COURSE   :   MAJOR – CORE
PAPER   :   OPTICS AND SPECTROSCOPY
TIME   :   3 HOURS   MAX. MARKS : 100

SECTION – A

ANSWER ALL QUESTIONS: **(30 x 1 = 30)**
   I   CHOOSE THE CORRECT ANSWERS:

1. A monochromatic ray of light enters from vacuum in to a medium of refractive index μ. The ratio of the wavelengths of the incident and refracted waves is
   a) $\mu:1$ b) $1:\mu$ c) $\mu^2:1$ d) $1:\mu^2$

2. The focal length of a plano-convex lens whose radius of curvature is 30 cm and refractive index 1.5 is
   a) 45 cm   b) -30 cm   c) 60 cm   d) 20.6 cm

3. If a convex lens of focal length 80 cm combine with a concave lens of focal 50 cm, the resulting power is
   a) 0.75 D   b) -0.75 D   c) 6.5 D   d) -6.5 D

4. In a crossed lens, the ratio of the radii curvature is
   a) 6:1   b)1:6   c) -6:1   d) -1:6

5. When white light is used, the central image of Newton's ring is
   a) white   b) coloured   c) dark   d) bright

6. Light from a source of wavelength 589 nm is incident on a thin glass plate of refractive index 1.5 appear to be dark by reflection. If the angle of refraction is 60°, the thickness of the plate is
   a) 0.393 μm   b) 0.393 mm   c) 0.786 μm   d) 0.786 mm

7. The focal length of the first zone in a zone plate of radius 0.316 mm illuminated by a light of wavelength 500 nm is
   a) 20 cm   b) 15.8 cm   c) 36 cm   d) 6.32 cm

8. Fraunhofer diffraction pattern formed on a screen at a distance 1 m from a single slit of width 0.1 mm is illuminated by monochromatic light of wavelength 5893 Å. The separation between the central maximum and the 1st secondary minimum is
   a) 0.59 mm   b) 0.59 μm   c) 5.9 mm   d) 5.9 μm

9. The angular separation between two distant objects resolved by the eye of pupil diameter 2 mm with a light of wavelength 550 nm is
   a) 12′   b) 12°   c) 1°   d) 1′

10. In calcite crystal, the angle of refraction for ordinary ray is less than that of extraordinary ray, then
   a) $\mu_o < \mu_e$ b) $\mu_o > \mu_e$ c) $\mu_o = \mu_e$ d) $\mu_o \leq \mu_e$

11. The polarizing angle for a dense flint glass of refractive index 1.768 is
    a) 30°   b) 45.3°   c) 60.5°   d) 19.6°

12. If the plane of polarization is turned through an angle of 20° traversing 20 cm length of 20% sugar solution, then the specific rotation is
    a) 50°   b) 60°   c) 0.5°   d) 2°

13. The region of electromagnetic spectrum with frequencies from 8×10^{14} Hz to 5×10^{17} Hz is called
    a) microwaves   b) visible light   c) UV rays   d) IR rays

14. Which of the following rays will penetrate through mist and fog
    a) X-rays   b) visible   c) UV rays   d) IR rays

15. In Raman effect if the wavelength of the incident light and anti-stokes lines are 5461 Å and 5441 Å respectively, the wavelength of the Stokes line is
    a) 5451 Å   b) 5461 Å   c) 5420 Å   d) 5481 Å

II   FILL IN THE BLANKS:

16. The plane passing through the nodal points and perpendicular to the axis is called _____

17. For a path difference x, the phase difference is _____

18. The spectrum obtained with a grating are comparatively _____ than those with a prism.

19. In right hand quartz crystal, the clockwise component travels _____ than the anticlockwise component.

20. The primary source of IR light is the _____ radiation.

III   STATE WHETHER TRUE OR FALSE:

21. Plano-convex lenses are used in optical instruments so as to reduce the spherical aberration.

22. The interference colour on a thin film is depending on angle of incidence.

23. In Fresnel diffraction the shape of the wave front is plane.

24. Mica is a biaxial crystal.

25. Hydrogen bonding shifts the ultra-violet absorptions to longer wavelength.

IV   ANSWER BRIEFLY:

26. State Snell's law.

27. What is meant by interference of light?

28. Give any two applications of UV-visible spectroscopy.

29. On what factors does the amount of optical rotation depend?

30. Why anti-stokes lines are less intense than stokes lines?

SECTION – B
ANSWER ANY FIVE QUESTIONS: **(5 x 5 = 25)**

31. A concavo-convex lens has refractive index 1.5 and the radii of curvature of its surface are 10 cm and 20 cm. The concave surface is upwards and is filled with an oil of refractive index 1.6. Calculate the focal length of the oil glass combination.

32. Explain the defect astigmatism and how it can be minimized?

33. In Michelson interferometer the distance through which the mirror is moved between two consecutive position giving best fringes in the case of sodium lines of wavelength 5896 Å and 5890 Å. Find the difference in wave-number of the two spectral lines of sodium.

34. Distinguish between a zone plate and a convex lens.

35. A light of wavelength 500 nm is incident normally on a plane transmission grating. Find the difference in the angle of deviation in the 1st and 3rd order spectra. Given that the number of lines per cm on the grating is 6000.

36. Calculate the thickness of quarter wave plate and half wave plate. Given that $\mu_o = 1.544$, $\mu_e = 1.553$ and $\lambda = 5000$ Å.

37. The Raman line associated with a vibrational mode which is both Raman and IR active is find at 4600 Å when excited by light of wavelength 4358 Å. Calculate the wavelength of the corresponding IR band.

SECTION – C
ANSWER ANY THREE QUESTIONS:
(3 x 15 = 45)

38. a) What is an eyepiece? Describe the construction and working of a Huygen's eyepiece with neat diagram.
    b) The focal length of a plano-convex lens of thickness 2 mm in an eyepiece is 20.2 cm. The velocity of light in the material of the lens is 2×10^8 ms^{-1}. Calculate the radius of curvature the plano-convex lens.

39. a) With necessary theory, describe the Fresnel's biprism method of producing the interference fringes and explain how will you determine the wavelength of the light?
    b) The separation between the coherent sources formed by a biprism is 3.5 mm. The slit source is at a distance of 10 cm away from the biprism of refractive index 1.5. Calculate the refracting angle of the biprism.

40. What is meant by resolving power of an optical instrument? Obtain an expression for the resolving power of a telescope. Deduce the relation between the resolving power and the magnifying power.

41. Give the Fresnel's explanation of optical activity. Describe Laurent's half shade polarimeter to find the specific rotatory power of a sugar solution.

42. Describe the various components and working of IR double beam spectrophotometer with neat block diagram. Explain the applications of IR spectroscopy.

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