Q.P. Code – 50821

Third Year B.Sc. Degree Examination

OCTOBER/NOVEMBER 2014

(Directorate of Distance Education)

Physics

(DSC 210) Paper III – SPECTROSCOPY, WAVE MECHANICS, STATISTICAL MECHANICS, RELATIVITY AND ASTROPHYSICS

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. Is simultaneity a relative concept according to Newtonian Physics?

2. What is the use of resonator in the production of laser?

3. Write significance of Einstein's mass–energy relation.

4. Expand CMB radiation.

5. What are Pulsars?

6. State the principle of indistinguishability.

7. Mention any one limitation of de Broglie's hypothesis.

8. What is the significance of a wave function?

9. State Duane-Hunt law.

10. Mention any two applications of Raman effect.

SECTION – B

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

11. Explain a method to find the ratio of mass of electron to that of proton using the concept of Rydberg constant.

12. Discuss in detail, the significance of Moseley's work.

13. Optical pumping is not employed in He-Ne laser, give reason.

14. Calculate the expectation values of energy, momentum and position, when electron is inside a potential well of width of 10 Å and it is in the ground state.

15. Distinguish between $M-B$, $F-D$ and $B-E$ statistics.

16. Write a note on H-R diagram.

17. Explain the concepts of space and time in relativity theory.

SECTION – C

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

18. Give the experimental evidences for the big bang model.

19. With necessary theory, discuss Thomson's method of determining e/m of electron.

20. Write a note on White dwarfs and Neutronstars.

21. Write Lorentz transformation equations and hence derive velocity addition theorem for all the components of velocity.

22. Set up Schrödinger's time dependent equation.

23. What is Compton effect? Give the theory of Compton effect.

24. (a) With neat labelled diagrams, discuss the construction and working of He-Ne laser.

    (b) Give an account of orbital magnetic quantum number 'm_l'. **4 + 2**

SECTION – D

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

25. (a) Illustrate Heisenberg's uncertainty principle using gamma ray microscope.

(b) Calculate the Schwarzschild radius of a star, with mass $M = 5M_{\odot}$, where solar mass is 2.96×10^{30} kg. **6 + 4**

26. (a) Discuss the quantum mechanics of an electron bound to a proton via coulomb potential in a hydrogen atom.

(b) Calculate de Broglie wavelength of a neutron at temperature 300 K. **7 + 3**

27. (a) Explain the normal Zeeman effect based on vector atom model.

(b) Write a note on holography. **7 + 3**

28. (a) Explain the origin of pure rotational spectrum of a molecule.

(b) Discuss the origin and theory of vibration-rotation spectrum of a diatomic molecule. **4 + 6**

SECTION – E

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

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

29. (a) Assuming validity of conservation of momentum in every inertial frame, derive an expression for relativistic mass.

(b) Obtain Einstein mass-energy relation. **6 + 4**

30. (a) Describe Davisson and Germer experiment and explain how it supports the concept of matter waves.

(b) Hydrogen atom has ground state energy – 13.6 eV. Calculate

(i) the energies in the first and second excited states and

(ii) the wavelength of light emitted or absorbed in a transition between these two states (given $h = 6.625 \times 10^{-34}$ JS and C = 3×10^{8} m/sec.) **6 + 4**
