MUZAFFARPUR INSTITUTE OF TECHNOLOGY, MUZAFFARPUR

COURSE FILE
OF
PHYSICS
(L-T-P:3-0-3)

By:

DR. A. DIXIT

ASSISTANT PROFESSOR,

DEPARTMENT OF PHYSICS

CONTENTS

Department of Physics

Vision

- To servethe nation by providing practical and theoretical knowledge to the students in the field of engineering and experimental research.

Mission

- To make the laboratory well equipped.
- To arrange new experiment in lab as per syllabus.
- To encourage innovative work to students by undertaking projects, collaboration with industries, institution, and government.

Engineering Physics Educational Objectives (PEO)

After one years of graduation a BE graduate would be able to

- Plan, design, construct, maintain, analyze, advance, and manage engineering projects of moderate complexity
- Pursue professional licensure and certifications
- Engage in life-long learning and pursue advanced level studies
- Demonstrate leadership skills through career advancement and active participation in the all engineering profession and in the community

Engineering Physics Student Outcomes (PO)

Students who complete the B.E. degree in different discipline will be able to:

1) An ability to apply knowledge of Physics in their specific branches
2) The ability to conduct laboratory experiments and to critically analyze and interpret experimental data
3) The ability to perform the design of different model by means of design experiences integrated throughout the professional component of the curriculum,
4) An ability to function on teams, that must integrate contributions from different areas of physics towards the solution of multi-disciplinary projects.
5) An ability to identify, formulate, and solve Electromagnetic problems in Electrical engineering.
6) An ability to write and speak effectively,
7) The broad education necessary to understand the impact of engineering Physics solutions in a global and societal context,
8) A recognition of the need for, and an ability to engage in life-long learning,
9) An ability to use the techniques, skills, and modern tools necessary for Physics engineering practice
10) Possess a thorough understanding of techniques that are appropriate to administer and evaluate construction contracts, documents and codes
11) Possess ability to estimate costs, estimate quantities and evaluate materials for construction purposes

Course Description

Engineering physics or engineering science refers to the study of the combined disciplines of physics, mathematics and engineering, particularly computer, nuclear, electrical, electronic, materials or mechanical engineering. By focusing on the scientific method as a rigorous basis, it seeks ways to apply, design, and develop new solutions in Unlike traditional engineering disciplines, engineering science/physics is not necessarily confined to a particular branch of science, engineering or physics. Instead, engineering science/physics is meant to provide a more thorough grounding in applied physics for a selected specialty such as optics, quantum physics, materials science, applied mechanics, electronics, nanotechnology, microfabrication, microelectronics, photonics, mechanical engineering, electrical engineering, nuclear engineering, biophysics, control theory, aerodynamics, energy, solid-state physics, etc. It is the discipline devoted to creating and optimizing engineering solutions through enhanced understanding and integrated application of mathematical, scientific, statistical, and engineering principles. The discipline is also meant for cross-functionality and bridges the gap between theoretical science and practical engineering with emphasis in research and development, design, and analysis.

Course Objectives

1. Creating an environment to make teaching more learning centric rather than curriculum centric.
To train students in basic science.
3. To develop industry institute interface for collaborative research, internship and fellowship for PG Programme.
4. To focus undergraduate engineering students on the application of established methods to the design and analyze of engineering solutions.

Course Outcomes

1. CE305.1 The course of quantum physics will provide understanding operator formalism,de Broglie hypothesis and various other things.

2. CE305.2 In optics students will learn interference, diffraction, and polarization which are vary basis in the field of signal propagation.

