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| Semester                                                          | <b>V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Course                                                            | <b>Physics(Major)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Paper Code                                                        | C3PH230531T                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Paper Title                                                       | OPTICS II and Special Relativity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| No. of Credits                                                    | <b>4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Theory / Practical / Composite                                    | <b>Theory</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Minimum No. of preparatory hours per week a student has to devote | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Number of Modules                                                 | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Syllabus                                                          | <p><b>Group A</b></p> <p>Fraunhofer diffraction: Diffraction pattern due to single slit, double slit, plane transmission grating, circular aperture. Babinet's principle.</p> <p style="text-align: right;"><b>[7 lectures]</b></p> <p>Fresnel Diffraction: Fresnel's half-period zones for plane wave. Explanation of rectilinear propagation of light (qualitative). Theory of a zone plate.</p> <p style="text-align: right;"><b>[3 lectures]</b></p> <p>Resolving power: Rayleigh's criterion of resolution, Resolving power of a telescope, prism and plane transmission grating.</p> <p style="text-align: right;"><b>[3 lectures]</b></p> <p>Polarization of light: Linearly polarised light: Methods of production. Different states of polarisation, double refraction, uniaxial and biaxial crystals, Huygens construction for uniaxial crystals, Nicol prism. Analysis of plane, circularly and elliptically polarized light. Brewster's law, phase retardation plates: quarter-wave and half-wave plates.</p> <p style="text-align: right;"><b>[8 Lectures]</b></p> <p>Rotatory Polarization: Optical rotation. Fresnel's theory of optical rotation. Specific rotation. Biquartz and Laurent's half-shade polarimeter.</p> <p style="text-align: right;"><b>[3 Lectures]</b></p> <p><b>Group B</b></p> <p>Postulates of the Special Theory of Relativity. Inertial frames of reference. Derivation of Lorentz transformation equations. Invariance of space-time interval. Length contraction. Time dilation. Simultaneity and the order of events. Spacelike and timelike intervals: Concept of causality.</p> <p style="text-align: right;"><b>[6 lectures]</b></p> |

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|                         | <p>Relativistic dynamics, Derivation of mass-energy equivalence and applications, Energy-momentum relation. Motion of a particle under a constant force, Relativistic kinematics</p> <p style="text-align: right;"><b>[6 lectures]</b></p> <p>Minkowski space-time diagram: light cone and world lines. Spacelike, timelike and lightlike intervals. Illustration of length contraction, time dilation, simultaneity etc. based on Minkowski diagram. Simple calculations involving space-time diagram. Twin paradox.</p> <p style="text-align: right;"><b>[4 lectures]</b></p> <p>Four-vectors: definitions and components of four-vectors corresponding to position, velocity, acceleration, momentum, force and wave-number. Transformation of components from one frame to another. Scalar product of two four-vectors. Four-momentum and energy-momentum relation. Doppler effect from four-vector perspective. Conservation of four-momentum. Relativistic kinematics involving four-vectors. (Problem solving: simple collisions and decays).</p> <p style="text-align: right;"><b>[8 lectures]</b></p> |
| Learning Outcomes       | <p><b>Group A</b></p> <ol style="list-style-type: none"> <li>1. This course will expose the students to the electromagnetic nature of light waves.</li> <li>2. Students will be exposed to near and far field diffraction phenomena.</li> <li>3. Methods and applications of polarized light would be introduced.</li> </ol> <p><b>Group B</b></p> <ol style="list-style-type: none"> <li>1. Paradigmatic shift from classical to relativistic viewpoint and understanding the space-time geometry of nature.</li> <li>2. Develop understanding in interpreting paradoxical phenomena, like time dilation and mass-energy equivalence.</li> <li>3. Develop competence in relativistic calculations, employing four-vectors and conservation laws.</li> </ol>                                                                                                                                                                                                                                                                                                                                                   |
| Reading/Reference Lists | <p><b>Group A</b></p> <p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Optics, by Eugene Hecht – 5<sup>th</sup> edition. Pearson Education.</li> <li>2. Optics, Schaum's Outline Series, by Eugene Hecht, 2017, McGraw Hill Education.</li> <li>3. Optics, by Ajoy Ghatak. 7<sup>th</sup> edition, 2020. Tata McGraw Hill.</li> </ol> <p><b>Group B</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

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|                                          | <b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. Introduction to Electrodynamics, D.J. Griffiths, 4<sup>th</sup> edition., 2015, Pearson Education</li> <li>2. Special Relativity by A. P. French, W. W. Norton &amp; Company Inc, New York, 1968</li> <li>3. Introduction to Special Relativity, R. Resnick, 2010, John Wiley and Sons</li> <li>4. Special Relativity: For the Enthusiastic Beginner, D. Morin, 2017, Createspace Independent Pub</li> <li>5. Introduction to Special Relativity, J.H. Smith, 2015, Dover Publications Inc</li> </ol> |                                                 |
| Evaluation                               | Theory CIA: 30 (2 x 10 + 5/assignment+ 5/attn.)<br>Semester Exam:70                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Practical (if applicable) CA:<br>Semester Exam: |
| Paper Structure for Theory Semester Exam | For each module of 35 Marks: 15 Marks from 3 marks questions (5 out of 7) 20 Marks from 10 marks questions (2 out of 3)                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                 |