18PH001

Hall Ticket Number:

I/IV B.Tech (Regular) DEGREE EXAMINATION

DECEMBER, 2018 **ECE,EEE&EIE**

First Semester **Waves and Modern Physics**

Time: Three Hours **Maximum :** 50 Marks

Answer Question No.1 compulsorily. (1X10 = 10 Marks)

Answer ONE question from each unit. (4X10=40 Marks)

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1. **Answer all the questions** **1x10=10M**

a. Define population inversion.
b. State Heisenberg uncertainty principle.
c. Define total internal reflection.
d. What is tunneling effect.
e. Give the expression for velocity of light in free space.
f. what is meant by dead time in GM counter.
g, What are ultrasonics.
h. Write any two applications of Hall effect.
i .What is skin effect.
j. Write the condition for progressive acceleration of a charged particle in cyclotron.

UNIT- I

2.a). Explain the construction and working of a Ruby laser with neat diagram. (CLO1) 8M
2.b). write any four differences between ordinary light and laser. (CLO1) 2M

(OR)

3.a). Derive the expression for acceptance angle. Show how it is related to numerical aperture. (CLO2) 8M
3.b). An optical fiber has a core and cladding materials of refractive indices 1.55 and 1.50 respectively .the light is launched into fiber from air. Calculate its numerical aperture. (CLO2) 2M

UNIT- II

4.a). Derive the expression for resonant frequency in series LCR circuit. (CLO3) 8M
4.b). A capacitor of 50μf and an inductance of 0.2H are connected in series .If the resistance of the circuit is negligible, find the resonance frequency. (CLO3) 2M

(OR)

5.a). Explain the construction and working of a cyclotron and mention its limitations. (CLO3) 8M
5.b). Write the integral form of Maxwell's equation. (CLO3) 2M

UNIT-III

6.a). Describe the Davisson and Germer experiment. What does it confirms. (CLO4) 8M
6.b). Calculate the wavelength associated with the electron accelerated by1000V. (CLO4) 2M

(OR)

7.a). Derive the expression for energy and wave function of a particle in 1dimensional box. (CLO4) 8M
7.b). An electron is bound in an infinite potential well of width 2.5×10^{-10}m .Calculate the lowest permissible quantum energy of the electron. (CLO4) 2M

UNIT-IV

8.a). What is magnetostriction effect? How will you produce ultrasonic waves experimentally with its help. (CLO5) 8M
8.b). Write any four general applications of Ultrasonics . (CLO5) 2M

(OR)

9.a). Explain the construction and working of GM counter. (CLO6) 8M
9.b). Mention industrial and medical applications of radio isotopes. (CLO6) 2M

SET-3

I/IV B.Tech Regular Degree Examination

December 2018

EEE, ECE, EIE

First Semester

Waves and Modern Physics (18PH001)

Time 3 hrs

Max marks - 50M

Scheme of valuation

1X10 = 10M

1) Answer all the questions.

a) Define population Inversion

→ The condition in which number of atoms in higher energy state is more than the no. of atoms in lower energy state.

b) State Heisenberg uncertainity principle.

→ It is Impossible to Calculate both position and momentum of a particle simultaneously and accurately.

c) Define Total internal reflection

It is the phenomenon which occurs when light propagates from denser medium to rarer medium and strikes the medium boundary at an angle greater than a particular critical angle.

d) What is tunneling effect

It is the quantum mechanical phenomenon where a particle passes through a potential barrier, which is classically not possible.

e) Give the expression for velocity of light in free space

$$V = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$$

μ_0 is Permeability in free space

ε_0 is Permittivity in free space

f) What is meant by dead time in GM counter

It is the time taken by the positively charged Argon ion to reach the cathode in GM counter.

g) What are Ultrasonics

Sound waves having frequency more than 20,000 Hz are known as ultrasonics.

h) Write any two applications of Hall effect

1) To find the nature of the charge carriers.
2) To calculate the unknown magnetic field.
3) To calculate the concentration of charge carries.
4) To calculate the mobility of charge carries.

