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**UNIVERSITY OF PETROLEUM & ENERGY STUDIES**

**School of Computer Science**

**Dehradun**

**COURSE PLAN**

Programme : B. Tech.

Course : Physics

Subject Code : PHYS-1002

No. of credits : 4 (3+1)

Semester : I /II

Session : 2017-8

Batch : 2017-21

Prepared by :

Email :

**Approved By**

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| --- | --- | --- | --- | --- | --- |
| **PHYS 1002** | **Physics** | L | T | P | C |
| **Version 1.0** |  | 3 | 1 | 0 | 4 |
| **Pre-requisites/Exposure** | 12th level Physics | | | | |
| **Co-requisites** | 12th level Mathematics | | | | |

**Course Objectives**

1. To demonstrate the principles of LASER and its applications in holography as well as in fiber-optic communications.
2. To determine gradient of scalar fields and divergence & curl vector fields.
3. To develop of electromagnetics, which forms the basis of several contemporary communication systems such as fiber optics communication and it, is also a prerequisite for forthcoming semesters.
4. To understand and apply the matter and energy equivalence as well as the applicability of Lorentz transformation equations.
5. To utilize fundament of quantum mechanics in various areas of Material Science and engineering.

**Course Outcomes**

On completion of this course, the students will be able to

CO1: To understand the working of LASER and optical fiber, need of various mechanics e.g. relativistic and quantum in addition to understanding of interaction between charges and current distributions.

CO2: To compute field of various charge and current distributions and to work out problems related to relativistic, Quantum mechanics, LASERS and optical fiber.

CO3: To apply the concepts of electrostatics and magnetostatics, relativistic mechanics and wave mechanics in general physics problems under various boundary conditions.

CO4: To analyze the behavior of electric field, magnetic field, effect of speed and dependency on size of a particle in various problems in physics.

**Catalog Description**

Physics is the backbone of every engineering stream. It inherently investigates the subtle intricacies of of nature and effectively explains various physical processes responsible for such intricacies. The Physics curriculum provides direct coherence of concepts and applications which adhere to the need of understanding engineering in a generic and dynamic manner. An introduction to optics subsequently leads to the understanding of various aspects of LASERs, Holography, Fiber Optics communication system and Optical instrumentation. These topics have revolutionized various technologies in a tremendous fashion. An understanding of electromagnetic theory leads the conceptualization of signal communication techniques and it also forms the basis of electric signal theory. In Faraday's law, magnetic fields are associated with electromagnetic induction and magnetism, and Maxwell's equations describe how electric and magnetic fields are generated and altered by each other and by charges and currents. Furthermore special theory of relativity instigates an out-of-box thinking habits among the students. Quantum Mechanics describes the physical phenomena in which the wave and particle aspects of matter and radiation are reconciled in a unified manner. The knowledge of the Quantum Mechanics can be applied to the study of optical and electronic sensor as well as to the behavior at microscopic and nano level.

**Course Content**

**Unit I: 10 lecture hours**

Lasers & Fibre Optics - Introduction, Spontaneous and Stimulated emission of radiation, Relation b/w Einstein’s A and B coefficients, Population inversion & types of pumping, Main components of a Laser, Construction & working of Ruby Laser and its applications, Construction & working of Helium-Neon laser and its applications. Holography: Elementary idea of holography and constructive and reconstructive of holography.

Fundamental ideas about optical fiber, Types of fibers, Acceptance angle and cone, Numerical aperture, Propagation mechanism and communication in optical fiber, Attenuation and losses.

**Unit II: 14 lecture hours**

Electro-Magnetics - Coordinate systems, Del operator, Gradient, Divergence, Divergence Theorem, Stoke’s Theorem, Introduction to electrostatics, calculation of electric field, potential and energy due to charge distribution by vector approach, Gauss law electric flux density.

Polarization in Dielectrics, Bound charges, Dielectric Constant and strength, Continuity equation and relaxation time Boundary Conditions.

Introduction, Biot-Savart’s law, Ampere’s Circuit Law; Applications, Magnetic flux density, Faraday’s Law, Transformer and motional EMF. Displacement current, Maxwell’s Equations in Final form.

