STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2015-16 and thereafter)

SUBJECT CODE : 15PH/MC/OS34

B.Sc. DEGREE EXAMINATION NOVEMBER 2017
BRANCH III - PHYSICS
THIRD SEMESTER

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 convex lens of radius *R* separated by two media of refractive index $\mu_1$and μ_2 respectively. If the angles are not small, then the real image formed by the real object kept on the first media is

   a) $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$ b) $\frac{\mu_1}{u} - \frac{\mu_2}{v} = \frac{\mu_2 - \mu_1}{R}$

   c) $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 \cos r - \mu_1 \cos i}{R}$ d) $\frac{\mu_1}{u} - \frac{\mu_2}{v} = \frac{\mu_2 \cos r - \mu_1 \cos i}{R}$

2. The wavelength of light passes through a medium of dispersive power 2.961 (assume Cauchy's constant B = 0.1523 x 10^{-14} cm^2) is

   a) 4685 Å b) 2343 Å c) 5234 Å d) 6896 Å

3. The rainbows are visible only when the altitude of the sun is

   a) greater than 32.5˚ b) less than 32.5˚ c) greater than 42˚ d) less than 42˚

4. The distance between two virtual sources formed by biprism of refractive index 1.5 placed at a distance of 10 cm from a slit illuminated by light of wavelength 5900 Å with refractive angle of 1˚ is

   a) 3.7 mm b) 1.7 mm c) 0.1 mm d) 0.1 m

5. If water is introduce between the lens and the glass plate of the Newton's ring experiment, the fringes

   a) disappear b) contract c) expand d) are only bright

6. The number of fringes crosses the field of view when the mirror is moved back by 0.15 mm in Michelson's interferometer illuminated by a source of wavelength 5896 Å is

   a) 88 b) 254 c) 442 d) 509

7. The focal length of zone plate is directly proportional to

   a) λ b) λ^2 c) $\frac{1}{\lambda}$ d) $\frac{1}{\lambda^2}$

8. The power of the first zone plate of radius 0.32 mm with a light of wavelength 500 nm is

   a) 4.88 m^{-1} b) 20.46 m^{-1} c) 0.488 m^{-1} d) 0.2148 m^{-1}

9. The angle of one second of an arc is equivalent to

   a) 2.9 x 10^{-4} rad b) 4.85 x 10^{-6} rad c) $\frac{\pi}{180}$ rad d) 17.45 rad

10. When a plane polarized light is allowed to pass through an analyzer, and the analyzer is rotated through an angle 90˚, then the intensity of the out coming ray is

    a) change from maximum to zero b) change from maximum to minimum
    c) change from zero to maximum d) remain the same

11. A ray of unpolarized light is incident on a glass plate of refractive index 1.54 at polarizing angle, and then the angle of refraction is

    a) 47.5˚ b) 90˚ c) 32.5˚ d) 57.5˚

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12. Which of the following is a biaxial crystal?
a) quartz b) calcite c) ice d) mica

13. The mid infrared region of electromagnetic spectrum is considered to cover the range from
a) 400 – 50 cm^{-1} b) 4000 – 400 cm^{-1} c) 12500 – 4000 cm^{-1} d) less than 50 cm^{-1}

14. The energy associated with the radiations having wavelength 480 nm is
a) 4.137×10^{-25} J b) 1.698×10^{-25} J c) 2.5 eV d) 25 eV

15. Which of the following is used in procedures for the reduction of cellulite and fat digestion?
a) X-rays b) UV- rays c) Visible rays d) IR-rays

II FILL IN THE BLANKS:

16. The lens whose ratio of radii of curvature $\frac{R_1}{R_2} = -\frac{1}{6}$, then the lens is called ----------.

17. A narrow wire is illuminated by a monochromatic light, as the diameter of the wire increases the fringe width ----------.

18. The intensity of the interference maxima in reflected system will be -------- %.

19. In quarter wave plate the emergent light is ---------- polarized.

20. Raman scattering arises from molecular vibration causing a change in ----------.

III STATE WHETHER TRUE OR FALSE:

21. Coma is the failure of eye lens to bring to focus of the tangential of the sagittal ray of light.

22. Due to interference, the energy is only transfer from the point of minimum to maximum displacement.

23. The central peak of the Fraunhofer diffraction from two narrow slits separated by spacing *h* has the same width as the central diffraction peak from a single slit with width $d = h$.

24. The amount of specific rotation depends on temperature.

25. Thermal radiation is the primary source of ultraviolet rays.

IV ANSWER BRIEFLY:

26. State the laws of refraction of light.

27. Explain the colours of thin films.

28. Distinguish between Fresnel and Fraunhofer classes of diffraction.

29. What do you understand double refraction?

30. List out the applications of Infra-Red spectra.

SECTION – B

ANSWER ANY FIVE QUESTIONS: (5 x 5 = 25)

31. Two thin lenses of focal length f_1 and f_2 separated by a distance *d* have an equivalent focal length of 50 cm. The combinations satisfy the conditions for no chromatic aberration and minimum spherical aberration. Find the value of f_1 and f_2 and *d*. Assume that both the lenses are of same material.

32. Derive an expression for the focal length of thick convex lens of radii of curvature R_1 and R_2 with thickness *t* and hence to explain the positions of the principal points.

33. Calculate the radius of 13^{th} bright rings of Newton's rings viewed with the reflected light of wavelength 6000 Å incident on a system,
(i) convex surface of radius of curvature 200 cm of a plano convex lens placed on a concave spherical surface of radius 400 cm.
(ii) the plano convex lens placed on a convex spherical surface of radius of curvature 400 cm.

34. A point source of light with wavelength 6000 Å incident on the axis of a zone plate, the strongest and the next strongest images are formed on the other side at a distance of 30 cm and 6 cm respectively from the zone plate. Calculate
i) the distance of the source from the zone plate
ii) radius of the first zone plate
iii) principal focal length.

35. The first lens of a telescope has a diameter of 30 cm, which is the only place where light is clipped. You wish to use the telescope to examine two stars in a binary system. The stars are approximately 25 light years away. How far apart need the stars be for you to distinguish them in visible range of wavelength 500 nm?

36. Describe how UV-visible spectrum can be scanned for a pure compound by using spectrophotometer.

37. The minimum thickness of a quartz plate made to operate as a quarter wave plate and half wave plate for a wavelength of 550 nm. The indices of the refraction of ordinary and extraordinary rays are 1.54424 and 1.5535.

SECTION – C

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

38. What do you mean by spherical and chromatic aberration of lens? Explain how they are caused? How would you correct for chromatic aberration in the case of lens system in contact?

39. a) Discuss the theory of interference in thin film and obtain the condition for the intensity to be maximum and minimum of a thin transparent film due to reflected light.

b) A soap film of refractive index 1.33 and of thickness 1.42×10^{-4} cm is illuminated by white light incident at an angle 60°. Calculate the wavelength of light reflected the thin film corresponding to 5^{th} dark band.

40. a) A monochromatic plane wave with intensity I_o and wavelength λ is incident on a single slit of width a followed by a lens of focal length f. Write the intensity distribution of Fraunhofer diffraction at a distance r from the slit.

b) A light of wavelength 5000Å is incident normally on a plane transmission grating. Find the difference in angle of deviation in the 1^{st} and 3^{rd} order spectra. The number of lines per cm on the grating is 6000.

41. What do you mean by polarization of light? Describe the process of production and detection of circularly and elliptically polarized light.

42. a) What is Raman Effect? Describe an experiment to explain Raman Effect in liquids.
b) Discuss Raman Effect on the basis of quantum theory. Mention the applications of Raman lines.

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