S – 6828

Reg. No. : .....

Name : .....

Third Semester M.Sc. Degree Examination, February 2024

Physics with Specialization in Space Physics

PHSP 534 : PHYSICS OF THE ATMOSPHERE

(2020 Admission Onwards)

Time : 3 Hours

Max. Marks : 75

SECTION – A

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

1. Explain LIDAR.
2. An air mass has a temperature of 30 °C. pressure of 1000 hPa and a relative humidity of 20 %, find the dew point temperature given the saturation vapor pressure at 30 °C is 43.67 hpa.
3. Obtain an expression for thermal wind balance.
4. Discuss the term convective available potential energy.
5. Define radiative-convective equilibrium.
6. Define a atmospheric boundary layer.
7. Calculate the Coriolis force per unit mass on a fluid parcel moving at 10 m/s northward at 45°N latitude ($\Omega = 7.2921 \times 10^{-5}\ S^{-1}$).
8. Explain thermally-direct circulation.

(5 × 3 = 15 Marks)

SECTION – B

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

9. (a) Derive the expression for Lapse rate and discuss the atmospheric stability categories interns of potential temperature.

   (b) Analyse the moisture dependence on vertical stability of the atmosphere.

OR

10. (a) Discuss the role of aerosols in atmospheric thermal structure.

    (b) Distinguish between homogeneous and heterogeneous nucleation processes.

11. (a) Derive horizontal equation of motion and continuity equation in spherical coordinates.

    (b) Reduce the obtained equations using the tangent plane approximations.

OR

12. (a) Discuss the fundamental wave propagation in the atmosphere.

    (b) Derive the dispersion relation for Kelvin waves and prove that the waves propagate eastward and also prove that zonal wind component is in geostrophic equilibrium with the pressure field.

13. (a) What are the remote sensing methods adopted for atmospheric parameters?

    (b) Discuss how satellites are used in atmospheric parameters sensing?

OR

14. (a) Discuss the characteristics of Quasi-Biennial oscillation.

    (b) Distinguish between regional and global climate models in terms of their spatial coverage, resolution and applications

(3 × 15 = 45 Marks)

SECTION – C

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

15. Starting with the horizontal equation of motion in a cartesian form and ignoring the friction force, derive a conservation law for vorticity (ζ) in horizontal flow on a rotating planet.

16. Derive expression for equivalent potential temperate.

17. (a) Define Russby number.

    (b) For a characteristic velocity scale of 20 m/s at what horizontal scale does the Earths rotation become significant ?

18. Derive an expression for cloud droplet growing by condensation and explain graphically its behaviour with time.

19. Show that in the absence of scattering, the monochromatic absorptivity approaches unity exponentially with increasing optical depth.

20. Explain cumulus convection and its necessity in general circulation models.

(3 × 5 = 15 Marks)