**Unit III: 6 lecture hours**

Special Theory of Relativity - Introduction, Inertial & Non-inertial frames, Michelson-Morley Experiment, Postulates, Lorentz transformation, Length contraction, Time dilation, Twin Paradox, Concept of simultaneity, velocities addition, and Concept variation of mass with velocity, Mass - energy equivalence and Energy momentum relation.

**Unit IV: 12 lecture hours**

Wave Mechanics - Introduction to Quantum Mechanics, photoelectric effect, Compton Effect, Pair production & Annihilation, Wave particle duality, De Broglie waves, phase and group velocities and their relations, Uncertainty principle and its applications, Wave function and its interpretation, Normalization, Schrodinger time independent & dependent wave equations, Particle in a 1-D box; generalization to 3-D box.

**Text Books**

1. Malik H.K, Singh A.K. (2011) Engineering Physics, TMH, New Delhi. ISBN: 9780070671539
2. Sadiku M.N.O. (2007) Elements of Electromagnetics, Oxford University Press. ISBN: 0195300483
3. Beiser A. (2002) Concepts of Modern Physics, McGraw Hill Education. ISBN: 9780070495531

**Reference Books**

1. Griffith D.J. (2012) Introduction to Electromagnetics, PHI Learning, 4th edition, ISBN: 9780138053260
2. Ghatak A. (2012) Optics, McGraw Hill Education. ISBN: 978-1259004346

**Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**

**Examination Scheme:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Components** | **CCT** | **Tutorial/Assignment** | **MSE** | **ESE** |
| **Weightage (%)** | **15** | **15** | **20** | **50** |

**Common Class Test (CCTs):** Three CCTs – Multiple-choice questions will be held online through Blackboard platform; those who do not appear in test examinations shall lose their marks.

**Tutorials:** Each tutorial class will be assessed based on the performance. The best eight scores in total held tutorial classes will be used for this component.

**Assignments:** After completion of each unit or in the mid of the unit, there will be home assignments based on theory and numerical problems. Those who fail to submit the assignments by the due date shall lose their marks.

**Mid Term Examination: Weightage – 20%**

Mid Term examination shall be Two Hours duration and shall be a combination ofShort and Long theory Questions.

**End Term Examination: Weightage – 50%**

End Term Examination shall be Three Hours duration and shall be a combination of Short and Long theory/numerical Questions.

**Relationship between the Course Outcomes (COs) and Program Outcomes (POs)**

|  |  |  |
| --- | --- | --- |
| **Mapping between COs and POs** | | |
|  | **Course Outcomes (COs)** | **Mapped Programme Outcomes** |
| **CO1** | To understand the working of LASER and optical fiber, need of various mechanics e.g. relativistic and quantum in addition to understanding of interaction between charges and current distributions. | **PO1, PO2, PO12** |
| **CO2** | To compute field of various charge and current distributions and to work out problems related to relativistic, Quantum mechanics, LASERS and optical fiber. | **PO1, PO2** |
| **CO3** | To apply the concepts of electrostatics and magnetostatics, relativistic mechanics and wave mechanics in general physics problems under various boundary conditions. | **PO1, PO2** |
| **CO4** | To analyze the behavior of electric field, magnetic field, effect of speed and dependency on size of a particle in various problems in Physics. | **PO1, PO2, PO12** |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Engineering Knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual or team work | Communication | Project management and finance | Life-long Learning |
| Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| PHYS 1002 | PHYSICS II | 3 | 2 |  |  |  |  |  |  |  |  |  | 1 |