3. CE305.3 The ability to conduct laboratory experiments and to critically analyze and interpret experimental data

4. CE305.4 An ability to identify, formulate, and solve Electromagnetic problems in Electrical engineering.
5. CE305.5 The broad education necessary to understand the impact of engineering Physics solutions in a global and societal context,

CO-PO MAPPING

Sr. No.	Course Outcome (CO)	PO
1.	CE305.1 The course of quantum physics will provide understanding operator formalism,de Broglie hypothesis and various other things.	PO1, PO4
2.	CE305.2 In optics students will learn interference, diffraction, and polarization which are vary basis in the field of signal propagation.	PO1, PO6, PO10
3.	CE305.3 The ability to conduct laboratory experiments and to critically analyze and interpret experimental data	PO2, PO6, PO8
4.	CE305.4 An ability to identify, formulate, and solve Electromagnetic problems in Electrical engineering.	PO2, PO4, PO11
5.	CE305.5 The broad education necessary to understand the impact of engineering Physics solutions in a global and societal context,	PO3, PO7, PO8, PO12

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CE305.1 The course of quantum physics will provide understanding operator formalism,de Broglie hypothesis and various other things.	√			√								
CE305.2 In optics students will learn interference, diffraction, and polarization which are vary basis in the field of signal propagation.	√					√				√		
CE305.3 The ability to conduct laboratory experiments and to critically analyze and interpret experimental data		√				√		√				
CE305.4 An ability to identify, formulate, and solve Electromagnetic problems in Electrical engineering.		√		√							√	
CE305.5 The broad education necessary to understand the impact of engineering Physics solutions in a global and societal context,			√				√	√				√

B. Tech. Semester (Physics Syllabus)

PH 1×01 Physics

UNIT-I

ELECTROSTATICS AND ELECTROMAGNETIC THEORY : Dielectrics - The three electric vectors, Gauss's law in Dielectrics, Energy stored in Electrostatic field, Boundary Conditions. Continuity Equation for charge, Displacement current, Maxwell's Equations in Differential and Integral form and their Physical significance, Maxwell's Equations in free space and speed of plane electromagnetic waves travelling in vacuum. Poynting theorem and Poynting vectors, electromagnetic waves propagation in dielectrics and conductors.

UNIT-II

OPTICS &LASER : Temporal coherence Michelson's interferometer for measurement of coherence length of source and line width, Spatial coherence, Measurement of spatial coherence using young’s Interferometer Fraunhofer diffraction by single slit, double slit and grating.Lasers and Laser light, Einstein A and B coefficient, Population inversion, Light amplification by optical resonator. Characteristics of Laser, Ruby laser, Working Principle of He-Ne Laser

POLARISATION : Unpolarised light, Production of plane polarised light by Polaroid technique (Principle of action should be emphasized) Brewster’s Law, Malu’s Law, Double Refraction, Production of Plane, Circular and elliptical, Polarized Light, Analysis of unpolarised light and polarized light, Magneto-optic effect, electro optic effect and photo elastic effect.

UNIT-III

QUANTUM PHYSICS : Planck’s theory of black body radiation, Compton effect, Photo electric effect, Einstein photo electric equation and its experimental verification Wave particle duality, De-Broglie waves, De-Broglie wave velocity, Wave and group velocity, Division and Germer experiment, Heisenberg’s uncertainty principle, Application of uncertainty principle. Wave functions and wave equation, physical interpretation of wave function and normalization condition, Expectation values, Schrodinger’s wave equation (Time dependent and time independent i.e. steady, state form) in one dimension, quantum-mechanical operators, Particle in a box (Infinite Potential Well), Finite Potential barrier and tunneling.

UNIT-IV

SPECIAL THEORY OF RELATIVITY : Michelson-Morely experiment, Postulates of special theory of relativity, Consequence of special theory of relativity, Lorentz transformation and its application. (Length contraction and time dilation)

UNIT-V

NANO-PHYSICS : Introduction and Basic definition of Nano Technology, Properties of Nano particles, Elementary ideas of Synthesis of Nano particles, Application of Nano Technology.

Books:

1 ‘Introduction of Electromagnetic Theory' by D.J. Grifit, 3rd EditionPrentic Hall, New Jersey

2 ‘Optics, Ajay Ghatak,SatyaPrakashPublicatio, New Delhi
Engineering Physics-Hitendra K. Malik and Ajay Kumar Singh by TMH Publication.

