

**Third Year B.Sc., Degree Examinations,
December 2017**

(Directorate of Distance Education)

PHYSICS

**Paper- III: DSC – 210: Spectroscopy, Wave Mechanics Statistical
Mechanics, Relativity and Astrophysics.**

Time: 3 hrs]

[Max. Marks: 75/85

Instruction to the Candidates:

- 1. Students who have attended 25 marks IA scheme will have to answer for total 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 the following in a word, a phrase or a sentence: 10 x 1 = 10 Marks

1. What path does beam of electrons trace when an electric field is applied in a direction perpendicular to the direction of motion of the beam of electrons?
2. Name any two uses of semi conductor laser.
3. What are white X – rays?
4. State Hubble's law.
5. What is the effect of finite mass of nucleus on the atomic spectra?
6. Which method is employed to study the microscopic states of a system?
7. What is space quantization?
8. In which region the pure rotational spectrum of a molecule can be observed?
9. Is the concept of simultaneity has an absolute meaning?
10. Write the quantum mechanical operator for energy.

SECTION – B

II. Answer any FIVE of the following questions: 5 x 3 = 15 Marks

11. Write a note on Rutherford's model of the atom.
12. Find the value of the ratio of mass of proton to that of electron. Given:
Rydberg constant of hydrogen atom = $1.096777 \times 10^7 / m$
Rydberg constant of Helium atom = $1.097224 \times 10^7 / m$
13. Explain the fine structure of sodium D lines.

Contd.....2

14. State and explain the significance of Mosley's law.
15. Write a note on Minkowski's world.
16. Can matter waves travel faster than light? Justify.
17. Write a note on H – R diagram.

SECTION – C

III. Answer any FIVE of the following questions:

5 x 6 = 30 Marks

18. Give the quantum mechanical explanation of normal Zeeman effect. Illustrate with p – state.
19. a) State and derive the Bragg's law of X – ray diffraction.
b) Write any four applications of X – rays.
20. Deduce the Planck's law of radiation from B – E statistics.
21. Write a note on a) Neutron stars and b) Black holes.
22. What is Raman effect? Describe the experimental study of Raman effect.
23. Distinguish between inertial mass and gravitational mass. Explain, any two experimentally observed facts which supports the Einstein's general theory of relativity.
24. Give the theory of pure rotational spectrum of a diatomic molecule.

SECTION – D

IV. Answer any TWO of the following questions:

2 x 10 = 20 Marks

25. a) Describe the construction and working of Ruby laser.
b) The wavelength of He – Ne laser is 6328\AA . Its output power is 3.147mW . How many photons are emitted per minute when it is in operation. (7 + 3)
26. a) Explain the quantum numbers associated with vector atom model.
b) Calculate the longest and shortest wavelength of the Balmer series of the hydrogen atom. Rydberg constant of hydrogen atom = $1.097 \times 10^7 / m$. (7 + 3)
27. a) Obtain the Schrodinger's equation for a particle in a one dimensional box and solve it to obtain the energy eigen values.
b) The position and momentum of 1 KeV electron are simultaneously determined and its position is located within 4\AA . What is the percentage of uncertainty in its momentum? (7 + 3)

Contd.....3

28. a) Write a note on i) Spin orbit interaction ii) Rayleigh scattering.
b) A proton has a wavelength of 0.5\AA . Calculate its energy in eV. (7 + 3)

SECTION – E

V. *Answer any ONE of the following questions:* 1 x 10 = 10 Marks
(Compulsory question for 85 marks scheme only)

29. a) Describe the Michelson Morley experiment. Also comment on the null result of the experiment.
b) Show that a particle of zero rest mass should move with the speed of light in vacuum. (7 + 3)
30. a) State Heisenberg's uncertainty principle. Illustrate it with the γ -ray microscope experiment.
b) Calculate the minimum voltage that should be applied to an x – ray tube to produce x – ray photons of wavelength 0.1\AA . (7 + 3)

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