i) What is Skin effect

The nature of ~~ate~~ A.C to be distributed with in the conductor such that the current density is large near the surface of the conductor.

j) Write the condition for progressive acceleration of a charged particle in cyclotron

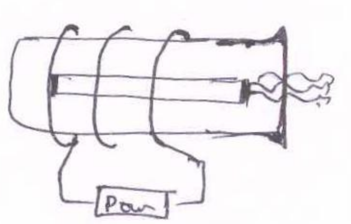
$$\frac{T}{2} = \frac{\pi r}{V}$$

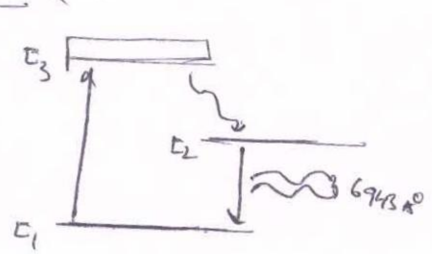
The time taken by the particle to complete semi circle of radius 'r' should be equal to $\frac{T}{2}$.

Unit - I

2 a) Explain construction & working of Ruby laser (8M)

Construction (3M)
working (3M)
~~Diagrams~~ (2M)





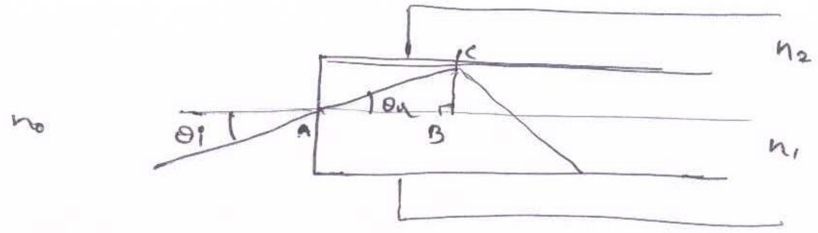
2 b) Write any four differences b/w Ordinary light & Laser (2)
Any four diff. (2 marks)

Laser	Ordinary light
1) high coherent light	1) no coherence
2) high intensity	2) low intensity
3) high directionality	3) no directionality
4) high monochromatic	4) low monochromatic
5) ~~Spontaneous~~ Stimulated emi	5) Spontaneous emission

3) a. Derive the expression for acceptance angle. How it is related to N.A.

Derivation (6 M)

relation to N.A (2 M)



$$\frac{\sin\theta_i}{\sin\theta_r} = \frac{n_1}{n_0}$$

$$\sin\theta_i = \frac{n_1}{n_0}\sin(90-\phi)$$

when $\theta_i = \theta_{i\,max}$ & for $\phi = \phi_c$

$$(\theta_i)_{max} = \sin^{-1}\sqrt{n_1^2 - n_2^2}$$

Numerical aperture is defined as sine of the acceptance angle

$$N.A = \sin\theta_{i\,max}$$
$$= \sin\sin^{-1}\left(\sqrt{n_1^2-n_2^2}\right)$$
$$= \sqrt{n_1^2-n_2^2}$$

3 b) formula – (1 M) Ans – (1 M)

refractive index of core (n_1) = 1.55

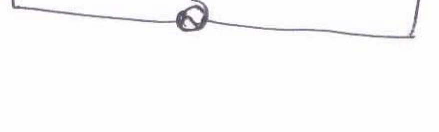
refractive index of cladding (n_2) = 1.50.