GATE SYLLABUS

Physics Engineering

Section 1: Mathematical Physics

Linear vector space: basis, orthogonality and completeness; matrices; vector calculus; linear differential equations; elements of complex analysis: Cauchy-Riemann conditions, Cauchy’s theorems, singularities, residue theorem and applications; Laplace transforms, Fourier analysis;

elementary ideas about tensors: covariant and contravariant tensor, Levi-Civita and Christoffel symbols.

Section 2: Classical Mechanics

D'Alembert's principle, cyclic coordinates, variational principle, Lagrange's equation of motion, central force and scattering problems, rigid body motion; small oscillations, Hamilton's formalisms; Poisson bracket; special theory of relativity: Lorentz transformations, relativistic kinematics, mass-energy equivalence.

Section 3: Electromagnetic Theory

Solutions of electrostatic and magnetostatic problems including boundary value problems; dielectrics and conductors; Maxwell's equations; scalar and vector potentials; Coulomb and Lorentz gauges; Electromagnetic waves and their reflection, refraction, interference, diffraction and polarization; Poynting vector, Poynting theorem, energy and momentum of electromagnetic waves; radiation from a moving charge.

Section 4: Quantum Mechanics

Postulates of quantum mechanics; uncertainty principle; Schrodinger equation; one-, two- and three-dimensional potential problems; particle in a box, transmission through one dimensional potential barriers, harmonic oscillator, hydrogen atom; linear vectors and operators in Hilbert space; angular momentum and spin; addition of angular momenta; time independent perturbation theory; elementary scattering theory.

Section 5: Thermodynamics and Statistical Physics

Laws of thermodynamics; macrostates and microstates; phase space; ensembles; partition function, free energy, calculation of thermodynamic quantities; classical and quantum statistics; degenerate Fermi gas; black body radiation and Planck's distribution law; Bose-Einstein condensation; first and second order phase transitions, phase equilibria, critical point.

Section 6: Atomic and Molecular Physics

Spectra of one- and many-electron atoms; LS and jj coupling; hyperfine structure; Zeeman and Stark effects; electric dipole transitions and selection rules; rotational and vibrational spectra of diatomic molecules; electronic transition in diatomic molecules, Franck-Condon principle; Raman effect; NMR, ESR, X-ray spectra; lasers: Einstein coefficients, population inversion, two and three level systems.

Section 7: Solid State Physics & Electronics

Elements of crystallography; diffraction methods for structure determination; bonding in solids; lattice vibrations and thermal properties of solids; free electron theory; band theory of solids: nearly free electron and tight binding models; metals, semiconductors and insulators; conductivity, mobility and effective mass; optical,ielectric and magnetic properties of solids; elements of superconductivity: Type-I and Type II superconductors, Meissner effect, London equation.

Semiconductor devices: diodes, Bipolar Junction Transistors, Field Effect Transistors; operational amplifiers: negative feedback circuits, active filters and oscillators; regulated power supplies; basic digital logic circuits, sequential circuits, flip-flops, counters, registers, A/D and D/A conversion.

Section 8: Nuclear and Particle Physics

Nuclear radii and charge distributions, nuclear binding energy, Electric and magnetic moments; nuclear models, liquid drop model: semi-empirical mass formula, Fermi gas model of nucleus, nuclear shell model; nuclear force and two nucleon problem; alpha decay, beta-decay, electromagnetic transitions in nuclei; Rutherford scattering, nuclear reactions, conservation laws; fission and fusion; particle accelerators and detectors; elementary particles, photons, baryons, mesons and leptons; quark model.

Course Handout:

Institute / College Name :	**MIT, Muzaffarpur**		
Program Name	**B. Tech 1st and 2nd Semester**		
Course Code	**L-T-P:3-0-3**		
Course Name	**PH 1×01 PHYSICS**		
Lecture / Tutorial (per week):	**15/1**	**Course Credits**	5.0
Course Coordinator Name	**Dr. A. Dixit**		

1. Scope and Objectives of the Course

This course is designed to understand fundamental concept of electromagnetic waves (EMW) propagating in different media. The aim of keeping this course is to develop capacity under student for different application of signal propagation in the different branches of engineering such as optical communication, networking and laser technology.The course is not limited only to EMT, but is extended in different other field of science and engineering for example polarization, optics and quantum physics.

