CARMEL COLLEGE OF ARTS, SCIENCE & COMMERCE FOR WOMEN, NUVEM-GOA
SEMESTER END EXAMINATION, JUNE 2022

Semester: IV OF BSC
Course Title: Optics & Modern Physics Course Code: PYC 104
Total marks: 80 Date: /06/2022 Duration: 120 minutes Total No of pages: 00

Instructions:

1) *Answer Section-1 and Section-2 on separate answer book.*
2) *All questions are compulsory, however internal choice is available.*
3) *Figures to the right indicate maximum marks to the question.*
4) *Symbols have their usual meanings unless otherwise stated.*
5) *Draw neat diagram wherever necessary.*
6) *Use of non-programmable calculator is permitted.*

Section -1

Q1. Answer any FOUR of the following questions. (4x4 = 16)

a) Name any two conditions required to obtain a stable interference pattern. Give one method to obtain coherent sources with the help of a ray diagram.

b) Show that the areas of the different half period zones are equal. Give two differences between Fraunhofar and Fresnel diffraction.

c) What is meant by double refraction? Show how a Nicol's prism is designed to produce plane polarised light.

d) State the Rayleigh's criterion for resolution. Calculate distance between two points that can be just resolved on the surface of the moon with help of a telescope of diameter 500cm, distance of the moon from earth is 3.8×10^5 km, the eye is sensitive to light of 5500 Å.

e) In Fraunhofer diffraction at a single slit of width **a**, arrive at the position of angles of maxima and minima.

f) Give two applications of interferometry. Calculate the distance moved by the movable mirror, when 100 fringes move across the field of view of a Michelson interferometer, with alight of wavelength of 5800Å.

Q2.(A) **(2x3 = 6)**

(p) Obtain expression for a resolving power of a telescope.

(q) A parallel beam of light incident normally of a grating having 4250 lines/cm and the second order deviation is observed at 30°. Calculate the wavelength of light used.

OR

Q2.(A) **(2x3 = 6)**

(x) In Newton's ring experiment the diameter of the 5th dark ring is 0.335cms and the 15th dark ring is 0.590cms. The radius of the plano-convex lens is 100cms.Find the wavelength of light used.

(y) Prove that reflected and refracted rays are perpendicular to each other when light is plane polarized by reflection at Brewster's angle.

Q2.(B) **(1x6 = 6)**

Arrive at the condition for a colour to appear in the reflected system in thin film interference.

Q3.(A) **(2x3 = 6)**

(p) Quartz has refractive indices μ_E=1.553 and μ_o=1.542. Calculate the thickness of the half wave plate for sodium light of wavelength 6000 Å.

(q) Describe the working of a simple polarimeter.

OR

Q3.(A) **(2x3 = 6)**

(x) Explain how light can be polarised by refraction.

(y) The mean wavelength of the two component of 'D' lines is 5893 Å .Calculate the difference between the wavelengths of sodium 'D' lines used in an experiment with Michelson's interferometer, the distance between two successive positions of the movable mirror for maximum distinctness of fringes is 0.2945mm.

Q3.(B) **(1x6=6)**

In the Fresnel diffraction at straight edge arrive at the expression for distance of diffraction bands from the geometrical edge.

Section -2

Q1. Answer any FOUR of the following questions. (4x4 = 16)

a) **S**how that the motion of charged particle in a uniform electric field is parabolic in nature. Also, draw the schematic diagram to illustrate the same.

b) Draw and explain the energy spectrum of a black body.

c) Which are the different types of 2D lattices. Illustrate them all with neat diagram and conditions.

d) What are Cathode rays? State few important features of Cathode rays.

e) Explain the concept of Compton Effect and also demonstrate the same with suitable diagram.

f) Explain the electric discharge through the gases.

Q2.(A) (2x3 = 6)

(p) Explain the effect of retarding potential difference on Photo Electric phenomenon.

(q) Singly ionised Mg atoms enter a Bainbridge mass spectrometer with the velocity selector having electric and magnetic fields respectively of 30kV/m and 0.1T. Calculate the radii of the path followed by the 3 isotope of masses 24, 25 and 26. When the deflecting magnetic field is 0.5T. (Given; $m_n = 1.67 \times 10^{-27}$ kg)

OR

Q2.(A) (2x3 = 6)

(x) State and compare he limitations of Wein's radiation formula and Rayleigh-Jeans Law.

(y) Deuterons in a cyclotron describe a circle of radius 0.32m just before emerging from the DEEs. The frequency of the applied e.m.f is 10MHz. Find the flux density of the magnetic field and the velocity of deuterons emerging out of the cyclotron. Mass of deuterium = 3.32×10^{-27}kg, e=1.6×10^{-19}C.

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Q2.(B) **(1x6 = 6)**

Draw and discuss the working of a Linear accelerator and show that the length of the tubes are proportional to $1, \sqrt{2}, \sqrt{3} \ldots \ldots$ etc.

Q3.(A) **(2x3 = 6)**

(p) Show that the packing fraction in FCC crystal structure is 74%.

(q) Prove that in the photo-electric effect from a metal surface the maximum velocity of the photo-electrons is related to the stopping potential by the equation $V_{max} = 5.927 \text{ x } 10^5 \sqrt{V_0}$. Where, V_{max} is in m/sec and V_o is in volts.

OR

Q3.(A) **(2x3 = 6)**

(x) Show that the packing fraction in BCC crystal structure is 68%.

(y) The photoelectric threshold wavelength of silver is 2762Å. Calculate

a) The maximum kinetic energy of the ejected electrons,
b) The maximum velocity of the electrons, and
c) The stopping potential in volts for the electrons when the silver surface is illuminated with ultraviolet light of wavelength 2000Å.

Q3.(B) **(1x6=6)**

Draw and Explain the construction Bainbridge mass spectrograph and state few of its advantages over other mass spectrographs.