1=weakly mapped

2= moderately mapped

3=strongly mapped

**Model Question Paper**

**Note: In the model question paper, the mapping of COs is done with the syllabus of even semester of 2016-17 (not with the current one).**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name:**  **Enrolment No:** | | UPES | | |
| Course: PHYS1002 – PHYSICS **Programme: B.Tech. (CIT Programmes) Semester: EVEN-2016-17**  **Time: 03 hrs. Max. Marks:100**  **Instructions:**  **All the Bold representations in the given questions are the vector quantities.** | | | | |
| **Section A**  (All partsare compulsory.Each part carries 4 marks**)** | | | | |
| 1(a) | What are the requirements for producing laser action? Explain. | | **[4]** | **CO1** |
| 1(b) | Write Maxwell’s equations for time varying electromagnetic fields in integral form. | | **[4]** | **CO2** |
| ­­­1(c) | Write Lorentz and inverse Lorentz transformation equations. | | **[4]** | **CO3** |
| 1(d) | Derive a formula expressing de-Broglie wavelength of an electron in terms of potential difference (V) in volts through which it is accelerated. | | **[4]** | **CO4** |
| 1(e) | Prove that group velocity (vg) is equal to the particle velocity (v) for a relativistic particle. | | **[4]** | **CO4** |
|  |  | |  |  |
|  | **SECTION B**  **(**Attempt all the Questions. Each question carries 8 marks. Questions 2-5 are compulsory. Attempt any one from each part of Question 6.**)** | |  | |
| 2. | a) An optical fibre made of silica glass has a refractive index difference of 0.45 % and acceptance angle for the fibre in the air is 0.115 radian. Find the speed of light in the fibre core. Assume velocity of light in free space is 3 x 108 m/s.  b) What are the important characteristics of laser radiation? Discuss some applications of laser in communication and industry. | | **[8]** | **CO1** |
| 3. | a) State Divergence theorem and Stoke’s theorem. Give their importance.  b) A point charge of 13.5 μC is enclosed at the centre of the cube of side 6.0 cm. Calculate the electric flux (i) through the whole volume and (ii) through one face of the cube. | | **[8]** | **CO2** |
| 4.(a) | Deduce expression for length contraction according to special theory of relativity. | | **[4]** | **CO4** |
| 4.(b) | Derive expression for the direction of recoiled electron, i.e.    when a beam of x-rays scatter from an electron, which is assumed to be at rest. | | **[4]** | **CO5** |
| 5. | a) Describe the pulse height vs voltage curve of gaseous counter with a suitable diagram.  b) G. M. Counter wire collects 108 electrons per discharge. When the counting rate is 500 counts/minute, what will be the average current in the circuit? | | **[8]** | **CO6** |
| 6. | The threshold wavelength for emission from a metallic surface is 6000 Å. What is the work function for that particular metal? Calculate the maximum speed of a photoelectron produced by each of the following wavelengths of light: (i) 5000Å (ii) 6000Å and (iii) 7000Å. **OR**  State Heisenberg’s uncertainty principle. On its basis, prove that the electron cannot be the part of nucleus. | | **[8]** | **CO5** |
|  | **SECTION C**  Attempt all the Questions. Each question carries 20 marks.  Question 7 is compulsory. Attempt any one from each part of Question 8. | |  | |
| 7. (a) | (i) Obtained a relation between transition probabilities for spontaneous and stimulated emission of radiation  (ii) Explain the re-construction of a hologram with suitable diagram. | | **[10]** | **CO1** |
| 7. (b) | (i) Derive time dependent Schrodinger wave equation.  (ii) A particle is confined within a box of length 20Å. Find the probability of finding a particle between 9Å and 11Å within the box, when the particle is in its ground state. | | **[10]** | **CO5** |
| 8. (a) | (i) Show that the Faraday’s law of electromagnetic induction can be expressed as one of the Maxwell’s equations for time varying field.  (ii) A steady current element of 10-3**az** A.m is located at the origin in free space. Determine the magnetic field intensity due to given current element at (1, 0, 0).  **OR**  (i) State Biot-Savart’s law. Write expression for magnetic field intensity for different current distributions. Determine the field due to a straight current carrying conductor of infinite length using Biot-Savart’s law.  (ii) A circular loop located on x2 + y2 = 9, z = 0, carries a direct current of 10 amperes along **aϕ**. Determine **H** at (0, 0, 4) and (0, 0, -4). | | **[10]** | **CO3** |
| 8. (b) | (i) Obtain the relativistic formula for the addition of velocities in inertial frames of references.  (ii) A radioactive atom moving with respect to laboratory at a speed 0.6c in X-direction. If it emits an electron having a speed of 0.9c in X-direction, find the velocity of the electron with respect to laboratory.  **OR**  Deduce an expression for variation of mass with velocity in accordance with the special theory of relativity. | | **[10]** | **CO4** |

**Sample format for Indirect Assessment of Course outcomes**

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| --- |
| NAME: |
| ENROLLMENT NO: |
| SAP ID: |
| COURSE: |
| PROGRAM: |

Please rate the following aspects of course outcomes Physics-II.