2. The course outcomes are:

1. The course of quantum physics will provide understanding operator formalism, de Broglie hypothesis and various other things.
2. In optics students will learn interference, diffraction, and polarization, which are, vary basis in the field of signal propagation.

3. Textbooks

TB1: 'Introduction of Electromagnetic Theory' by D.J. Grifit, 3rdEditionPrentic Hall, New Jersey

4. Reference Books

RB1:'Optics, Ajay Ghatak,SatyaPrakashPublicatio, New Delhi

RB2: Engineering Physics-Hitendra K. Malik and Ajay Kumar Singh by TMH Publication.

Other readings and relevant websites:

S.No.	**Link of Journals, Magazines, websites and Research Papers**
1.	http://optics.byu.edu/BYUOpticsBook_2008.pdf
2.	http://qa.answers.com/Q/Difference_between_he-ne_laser_and_ruby_laser
3.	https://www.slideshare.net/Tuhin_Das/laser-its-application
4.	https://www.elprocus.com/laser-diode-construction-working-applications/
5.	

Course Plan:

Lecture Number	**Date of Lecture**	**Topics**	**Web Links for video lectures**	**Text Book / Reference Book / Other Reading Material**	**Page numbers of Text Book(s)**
1-9		Electromagnetic Theorem	https://www.google.co.in/search?q=gauss+divergence+theorem&spell=1&sa=X&ved=0ahUKEwiM242TnarZAhWMqI8KHe_tDt0QkeECCCMoAA&biw=1366&bih=654	TB1, RB2	Chapter 6
Tutorial - 1					
10-16		Optics and Laser	http://www.waves.utoronto.ca/prof/mojahedi/ECE1228/Course%20Notes%20Set%201.pdf	TB1, RB2	
Tutorial – 2, Assignment I					
				RB1	
17-23		Polarisation			
24-41		Quantum Physics		https://en.wikipedia.	

				org/wiki/Quantum_ mechanics	
42-46		Special Theory of Relative		https://en.wikipedia. org/wiki/Special_rela tivity	
46-50		Nano Physics		http://www.physics.u del.edu/~bnikolic/tea ching/phys824/lectur es/what_is_nanophys ics.pdf	
Tutorial 6					

1. **Evaluation Scheme:**

Component 1	Mid Semester Exam + Assignment + Attendance	30
Component 2	Lab Attendance + Class Performance	20
Component 3**	Sessional Examination**	30
	Total	**80**

****** The End Term Comprehensive examination will be held at the end of semester. The mandatory requirement of 75% attendance in all theory classes is to be met for being eligible to appear in this component.

SYLLABUS

Topics	No of lectures	Weightage
ELECTROSTATICS AND ELECTROMAGNETIC THEORY : Dielectrics - The three electric vectors, Gauss's law in Dielectrics, Energy stored in Electrostatic field, Boundary Conditions. Continuity Equation for charge, Displacement current, Maxwell's Equations in Differential and Integral form and their Physical significance, Maxwell's Equations in free space and speed of plane electromagnetic waves travelling in vacuum. Poynting theorem and Poynting vectors, electromagnetic waves propagation in dielectrics and conductors.		25%
OPTICS &LASER : Temporal coherence Michelson's interferometer for measurement of coherence length of source and line width, Spatial coherence, Measurement of spatial coherence using young's Interferometer Fraunhofer diffraction by single slit, double slit and grating.Lasers and Laser light, Einstein A and B coefficient, Population inversion, Light amplification by optical resonator. Characteristics of Laser,		10%