Numerical aperture $= \sqrt{n_1^2-n_2^2} = \sqrt{(1.55)^2 + (1.50)^2} = 0.390$

Unit II

4 a) Derivation for resonance frequency (8M)

$$L\frac{di}{dt} + \frac{q}{c} + iR = V_0 \sin\omega t$$



$$\frac{d^2i}{dt^2} + \frac{R}{L}\frac{di}{dt} + \frac{1}{LC}i = \frac{V_0\omega}{L}\cos\omega t$$

$$i = \frac{V_0}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$$

$$Z = \sqrt{(X_C - X_L)^2 + R^2}$$

when $X_C = X_L$ $\quad \frac{1}{\omega C} = \omega L \Rightarrow f = \frac{1}{2\pi\sqrt{LC}}$

4b) formula - 1(M) Ans - (M)

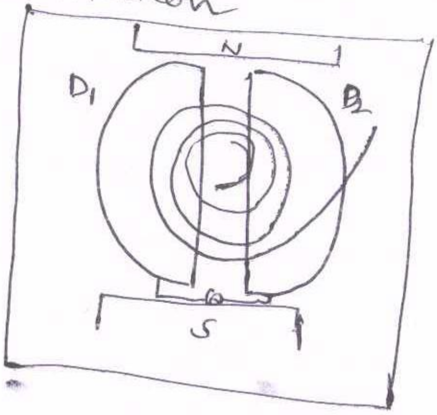
$$f = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{0.2 \times 50\times10^{-6}}} = 50.3\ Hz \simeq 50\ Hz$$

5a) Construction of cyclotron (2M)

working. (3M)

Diagram (2M)

Limitation (1 M)



$$t = \frac{\pi r}{v} \quad \& \quad r = \frac{mv}{Bq}$$

$$\frac{\pi r}{v} = \frac{T}{2}.$$

$$f = \frac{1}{T} = \frac{v}{2\pi r}$$

$$v = \frac{Bqr}{m}$$

$$E_{max} = \frac{1}{2} m \left[\frac{Bqr}{m}\right]^2$$

Limitations:- mass of the particle changes with velocity $m = \frac{m_0}{\sqrt{1-v^2/c^2}}$

5b) Integral form of Maxwells eq (2M)

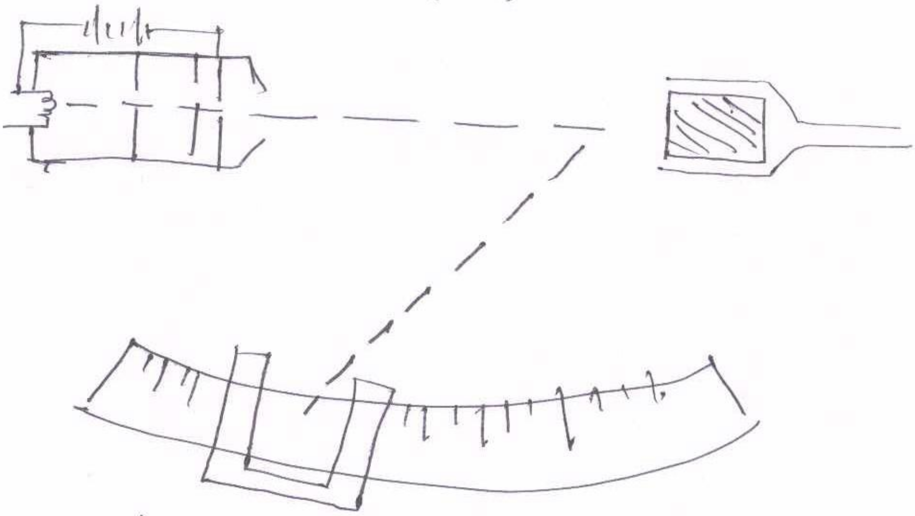
$$\int \bar{E} \cdot \bar{ds} = q/\varepsilon_0$$

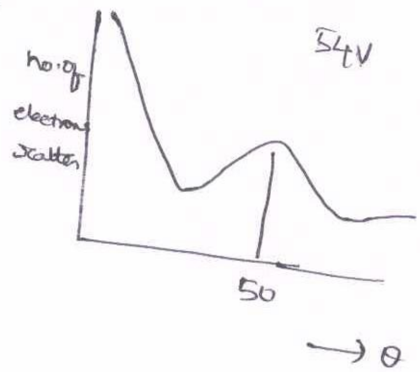
$$\int B \cdot ds = 0$$

$$\int \bar{E} \cdot \bar{dl} = -\frac{d\phi_B}{dt}$$

$$\int \bar{B} \cdot dl = \mu_0 i + \mu_0 \varepsilon_0 \frac{d\phi_E}{dt}$$

6) a) Construction (2M)
Working. (3M)
Diagram. (2M)
what does it conforms (1M)





