Reg. No. : ....

Name : ....

Fourth Semester M.Sc. Degree Examination, August 2022

Physics with Specialization in Space Physics

Special Paper

PHSP 542 : SPACE PHYSICS

(2020 admission)

Time : 3 Hours   Max. Marks : 75

PART – A

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

1. Briefly explain how plasma oscillations are created in a medium.

2. Explain the concept of 'ambipolar diffusion'.

3. Why solar corona is hotter than photosphere?

4. What is 'solar wind'? How it is generated?

5. Explain the term 'diamagnetic drift' in space plasma.

6. What makes the mesopause, the coolest part of atmosphere?

7. Why sun exhibits differential rotation? How it is different over equatorial and polar regions?

8. How 'Aurora' is generated? Why magnetic field is necessary for its formation?

(5 × 3 = 15 Marks)

P.T.O.

PART – B

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

9. (a) Explain the behavior of charged particles in non-uniform fields under the conditions of (i) grad B (ii) curved B (iii) grad B parallel to B.

    (b) Discuss the concept of 'magnetic mirror' in plasma confinement.

OR

10. (a) Describe the concept of the guiding center. What is the reason for drifts?

    (b) Briefly discuss the importance of adiabatic invariants. With proper explanations, starting from the action integral, prove the constancy of all the three adiabatic invariants μ, J and ϕ.

11. (a) Discuss various features associated with quiet photosphere.

    (b) What are the various sources of fast and slow solar winds?

OR

12. (a) Discuss the various techniques used for 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) How does the surface magnetic field and large scale magnetic field in sun explain the cause of solar magnetism? Also briefly explain role of Parker's spiral in creating the changes in the interplanetary medium.

13. (a) What is 'space weather'? With proper diagrams, explain the structure of magnetosphere and interaction of solar wind with the earth's magnetic field using geocentric solar ecliptic (GSE) coordinate system.

    (b) Explain the generation of ring current and how it is manifested in ground based magnetometers? What are the indices used to represent ring current and explain how they are estimated?

OR

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14. (a) What is meant by Equatorial Electrojet? Explain the slab geometry model for the formation of Equatorial Electrojet. How it is different from the formation of Sq currents in the ionosphere?

(b) Discuss the generation of ions and electrons at D, E and F regions of earth's ionosphere. Also explain the important species present in each region and their relative roles in deciding the time constant of ionospheric electrons.

(3 × 15 = 45 Marks)

PART – C

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

15. How MSIS model is different in explaining the upper atmosphere in context of IRI model?

16. What are Field Aligned Current systems (FACs)? Discuss the generation and importance of Region-1 FAC and Region II FAC in the earth's magnetospheric studies?

17. Explain the solar spectrum in comparison with the spectrum of a typical black body.

18. The Xe+ ions make elastic collisions in weakly ionized plasma in xenon atmosphere at room temperature (20° C) at the pressure:

(a) 1000Pa

(b) 10Pa

(c) 0.1Pa

How long is the time period between two subsequent collisions, if the mean temperature of Xe ions is T = 1000 K? Given that Scattering cross section σ for elastic collisions of Xe+ ions with Xe atoms is independent on their energy with cross section value of $\sigma = 10^{-14}$ cm^2.

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19. Estimate the plasma frequency and Debye length of welding arc with electron concentration of 1.6×10^{17} cm^{-3} and electron temperature of 1. 3 eV.

20. How magnetic diffusion is different from magnetic reconnection?

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

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