Ruby laser, Working Principle of He-Ne Laser		
POLARISATION : Unpolarised light, Production of plane polarised light by Polaroid technique (Principle of action should be emphasized) Brewster's Law, Malu's Law, Double Refraction, Production of Plane, Circular and elliptical, Polarized Light, Analysis of unpolarised light and polarized light, Magneto-optic effect, electro optic effect and photo elastic effect.		10%
QUANTUM PHYSICS : Planck's theory of black body radiation, Compton effect, Photo electric effect, Einstein photo electric equation and its experimental verification Wave particle duality, De-Broglie waves, De-Broglie wave velocity, Wave and group velocity, Division and Germer experiment, Heisenberg's uncertainty principle, Application of uncertainty principle. Wave functions and wave equation, physical interpretation of wave function and normalization condition, Expectation values, Schrodinger's wave equation (Time dependent and time independent i.e. steady, state form) in one dimension, quantum-mechanical operators, Particle in a box (Infinite Potential Well), Finite Potential barrier and tunneling.		25%
SPECIAL THEORY OF RELATIVITY : Michelson-Morely experiment, Postulates of special theory of relativity, Consequence of special theory of relativity, Lorentz transformation and its application. (Length contraction and time dilation)		15%
NANO-PHYSICS : Introduction and Basic definition of Nano Technology, Properties of Nano particles, Elementary ideas of Synthesis of Nano particles, Application of Nano Technology.		15%

This Document is approved by:

Designation	**Name**	**Signature**
Course Coordinator	Dr. A. Dixit	
H.O.D	Dr. R. P. Singh	
Principal	Dr. J. N. Jha	
Date		

Evaluation and Examination Blue Print:

Internal assessment is done through quiz tests, presentations, assignments and project work. Two sets of question papers are asked from each faculty and out of these two, without the knowledge of faculty, one question paper is chosen for the concerned examination. Examination rules and regulations are uploaded on the student's portal. Evaluation is a very transparent process and the answer sheets of sessional tests, internal assessment assignments are returned back to the students.

The components of evaluations alongwith their weightage followed by the University is given below

Class test	5%
Assignments/Quiz Tests/Seminars	5%
Mid Semester	20%
End term examination	70%

Institute / School Name :	Physics Dept. MIT, Muzaffarpur		
Program Name	-		
Course Code	L-T-P: 3-0-3		
Course Name	PH 1×01 PHYSICS		
Lecture / Tutorial (per week):	15/1	**Course Credits**	5
Course Coordinator Name	DR. A. Dixit		

Lecture Plan:

Topics	**Lecture Number**	**Date on which the Lecture will be taken**
ELECTROSTATICS AND ELECTROMAGNETIC THEORY :		
Dielectrics - The three electric vectors, Gauss's law in Dielectrics, Energy stored in Electrostatic field, Boundary Conditions.	**1-2**	
Continuity Equation for charge, Displacement current, Maxwell's Equations in Differential and Integral form and their Physical significance	**3-4**	
Maxwell's Equations in free space and speed of plane electromagnetic waves travelling in vacuum.	**4-6**	
Poynting theorem and Poynting vectors, electromagnetic waves propagation in dielectrics and conductors.	**6-8**	

