SVKM'S NMIMS

MUKESH PATEL SCHOOL OF TECHNOLOGY MANAGEMENT & ENGINEERING

Program: B. Tech (All Streams) Year: I Semester : I

Academic Year: 2018-2019

Subject: Physics Marks: 100

Time: 2.00 pm to 5.00 pm

Date : 10 January 2019 Durations: 3 (hrs)

No. of Pages: 02

Re-examination (2018-19)

Instructions: Candidates should read carefully the instructions printed on the question paper and on the cover of the Answer Book, which is provided for their use.

1) Question No. 1 is compulsory.
2) Out of remaining questions, attempt any 4 questions.
3) **In all 5 questions to be attempted.**
4) All questions carry equal marks.
5) **Answer to each new question to be started on a fresh page.**
6) **Figures in brackets on the right hand side indicate full marks.**
7) **Assume suitable data if necessary.**

Que. 1 Attempt *any ten* of the following.

a) State any four necessary conditions for producing sustained interference pattern. (02)
b) Define magnetic susceptibility and permeability. (02)
c) Discuss the different types of diffraction. (02)
d) State Heisenberg's uncertainty principle. Write its mathematical form for the following pairs of the variables: i) Position and momentum, ii) Energy and time. (02)
e) What is dielectric substance? Give examples. (02)
f) It is desired to use a plate of glass to obtain polarized light. If the R.I. of glass is 1.5, what is polarizing angle? (02)
g) Find the de Broglie wavelength of an electron accelerated through a potential difference of 182 volts. (Given: $m_e = 9.1 \times 10^{-31}$ Kg) (02)
h) Give any four applications of LASER. (02)
i) State Coulomb's law in electrostatics. What do you mean by flux of an electric field? (02)
j) What do you mean by wave function? Give the physical significance of wave function. (02)
k) The magnetic susceptibility of aluminium is 2.3×10^{-5}. Find its permeability and relative permeability. (Given: $\mu_0 = 4\pi \times 10^{-7}$ H/m) (02)
l) Give any two points of failure of classical wave theory. (02)

Que. 2

a) Explain the construction and working of He-Ne laser. (08)
b) Draw the block diagram of an optical fiber communications system and explain the function of each. (06)

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c) Light of wavelength 5893 Å is ~~reflected by making~~ an angle of 30° ~~at normal incidence~~ from a soap film of refractive index 1.42. What is the least thickness of the film that will appear i) Bright and ii) Dark? (06)

Que. 3

a) What do you understand by double refraction? How do you use the phenomenon of double refraction to produce a plane polarized light? Explain in detail with diagrams. (08)

b) State and prove Gauss's law. Express it in differential form and show that $\nabla \cdot \mathbf{E} = \rho/\epsilon_0$. (06)

c) A hollow metallic sphere of radius 0.1 m has 1 x 10^{-8} C of charge uniformly spread over it. Determine the electric field intensity i) on the surface of the sphere, ii) at point 7 cm away from centre and iii) at point 0.5 m away from the centre. (Given: $\epsilon_0 = 8.85 \times 10^{-12}$ F/m) (06)

Que. 4

a) How does the concept of displacement current helpful in removing discrepancy in Ampere's law? (08)

b) Derive Clausius-Mosotti relation for non-polar dielectrics. (06)

c) An isotropic material permittivity ϵ_r is placed normal to a uniform external electric field with an electric displacement vector of magnitude 5 x 10^{-4} C/m^2. If the volume of the slab is 0.5 m^3 and magnitude of polarization is 4 x 10^{-4} C/m^2, find the value of ϵ_r and total dipole moment of the slab. (Given: $\epsilon_0 = 8.85 \times 10^{-12}$ F/m) (06)

Que. 5

a) Classify the materials on the basis of their magnetic behavior. What is the hysteresis curve? (08)

b) Derive the expressions for Eigen functions and Eigen values for one dimensional harmonic oscillator. (06)

c) Evaluate the first three energy levels of an electron enclosed in a box of width 10 Å. Compare it with those of glass marble of mass 1 gm, contained in a box of width 20 cm. Can these levels of the marble be measured experimentally? (Given: $m_e = 9.1 \times 10^{-31}$ Kg) (06)

Que. 6

a) Describe the Davisson and Germer experiment to confirm the wave nature of electron giving suitable diagram. (08)

b) Derive time dependent Schrödinger's wave equation for a free particle. (06)

c) Calculate the value of Planek's constant from the following data, assuming that the electronic charge e has value of 1.6 x 10^{-19} C. A surface when irradiated with light of wavelength 5896 Å emits electrons for which the stopping potential is 0.12 V. When the same surface is irradiated with light of wavelength 2830 Å, it emits electrons for which stopping potential is 2.2 V. (06)

Que. 7

a) What is Compton effect? Hence derive the expression for Compton shift. (08)

b) Discuss the Fraunhoffer's diffraction from a single slit. Give the condition for minima, also give the expression for intensity at a point on the screen, giving a neat diagram. (06)

c) A glass clad fiber is made with core glass of refractive index 1.5 and the cladding is doped to give a fractional index difference of 0.005. Find i) the cladding index, ii) the critical internal reflection angle, iii) the external critical acceptance angle, iv) the numerical aperture. (06)