Q.P. Code – 50821

Third Year B.Sc. Degree Examination, OCTOBER/NOVEMBER 2016

(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 the questions :** 10 × 1 = 10

1. What is ESR?

2. What is Rayleigh Scattering?

3. What is Hamiltonian operator?

4. Define proper length.

5. Define Gyro magnetic ratio of an electron.

6. What is the principle of laser action?

7. Define parsec.

8. What are White X-rays?

9. Define thermodynamic probability of a macro state.

10. State Hubble's law.

SECTION – B

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

11. Give the difference between Inertial mass and Gravitational mass.

12. What is meant by laser pumping? Mention its types.

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13. Explain the variation of Rydberg constant with finite mass of the nucleus.

14. What are Matter waves? Obtain the De-Broglie wavelength of a particle moving with kinetic energy E.

15. Show that for a relativistic particle the maximum attainable velocity is the velocity of light.

16. Distinguish between M-B and B-E Statistics.

17. There are certain types of stars called variable stars, which undergo periodic change in their light output. If such a star doubles its light output, how much does its magnitude change?

SECTION – C

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

18. Describe with neat diagram Michelson-Morley experiment. Explain the significance of Negative results.

19. With neat diagram, relevant theory and principle describe Thomson's method of determining specific charge of an electron.

20. (a)   What is H-R diagram? Explain.

    (b)   When does a star end up as a white dwarf?

21. Describe the construction and working of He-Ne laser with energy level diagram.

22. What is Zeeman Effect? Give the Quantum theory of Normal Zeeman Effect.

23. Obtain the Schrödinger's equation of a particle in an infinite square well potential and solve for energy Eigen values.

24. Derive an expression for the change in wavelength of the photon due to Compton scattering. Why X-rays are best suited for the study of Compton Effect?

SECTION – D

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

25. (a)   With relevant theory, explain Davisson and Germers experiment to substantiate concept of matter waves.

    (b)   An electron of mass 9.1×10^{-31} kg has a speed of 350 m/s with an accuracy of 0.015%. Calculate the uncertainty with which position of electron can be located.   **7 + 3**

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26. (a) Deduce Einstein's mass-energy relation.

    (b) A particle of rest mass moves with a speed 0.6 c. Calculate its mass, momentum, total energy and kinetic energy. **6 + 4**

27. (a) Give the quantum theory of Raman effect and mention the application of Raman effect.

    (b) When 400 V electrons are diffracted by a crystal, the angular diffraction pattern is identical with that produced by X-rays of wavelength 0.61 Å. Calculate Planck's constant. **6 + 4**

28. (a) Explain briefly Einstein's theory of Gravitation. Mention the experimental observations in support of Einstein's theory and explain advance of perihelion of planet mercury.

    (b) In a normal Zeeman Effect, the sodium 422.6 nm line splits into three components separated by 0.025 nm in a magnetic field of 3T. Calculate the value of specific charge of the electron. **7 + 3**

SECTION – E

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

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

29. (a) Obtain time-independent Schrödinger wave equation for a quantum particle.

    (b) Calculate the zero point energy and the spacing of the energy levels in a one dimensional oscillator of frequency 2 kHz. **6 + 4**

30. (a) Derive Planck's law from B-E statistics.

    (b) Mention any four applications of NMR. **6 + 4**

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