OPTICS &LASER :		
Temporal coherence Michelson's interferometer for measurement of coherence length of source and line width, Spatial coherence,	**9-10**	
Measurement of spatial coherence using young's Interferometer Fraunhofer diffraction by single slit, double slit and grating.Lasers and Laser light, Einstein A and B coefficient, Population inversion, Light amplification by optical resonator.	**11-12**	
Characteristics of Laser, Ruby laser, Working Principle of He-Ne Laser	**13-14**	
Unpolarised light, Production of plane polarised light by Polaroid technique (Principle of action should be emphasized) Brewster's Law,	**15-16**	
Malu's Law, Double Refraction, Production of Plane, Circular and elliptical, Polarized Light, Analysis of unpolarised light and polarized light,	**17-18**	
Magneto-optic effect, electro optic effect and photo elastic effect.	**19-20**	
QUANTUM PHYSICS :		
Planck's theory of black body radiation, Compton effect, Photo electric effect, Einstein photo electric equation and its experimental verification Wave particle duality,	**21-22**	
De-Broglie waves, De-Broglie wave velocity, Wave and group velocity, Division and Germer experiment, Heisenberg's uncertainty principle,	**23-24**	
Application of uncertainty principle. Wave functions and wave equation, physical interpretation of wave function and normalization condition,	**25-26**	
Expectation values, Schrodinger's wave equation (Time dependent and time independent i.e. steady, state form) in one dimension,	**27-28**	
Expectation values, Schrodinger's wave equation (Time dependent and time independent i.e. steady, state form) in one dimension,	**29-30**	
quantum-mechanical operators, Particle in a box (Infinite Potential Well), Finite Potential barrier and tunneling.	**31-34**	
SPECIAL THEORY OF RELATIVITY :		
Michelson-Morely experiment,	**35**	
Postulates of special theory of relativity,	**36**	
Consequence of special theory of relativity,	**37**	
Lorentz transformation and its application. (Length contraction and time dilation)	**38**	
NANO-PHYSICS :		

Introduction and Basic definition of Nano Technology,	**39**	
Properties of Nano particles,	**40**	
Elementary ideas of Synthesis of Nano particles,	**41**	
Application of Nano Technology.	**42**	

Department of Physics

Assignment 1

1. Suppose the world was actually governed by classical mechanics. In such a classical universe, we might try to build a Hydrogen atom by placing an electron in a circular orbit around a proton. However, we know from 8.03 that a non-relativistic, accelerating electric charge radiates energy at a rate given by the Larmor formula,

$$\frac{dE}{dt} = \frac{-2\,q^2a^2}{3\,c^3}$$

(in cgs units) where q is the electric charge and a is the magnitude of the acceleration. So the classical atom has a stability problem. How big is this effect?

(a) Show that the energy lost per revolution is small compared to the electron's kinetic energy. Hence, it is an excellent approximation to regard the orbit as circular at any instant, even though the electron eventually spirals into the proton.

(b) Using the typical size of an atom (1 Å) and a nucleus (1 fm), calculate how long it would take for the electron to spiral into the proton.

(c) Compare the velocity of the electron (assuming an orbital radius of 0.5 Å) to the speed of light – will relativistic corrections materially alter your conclusions?

(d) As the electron approaches the proton, what happens to its energy? Is there a minimum value of the energy the electron can have?

Department of Physics

Assignment 2

(a) Light Waves as Particles

The Photoelectric effect suggests that light of frequency ν can be regarded as consisting of photons of energy E = hν, where $h = 6.63\cdot 10^{-27}$ erg · s.

i. Visible light has a wavelength in the range of 400-700 nm. What are the energy and frequency of a photon of visible light?

ii. The microwave in my kitchen operates at roughly 2.5 GHz at a max power of $7.5 \cdot 10^{9}\ \frac{\text{erg}}{\ }$. How many photons per second can it emit? What about a low-power laser ($10^{4}\ \frac{\text{erg}}{\ }$ at 633 nm), or a cell phone ($4 \cdot 10^{6}\ \frac{\text{erg}}{\ }$ at 850 MHz)?

iii. How many such microwave photons does it take to warm a 200ml glass of water by 10°C? (The heat capacity of water is roughly $4.18 \cdot 10^{7}$.)

iv. At a given power of an electromagnetic wave, do you expect a classical wave description to work better for radio frequencies, or for X-rays?

(b) Matter Particles as Waves If a wavelength can be associated with every moving particle, then why are we not
forcibly made aware of this property in our everyday experience? In answering, calculate the de Broglie wavelength $\lambda = \frac{h}{p}$ of each of the following particles:

i. an automobile of mass 2 metric tons (2000 kg) traveling at a speed of 50 mph ($22\ \frac{m}{s}$),

ii. a marble of mass 10 g moving with a speed of $10 \frac{cm}{s}$

TUTORIAL SHEET

1. Calculate the de Broglie wavelength for
   (a) a proton of kinetic energy 70 MeV and
   (b) a 100 g bullet moving at 900 ms^{-1}.

