STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2011-12 & thereafter)

SUBJECT CODE : 11PH/MC/OS44

B.Sc. DEGREE EXAMINATION APRIL 2014
BRANCH III - PHYSICS
FOURTH SEMESTER

REG. No._____

COURSE : MAJOR – CORE
PAPER : OPTICS AND SPECTROSCOPY
TIME : 30 MINS. MAX. MARKS : 30

TO BE ANSWERED IN THE QUESTION PAPER ITSELF
SECTION – A

ANSWER ALL QUESTIONS: (30 x 1 = 30)

I Choose the Correct Answer:

1. Snell's law of refraction is represented as
   (a) $\mu_1 \cos i = \mu_2 \sin r$
   (b) $\mu_1 \sin i = \mu_2 \sin r$
   (c) $\mu_2 \sin i = \mu_1 \cos r$

2. A crossed lens has
   (a) $R_1 / R_2 = 6$
   (b) $R_2 / R_1 = 1/6$
   (c) $R_1 / R_2 = - 1/6$

3. In Huygens eye piece, the two lenses have focal lengths in the ratio
   (a) 3 : 1
   (b) 2 : 3
   (c) 1 : 1

4. A biprism is placed 0.05 m from a slit illuminated by sodium light ($\lambda = 5890$ A°). The width of the fringes obtained on a screen 0.75 m from the biprism is 9.424×10^{-4} m. What is the distance between the two coherent sources?
   (a) 0.0005 m
   (b) 0.0025 m
   (c) 0.005m

5. In the formation of Newton's rings, the radius of the dark ring is proportional to
   (a) $r = \sqrt{(2n-1)\lambda R/2}$
   (b) $r = \sqrt{2n-1)\lambda R}$
   (c) $r = \sqrt{n\lambda R}$

6. In the standardisation of the metre, the number of etalons used are
   (a) 8
   (b) 9
   (c) 5

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7. The function of a zone plate is similar to that of a
   (a) Convex lens
   (b) Concave lens
   (c) Plane mirror

8. The half angular width of the central bright maximum in the Fraunhofer diffraction pattern of a slit of width 12 x 10^{-7}m when the slit is illuminated by light of wave length 6000 A° is
   (a) 60°
   (b) 30°
   (c) 45°

9. The least distance of distinct vision from the eye is
   (a) 25 cm
   (b) 2.5 cm
   (c) 250 cm

10. Calcite is chemically known as
    (a) $MgCo_3$
    (b) $CaCo_3$
    (c) Na_2Co_3

11. If plane polarized light inclined at an angle of 45° to the optic axis, is incident on a Quarter Wave Plate, the emergent light is
    (a) Elliptically polarized
    (b) Plane polarized
    (c) Circularly polarized

12. Which substance is not optically active
    (a) Sugar solution
    (b) Calcite
    (c) Turpentine

13. According to the quantum theory, light is composed of small packets of energy called
    (a) Photons
    (b) Electrons
    (c) Protons

14. In the structural elucidation, ultraviolet and visible spectrophotometry is mainly used for
    (a) Qualitative analysis
    (b) Quantitative analysis
    (c) Moderate analysis

15. The lines having wavelength greater than that of the incident wavelength are called
    (a) Antistokes lines
    (b) Stokes lines
    (c) Parent line

II Fill in the blanks:

16. Astigmatism can be minimized by using a lens combination called ……..
17. Circular fringes are produced in Michelson's interferometer when the mirrors M_1 and M_2 are ……
18. (a + b) is called the …… of a grating and it is equal to the reciprocal of ……..
19. …… is a device for producing and analysing plane polarised light.
20. According to the rule of mutual exclusion, if a molecule has a centre of symmetry then Raman active vibrations are …… inactive and vice versa.

III State whether True or false:

21. Crosswires cannot be used in a Huygens eye piece.
22. In Fresnels biprism, the acute angle α on both sides is equal to $50°$.
23. The zone plane has only one focal length.
24. The Half wave plate rotates the azimuth of a beam plate of plane polarised light by 90° when the incident light is inclined at 45° to the optic axis.
25. Solid samples are more difficult to examine with an IR Spectrometer.

IV Answer briefly:

26. State Fermat"s principle of least time.

27. What are the conditions for maxima and minima in interference in thin films due to reflected light.

28. State the differences between Fresnel's and Fraunhofer's diffraction.

29. What is double refraction.

30. What are the applications of IR spectroscopy.

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SECTION – B

Answer any FIVE of the following: **(5 x 5 = 25)**

1. What is Raman effect. Explain the Quantum theory of Raman Effect?

2. Describe the construction and working of a Nicol prism.

3. The dispersive powers for crown and flint glass are 0.015 and 0.030 respectively. Calculate the focal lengths of the lenses which form an achromatic doublet of focal length 60 cm when placed in contact.

4. In Newtons rings experiment, find the radius of curvature of the lens surface in contact with the glass plate when with a light of wavelength 5890 x 10^{-8}cm, the diameter of the third dark ring is 3.2 mm. The light is falling at such an angle that it passes through the air film at an angle of zero degree to the normal.

5. A grating has 1000 per m lines ruled on it. In the region of wavelength 6000A°,find (i) the difference between two wavelengths that just appear separated in the first order and (ii) the resolving power in the second order spectrum.

6. A 20 cm long tube containing 48 cm^3 of sugar solution produces an optical rotation of 11° when placed in a saccharimeter. If the specific rotation of sugar solution is 66°,calculate the quantity of sugar contained in the tube in the form of a solution.

7. The inclined faces of a glass prism (μ = 1.5) make an angle of 1 º with the base of the prism. The slit is 10 cm from the biprism and is illuminated by light of λ = 5900 A°.Find the fringe width observed at a distance of 1m from the biprism.

SECTION – C

Answer any THREE of the following: **(3x15 =45)**

8. Explain optical activity. Define specific rotation. Describe Laurents half shade polarimeter for determining the specific rotation of sugar solution.

9. Explain the theory of a plane transmission grating. Derive the expression for the width of the principal maxima.

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10. Describe the construction and working of Michelson's Interferometer. How will you use it to standardize a metre in terms of wavelength of light.

11. Explain the construction and working of a Ramsdens eyepiece. What are the advantages of using it.

12. Write the basic principle of Infrared spectroscopy. Describe the parts and explain the working of an Infrared spectrophotometer.