S – 5068

Reg. No. : ....

Name : ....

Fourth Semester M.Sc. Degree Examination, October 2023

Physics with Specialization in Space Physics

SPECIAL PAPER

PHSP 542 : SPACE PHYSICS

(2020 Admission Onwards)

Time : 3 Hours

Max. Marks : 75

PART – A

Answer any **five** questions. **Each** question carries **3** marks.

1. How does Debye length changes with temperature?

2. What are Alfven waves?

3. How does the source of a fast solar wind differ from that of slow wind?

4. Give any four applications of Space weather studies?

5. How molecular diffusion is different from Eddy diffusion?

6. Why sunspots are relative cooler than surrounding solar surface?

7. Obtain an equation for the magnetic pressure and discuss various factors affecting it?

8. Discuss the concept of 'frozen in magnetic field'?

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer any **three** questions. **Each** question carries **15** marks.

9. (a) Briefly discuss the motion of charged particles in uniform fields under

      (i) Finite E and B = 0 ;

      (ii) E = 0, B finite

      (iii) Combined E and B.

  (b) Explain why the **ExB** drift is Independent of charge and mass?

OR

10. (a) What are adiabatic invariants? Show that the first adiabatic constant μ is a constant and explain its significance?

  (b) Prove that second adiabatic invariant J is a constant?

11. (a) Discuss the basic Black body radiation curve and solar spectrum. Also explain various radiation laws governing the same.

  (b) With schematic diagram explain various layers of Sun and different features therein.

OR

12. (a) Briefly discuss the ground based observations of Sun and its interior. Also explain how the satellite based observations improved our understanding of the Sun? Also describe the major challenges and technology involved?

  (b) Distinguish between the surface magnetic field and large scale magnetic field causing the solar magnetism. Also discuss the role of Parker's spiral in creating the changes in the interplanetary medium?

13. (a) With the help of suitable diagrams, explain the various phases in the evolution of geomagnetic storms. Also discuss the role of magnetospheric convection electric field in modulating the high latitude electrodynamic?

(b) Distinguish between various geomagnetic activity indices such Kp, ap, Ap, sym-H and Dst indices? How they are estimated?

OR

14. (a) What is meant by Sq current. Also explain the slab geometry model for the formation of Equatorial Electrojet.

(b) What are the different mechanisms creating ionization in the terrestrial ionosphere. With the proper diagram, explain various layers in the ionosphere and the major chemical specie in each layer?

(3 × 15 = 45 Marks)

PART – C

Answer any **three** questions. **Each** question carries **5** marks.

15. Briefly discuss how one can study the laboratory dusty plasmas?

16. Explain the generation of ring current and how it is manifested in ground based magnetometers?

17. Plasma of so called E layer of Earths ionosphere has electron density $\sim 10^5$ cm^{-3} and is at altitude of approximately 100 km.

(a) Electromagnetic waves of what frequency can be reflected from this layer?

(b) Calculate the dielectric constant of plasma for the waves with frequencies of 100 MH_z and 1000 H_z.

(c) Calculate the skin depth of the wave with frequency of 1000 H_z.

3

18. Calculate mean free path l of Xe^+ ions for elastic collisions in weakly ionized plasma in xenon atmosphere at room temperature (20°C) at the pressure:

    (a) 1000 Pa

    (b) 10 Pa

    (c) 0.1 Pa

    Given that Scattering cross section σ for elastic collisions of $Xe+$ ions with Xe atoms is approximately independent on their energy with cross section value of $\sigma = 10^{-14}$ cm².

19. Compute the plasma frequency and Debye length of earth's ionosphere with electron concentration $n_e = 10^6$ cm^{-3} and electron temperature k. $T_e = 0.2$ eV.

20. Briefly discuss the main cycle of nuclear reactions occurring in the solar core resulting in the energy production?

$(3 \times 5 = 15 \text{ Marks})$

————————