2. Estimate the uncertainty in the position of (a) a neutron moving at 5 X 10^{6} ms^{-1} and (b) a 50 kg person moving at 2 ms^{-1}.

3. A 45 kW broadcasting antenna emits radio waves at a frequency of 4 MHz.
   (a) How many photons are emitted per second?
   (b) Is the quantum nature of the electromagnetic radiation improtant in analyzing the radiation emitted from this antenna?

4. When light of a given wavelength is incident on a metallic surface, the stopping potential for the photoelectrons is 3.2 V. If a second light source whose wavelength is double that of the first is used, the stopping potential drops to 0.8 V. From these data, calculate
   (a) the wavelength of the first radiation and
   (b) the work function and the cutoff frequency of the metal.

B. Tech 1st Semester Mid-Term Examination (Sample Paper)
Sub.- Physics

Max. Marks 20 **Time: 2 Hours**

Answer any three questions.

1. Write Maxwell’s equations in integral and differential form for free space, solve it in terms of electric field, and obtain the expression of the electromagnetic waves in vacuum.

2. What is displacement current? Derive fourth Maxwell equation.

3. Define Compton’s effect and obtain an expression for Compton shift.

4. Discuss de-Broglie hypothesis and prove it experimentally.

5. Explain time dependent Schrodinger wave equation.

6. Write short note on any two of the followings:

(a) Energy stored in electrostatic field.

(b) Three electric vectors.

(c) Explain relativity and give postulates of special theory of relativity.

(d) Discuss polarised and un-polarised light.

B. Tech 1st Semester Mid-Term Examination
Sub.- Physics (Sample Paper)

PHYSICS ***Time*: 2 hours *Full Marks*: 20**

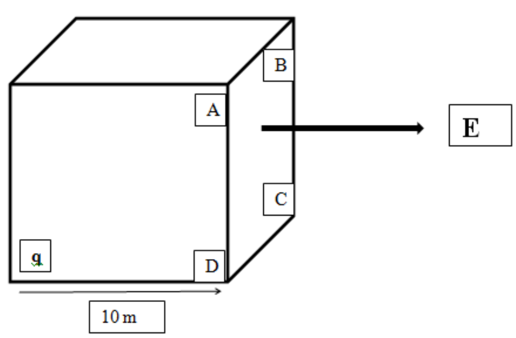
Instructions:

(i) There are six questions in the paper.

(ii) Attempt any four questions.

(iii) All questions carry equal marks.

(1) Calculate the flux passes through the surface ABCD of a hollow cube of side 10 meter each where charge ‘q’ sitting at one of the corner. What happen if that charge moves outside of the cube? [5]



(2) Prove that electric vector in always perpendicular to direction of propagation [5] of EM wave.

(3) (a) Draw the energy level diagram for ‘He-Ne’ LASER.[3]
(b) Why four levels LASER are better than three levelsLASER?[2]

(4) Attempt any**two** questions[2.5x2]
(a)What do you understand by the diffraction of light? Describe the various types of diffractions for light wave.
(b)Write the expression for the diffraction of the light with single slit.Draw the pattern of intensity at various orientations for the diffraction of light with single slit .
(c)What is the significance of surface to volume ratio in nanoparticles?

(5) (a) What do you understand by theMalu's Law?[2.5]
(b) Describe the different methods of production of polarized light.[2.5]

(6) Write short note on any **two** of following[2.5x2]
(a) Population inversion in LASER
(b) Electromagnetic induction
(c)Polarized and unpolarized light
(d) Lorentz transformation

MUZAFFARPUR INSTITUTE OF TECHNOLOGY, MUZAFFARPUR

B. Tech 1st Year Question Bank

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1. SECTION A

a) What is the physical significance of curl of a vector field?
b) State Poynting theorem and interpret each term in its expression.
c) What is the atomic origin of Para magnetism exhibited by certain materials?
d) What are the essential conditions for a unit cell to be called a primitive cell?
e) What is population inversion and give its significance in lasing action?
f) How does light propagate through an optical fiber?
g) Give basic postulates of special theory of relativity.
h) Justify why an electron can't be accelerated in a cyclotron. i) List properties of a well behaved wave functions for a given system. j) Give a brief and broad outline of synthesis of nanomaterials through chemical vapors deposition.