Use the scale 1-4\*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COs |  | 1 | 2 | 3 | 4 |
| **CO1** | To understand the working of LASER and optical fiber, need of various mechanics e.g. relativistic and quantum in addition to understanding of interaction between charges and current distributions. |  |  |  |  |
| **CO2** | To compute field of various charge and current distributions and to work out problems related to relativistic, Quantum mechanics, LASERS and optical fiber. |  |  |  |  |
| **CO3** | To apply the concepts of electrostatics and magnetostatics, relativistic mechanics and wave mechanics in general physics problems under various boundary conditions. |  |  |  |  |
| **CO4** | To analyze the behavior of electric field, magnetic field, effect of speed and dependency on size of a particle in various problems in Physics. |  |  |  |  |

3

Below Average

Good

1

**\***

Very Good

Average

4

2

**Lecture wise Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Lecture No. | Learning Objective | Topics to be covered | | References (Chap./Sec./ Page Nos. of Text Book) | Pedagogy | |
| L-1 | UNIT -1 : LASER & FIBRE OPTICS | LASERS: Introduction, Spontaneous and Stimulated emission of radiation, | | T1: (Ch:4) | HA# 1 | |
| L-2 | Relation b/w Einstein’s A and B coefficients, | |
| L-3 | Population inversion & types of pumping, Main components of a Laser. | |
| L-4 | Construction & working of Ruby Laser and its applications | |
| L-5 | Construction & working of Helium-Neon laser and its applications | |
| L-6 | HOLOGRAPHY: Elementary idea of holography and constructive and reconstructive of holography | | T1: (Ch:4) |
| L-7 | FIBRE OPTICS: Fundamental ideas about optical fiber, Types of fibers | | T1: (Ch:5) |
|  | **Class test #1** | |
| L-8 | Acceptance angle and cone, Numerical aperture | |
| L-9-10 | Propagation mechanism and communication in optical fiber, Attenuation and losses. | |
| **Activity 1** |  | **Flip classroom activity for L – 9, 10** | |  |
| L-11 to 15 | Unit II:  ELECTRO-MAGNETICS | Coordinate systems  Del operator, Gradient, Divergence, Divergence Theorem, Stokes’s Theorem  Introduction to electrostatics, calculation of electric field, potential and energy due to charge distribution by vector approach, Gauss law electric flux density. | | T3  Ref. 1 |
| L-16 to 18 | Polarization in Dielectrics, Bound charges, Dielectric Constant and strength, Continuity equation and relaxation time Boundary Conditions | |
|  | **Class test #2** | |  |
| L-19 to 21 | Introduction, Biot-Savart’s law, Ampere’s Circuit Law; Applications, Magnetic flux density | | T3  Ref. 1 |
| L-22 to 24 | Faraday’s Law, Transformer and motional EMF. Displacement current, Maxwell’s Equations in Final form. | |
| **Mid sem Exam** | | | | | | |
| L-25 | Unit III:  SPECIAL THEORY OF RELATIVITY | | Introduction, Inertial & Non-inertial frames, Michelson-Morley Experiment, | T1: (Ch:11)  T4: (Ch: 1) | | HA# 2 |
| L-26 | Postulates, Lorentz transformation, |
| L-27 | Length contraction, Time dilation, Twin Paradox, Concept of simultaneity |
| L-28 | velocities addition, Concept variation of mass with velocity, |
| L-29 | Mass-energy equivalence and Energy momentum relation |
| L-30 | Unit IV:  WAVE MECHANICS | | Introduction to Quantum Mechanics, photoelectric effect, | T4: (Ch: 2,3,5) | |
| L-31 | Compton Effect, |
| L-32 | Pair production & Annihilation, Wave particle duality |
| L-33-35 | De Broglie waves, phase and group velocities and their relations |
| L-36 | Uncertainty principle and its applications, |
| L-37 | Wave function and its interpretation, Normalization, |
| L – 38- 40 |  | | Schrodinger time independent & dependent wave equations, |  | |  |
| L -41,42 | Particle in a 1-D box; generalization to 3-D box. |
| **Activity 2** |  | | **Flip classroom activity for L-41** | **Activity 2** | |  |
|  |  | | **Class test #3** |  | |  |