$\lambda = \frac{12.26}{\sqrt{V}} = \frac{12.26}{\sqrt{54}} = \underline{1.65 A^o}$

$\lambda = 2d\sin\theta$.
$= 2 \times 0.91 \times \sin 65 = \underline{1.65 A^o}$

It confirms the wave nature of the matter

6b) formula - (1M) Ans (1M)

$\lambda = \frac{12.26}{\sqrt{V}} A^o = \frac{12.26}{\sqrt{1000}} A^o \simeq \frac{12.26}{31.6} = 0.38 A^o$

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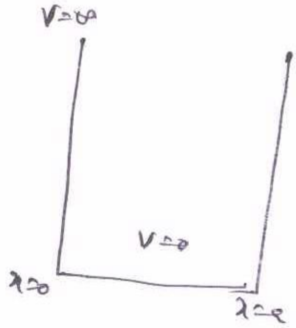
7 a) Derivation for energy (6M)
Normalisation condition (2M)



$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2} E\psi = 0$

$\frac{d^2\psi}{dx^2} + k^2\psi = 0$

$\psi = A\sin kx + B\cos kx$

$\boxed{B=0}$

$\sin ka = 0$

$\boxed{E = \frac{n^2 h^2}{8ma^2}}$

$\int_{x=0}^{x=a} |\psi|^2 dx = 1$

$\int_0^a A^2 \sin^2 kx\, dx = 1$

$A = \sqrt{\frac{2}{a}}$

$\boxed{\psi = \sqrt{\frac{2}{a}} \sin \frac{n\pi x}{a}}$

(Formula - 1M) (Ans - 1M)

b). $E = \frac{n^2 h^2}{8ma^2}$ J

$= \frac{(1)^2 (6.6\times10^{-34})^2}{8\times(9.1\times10^{-31})(2.5\times10^{-10})^2}$ $\frac{43.56\times10^{-68}}{455\times10^{-51}}$ $= 9.57\times10^{-19}$ J

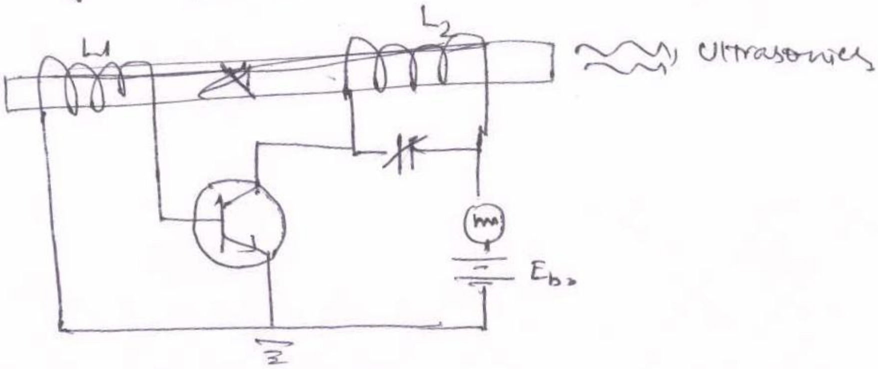
Unit - IV

8 a) Definition of magnetostriction (1 M)

Diagram (2M)

Construction (2M)

working (3 M)



change of dimensions of ferromagnetic rod by the application of magnetic field is known as magnetostriction.

The frequency of vibration of rod $f = \frac{1}{2l}\sqrt{\frac{E}{\rho}}$

E - Youngs modulus.
ρ - density
L - length of rod

frequency of LC circuit $f = \frac{1}{2\pi\sqrt{L_2 C}}$

8b) Any four applications (4 M)

1) Cutting -
2) Drilling. -
3) Cavitation -
4) Ultrasonic Imaging -
5) NDT -
6) SONAR —
7) welding —