2. SECTION-B

a) Derive the equations of electromagnetic waves propagation through free space. Further deduce important properties of EM wave propagation in free space.
b) What is Ampere's circuital rule? What is the drawback of this rule and how it was accounted for by Maxwell?

c) Describe how ultrasonic waves are generated using the method of magnetostriction.
d) What are type I and type II superconductors and give their distinguishing features.
e) What is Bragg's law. Derive the Bragg's condition for x-ray diffraction. What are the limitations of Bragg's law?
f) A certain orthorhombic crystal has a ratio of a : b : c of 0.428:1:0.376. Find Miller indices of the faces with intercepts 0.214:1:0.188. 3 5.
g) Discuss the construction and working of a Semiconductor laser.
h) Give a qualitative idea of formation and reconstruction of hologram.

3. **SECTION-C**

a) What are different kinds of optical fibers? How is light wave guided through an optical fiber? Derive and interpret the numerical aperture of an optical fiber.
b) Give various kinds of dispersion suffered by the light wave while propagating through an optical fiber.
c) How is Heisenberg's uncertainty principle a natural consequence wave nature of moving particles?
d) Consider a particle of mass m trapped in an one dimensional box of infinite depth. Using steady state Schrodinger's equation obtain permissible states and corresponding energies of the particle.
e) Derive the expression for variation of mass of a relativistic body with velocity.
f) The mean life of a muon, when it is at rest, is 2.2μs. Calculate the average distance it will travel in vacuum before it decays, if it has velocity of 0.9c.
g) Discuss sol-gel technique for synthesis of nanomaterials.
h) Write a short note on properties of nanomaterials which distinguish it from bulk matter

4. **SECTION-D**

a) Differentiate between dielectrics and conductors by taking suitable example(s).
b) Define Poynting vector.
c) Suggest some method to detect Ultrasonic waves
d) What is meant by stimulated emission?
e) What is meant by space lattice? f) What do you mean by pulse broadening?
f) What is the outcome of Michelson Morley Experiment?
g) Where do we use Lorentz transformations, and why. i) What do you understand by Eigen functions. j) Explain electron confinement.

5. **SECTION E**

a) What do you understand by displacement current . Suggest a method to calculate it.
b) Solve Maxwell's equations in time varying fields.
c) A magnetizing field of 1400 Am-1 produces a magnetic flux of 3x10-5 weber in an iron bar of cross sectional area 0.3 cm2. Calculate permeability and susceptibility of the bar.
d) What do you understand by ferrites? Discuss their main applications. A. Find the maximum frequency present in the radiation from an X-ray tube whose accelerating

potential is 5x104 V. B. Discuss working principle and construction of Braggs spectrometer.

e) Using appropriate energy level diagram, discuss the working of He-Ne laser.

f) Discuss relevance of Einstein's coefficients in context of Lasing mechanism.

6. SECTION F

a) A glass fiber has a core material of refractive index 1.50 and cladding material of refractive index 1.45. If it is surrounded by air, compute the critical angle (i) at core-cladding boundary and (ii) at cladding -air boundary.

b) Discuss merits and demerits of multi-mode optical fibres.

c) The mass of a moving electron is 8 times its rest mass. Find its kinetic energy and momentum.

d) What do you understand by simultaneity in relativity.

e) Derive time independent Schrodinger wave equation and discuss its significance in today's context.

f) What is the significance of quantum mechanics for macroscopic bodies.

g) Explain the concept of Super-Para magnetism in view of Nano synthesis.

h) Discuss some important application(s) of Nano particles