries 4 marks.

18. Deduce the expression for the capacitance of a parallel plate capacitor, when a dielectric slab is inserted between its plates. Assume the slab thickness be less than the plate separation.

19. With the help of a neat diagram and necessary theory, explain how the temperature coefficient of the material of a resistor can be determined using Carey Foster's Bridge.

20. Explain the laws of radioactive disintegration and hence obtain the expression for half life period T.

21. Discuss with neat diagram the working of a semiconductor detector.

22. Show that the conservation of the relevant quantum numbers holds for the neutron decay :

$$n \rightarrow p + e^- + v_e.$$
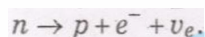
<div align="right">(2 × 4 = 8 marks)</div>

Section D (Problems)

Answer any three questions.
Each question carries 4 marks.

23. A 600 pF capacitor is charged by 200 V supply. It is then disconnected from the supply and connected to another uncharged 600 pF capacitor. How much electric energy is lost in the process ?

24. The resistance of potentiometer wire of length 10 m is 20 Ω. A resistance box and a 2V accumulator are connected in series with it. What resistance should be introduced in the box to have a potential drop of one microvolt per millimeter of the potentiometer wire ?

25. At 52° from the magnetic meridian, a magnetic needle in a vertical plane makes an angle 45° with the horizontal plane. Find the actual angle of dip at that place.

26. Half life of U^{238} against alpha decay is 1.42×10^{17}. How many disintegration per second occur in 1 gm of U^{238} ? Given, Avagadro number is 6.02×10^{23} mol^{-1}.

27. Which of the following reactions can occur ? State the conservation laws violated by the others.

$p + p \rightarrow n + p + \pi^+$ .... (i)

$p + p \rightarrow p + \Lambda^\circ + \Sigma^+$ .... (ii)

$e^+ + e^- \rightarrow \mu^+ + \pi^-$ .... (iii)

$\Lambda^\circ \rightarrow \pi^+ + \pi^-$ .... (iv)

<div align="right">(3 × 4 = 12 marks)</div>

Section E (Essays)

Answer any **two** *questions.*
Each question carries 10 *marks.*

28. Explain the theory of vibration magnetometer. Describe how it can be used to compare the magnetic moments of two bar magnets of (i) same size and (ii) unequal size.

29. Define Gauss' law in electrostatics. Use this to find the electric fields due to (i) similarly ; and (ii) oppositely charged two infinite plane parallel sheets. Also derive the capacitance of a parallel plate capacitor.

30. What are cosmic rays ? Discuss the phenomenon of cosmic ray showers with special reference to its latitude and longitude effects.

$(2 \times 10 = 20$ marks)