B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, OCTOBER 2013

Third Semester

Complementary Course—QUANTUM MECHANICS, SPECTROSCOPY, NUCLEAR PHYSICS AND ELECTRONICS

(Common for B.Sc. Chemistry and B.Sc. Geology)

Time : Three Hours   Maximum Weight : 25

Part A (Objective Type Questions)

Answer all questions.
Each bunch of four questions carries a weight of 1.

Bunch I

1. Photoelectric emission is :

     (a) Stimulated process.   (b) A spontaneous process.

     (c) An instantaneous process.   (d) None of the above.

2. The angular momentum of an electron in the third orbit is given by :

     (a) $nh/2\pi$.   (b) $sh/2\pi$.

     (c) $h/2\pi$.   (d) $3h/2\pi$.

3. Neutrons possess magnetic moment due to :

     (a) Orbital motion.   (b) External magnetic field.

     (c) Spin motion.   (d) Both orbital and spin motion.

4. Forbidden energy gap exists between :

     (a) Valence bands.   (b) Conduction bands.

     (c) Energy bands.   (d) Valence band and conduction band.

Bunch II

5. Wave function is associated with :

     (a) Space and time.   (b) Time only.

     (c) Space only.   (d) None of the above.

6. The Balmer series of hydrogen falls in :

     (a) Ultraviolet region.   (b) Visible region.

     (c) Infrared region.   (d) For infrared region.

Turn over

7. Greater the binding energy per nucleon, the more :

    (a) Stable the nucleus is.   (b) Unstable the nucleus is.

    (c) The activity is.   (d) None of the above.

8. The maximum efficiency of a half wave rectifier is :

    (a) 50 %.   (b) 100 %.

    (c) 40.6 %.   (d) 81.2 %.

Bunch III

9. The work function for sodium is :

    (a) 6.4 eV.   (b) 2.3 eV.

    (c) 1.9 eV.   (d) 0.9 eV.

10. Raman shift :

    (a) Depends on Stokes lines.

    (b) Depends on antistokes lines.

    (c) Is independent of the frequency of the parent line.

    (d) Depends on the frequency of the parent line.

11. The energy of sun is due to :

    (a) Fission.   (b) Fussion.

    (c) Nuclear reactions.   (d) All the above.

12. Positive feedback is used in :

    (a) Oscillators.   (b) Amplifiers.

    (c) Power amplifiers.   (d) Both in oscillators and amplifiers.

Bunch IV

13. The non-existence of electrons in the nucleus can be proved by :

    (a) Dual nature of matter.   (b) Quantum theory.

    (c) Wave nature of particles.   (d) Uncertainty principle.

14. The potential energy of a diatomic molecule varies with :

    (a) The velocity.   (b) The mass.

    (c) Internuclear distance.   (d) The position.

15. The neutron production rate can be controlled by using :

    (a) Graphite rod.   (b) Cadmium rod.

    (c) Boron rod.   (d) Both Cadmium and Boron rod.

16. Faithfull amplification is the process of raising the strength of a weak signal without any change in its :

    (a) Shape.   (b) Power.

    (c) Quality.   (d) Size.

$(4 \times 1 = 4)$

Part B

*Answer any **five** questions.*
Each question carries a weight of 1.

17. State the laws of photoelectric effect.

18. What is a wave function ? Explain normalisation.

19. Give the postulates of Bohr atom model.

20. Briefly discuss the quantum theory of Raman effect.

21. List the properties of nuclei.

22. Explain the energy production in stars.

23. How stability of a nucleus is achieved ? Explain.

24. What is transistor biasing ? State its relevance in the circuit.

$(5 \times 1 = 5)$

Part C

*Answer any **four** questions.*
Each question carries a weight of 2.

25. An electron has a speed of 1.05×10^4 ms^{-1} with in an accuracy of 0.01 %. Calculate the uncertainty in the position of electron.

26. Determine the wavelength of H_β line of hydrogen spectrum.

27. The disintegration rate of a radioactive sample at any instant is 4750 per minute. Five minutes later this rate becomes 2700 per minute. Calculate the decay constant and half life.

28. Calculate the energy released in kWh by the fission of one gram of $^{235}_{92}U$, if each fission yields 200 eV.

29. A piece of wood from the ruins of an ancient dwelling was found to have a ^{14}C activity of 13 disintegrations per minute per gram of its carbon coefficient. The activity of living wood is 16 disintegrations per minute per gram. How long ago did the tree die from which the wood sample came ?

30. A bridge rectifier with capacitor filter is to be used to convert 230 V a.c. to 12 V d.c. for small load currents. Find the turn ratio of the transformer.

$(4 \times 2 = 8)$

Part D

*Answer any **two** questions.*
Each question carries a weight of 4.

31. Describe the Davison-Germer experiment and bring out the various conclusions.

32. Discuss the fabrication, working and maintenance of a nuclear reactor.

33. Obtain the input and output characteristics for a common emitter *n-p-n* transistor.

$(2 \times 4 = 8)$