

## Subject Description Form

|   |  |
|---|--|
| <b>Subject Code</b>                                   | EE1D04   |
| <b>Subject Title</b>                                  | What is light and what has humanity done with light  |
| <b>Credit Value</b>                                   | 3  |
| <b>Level</b>  | 1  |
| <b>Pre-requisite/<br/>Co-requisite/<br/>Exclusion</b> | Nil  |
| <b>Objectives</b>                                     | Technologies have brought about changes to human lives in a rate that is unprecedented. A major portion of the new technologies we are enjoying today are based on clever usage of light. In this course, we will highlight how our continual understanding of light and their real-life applications shape the way we live. We will also discuss potential future directions on light and optical technologies on various aspects of human lives.   |
| <b>Intended Learning Outcomes</b>                     | <p>Upon completion of the subject, students will be able to:</p> <ol style="list-style-type: none"> <li>a. obtain a qualitative and quantitative understanding of the nature of light</li> <li>b. appreciate how our understanding of light deepens with time and how we make use of such understanding to build machines and devices to improve our lives</li> <li>c. understand how light is used in applications such as energy generation and conservation, imaging and displays, medicine, communications and astronomy</li> <li>d. understand the technical as well as economic aspects of developing lightwave technologies for real-life applications and society as a whole</li> <li>e. identify potential future trends in the application of light for a better way of living</li> </ol> <p>The qualitative and quantitative (at secondary school level) understanding of the nature of light provides a background for students to appreciate various current technologies using light. This allows students to ‘connect’ the operating principles of different lightwave technologies and provide a deeper level of understanding of lightwave technologies and their usage which promote higher-order thinking. Emphasis will be put on current issues (technological and social) relating to the use of light in daily lives and their future trends in order to promote life-long and continued learning.</p> <p>The reading assignments are to fulfill the University’s English Reading and Writing Requirements and enhance the reading and writing skills of students</p> |
| <b>Subject Synopsis/<br/>Indicative Syllabus</b>      | <p>Syllabus:</p> <ol style="list-style-type: none"> <li>1. Introduction to light: The nature of light as beam of particles, waves, electromagnetic radiation and quantum objects; electromagnetic spectrum; Ray Optics. Reflection and refraction of light rays; Fermat’s principle; curved mirrors; curved lens; diffraction and wave description; speed of light, wavelength and frequency; dispersion; Doppler effect; constructive and destructive interference; Electric field and magnetic field; scattering, polarization of light; temperature and Blackbody radiation; quantum nature of light energy; photons; photo electric effect; electron energy levels and light; Absorption and emission spectrum; energy and power associated with light</li> <li>2. Light for energy conservation and generation: input/output energy from light bulbs; energy saving bulbs; Light Emitting Diodes (LED); improvement in energy efficiency; emerging applications of LED; the need for reusable energy; light from the sun as free and under-utilized form of energy; the solar panel and its principle of operation; Cost and efficiency analysis; Current state of solar panel utilization in various countries and regions.</li> </ol>   |

|   | <p><b><u>Case study/Reading Assignment 1:</u></b> <i>Solar power technologies: government incentive policies in various countries [Ref 11, Ch. 7]</i></p> <p>3. Light for imaging applications: lens, glasses, cameras; simple ray tracing techniques for imaging analysis; microscopes and telescopes; range and resolution; the smallest and the farthest thing we can currently see; X-ray scans; CT scans, MRI; endoscopes; Discovery process of heliocentric universe and the conflict between science and religion.</p> <p><b><u>Case study/Reading Assignment 2:-</u></b><i>The conflict between-Science and Religion [Ref 10, pp. 129-180]</i></p> <p>4. Optics engineering for communications and information science: the need to go beyond copper wire communications; superior bandwidth provided by fiber; growth of communication; Current global internet backbone; lasers, fibers; transmission of laser light through fibers; current status of bandwidth supply and demand for fiber-optic communications worldwide; social implications and trends of modern and future communications technology.</p> <p><b><u>Case study/ Reading Assignment 3:</u></b><i>Social media: effects and trends for individuals and business [Ref 3, pp. 1-63,120-135,189-238]</i></p>  |                                   |             |   |   |   |  |  |   |   |   |   |   |   |     |   |   |   |   |   |                   |     |  |   |   |   |  |                       |     |  |   |   |   |   |             |     |   |   |   |  |  |               |     |   |  |   |  |  |       |      |  |  |  |  |  |
|---|---|-----------------------------------|-------------|---|---|---|--|--|---|---|---|---|---|---|-----|---|---|---|---|---|-------------------|-----|--|---|---|---|--|-----------------------|-----|--|---|---|---|---|-------------|-----|---|---|---|--|--|---------------|-----|---|--|---|--|--|-------|------|--|--|--|--|--|
| <p><b>Teaching/Learning Methodology</b></p>                                   | <p>The students will gain an understanding of the various aspects of light and its applications in our lives through regular lectures, tutorials, homeworks as well as seminars. Students will also be given regular reading assignments throughout the course. Specifically, in-depth articles relating to the 3 case studies will be given and students will be required to choose 1 case study and submit corresponding write-ups of length 500 words each as one of the two course homeworks. The other homework will consist simple math and physics questions relating to the topics covered in class. For the group presentation and report, students will form groups of 3 or 4 and choose a topic (a list of topics will be provided by the lecturers at the first or second week of class) related to the course materials. The group will then be asked to investigate the topic in detail through in-depth reading and literature search and present their findings in a 15-20 -minute presentation. In addition, each student will be asked to submit an individual term report of length 1500 - 2500 words. The total amount of reading required for this course will be 200 pages or more. In addition, simple laboratory experiments on ray and wave properties of light will be conducted to better enable students to appreciate the actual characteristics of light. The lecturers will provide assistance on how to conduct literature search or perform data analysis throughout the completion of the term project.</p> |                                   |             |   |   |   |  |  |   |   |   |   |   |   |     |   |   |   |   |   |                   |     |  |   |   |   |  |                       |     |  |   |   |   |   |             |     |   |   |   |  |  |               |     |   |  |   |  |  |       |      |  |  |  |  |  |
| <p><b>Assessment Methods in Alignment with Intended Learning Outcomes</b></p> | <table border="1"> <thead> <tr> <th rowspan="2">Specific assessment methods/tasks</th> <th rowspan="2">% weighting</th> <th colspan="5">Intended subject learning outcomes to be assessed</th> </tr> <tr> <th>a</th> <th>b</th> <th>c</th> <th>d</th> <th>e</th> </tr> </thead> <tbody> <tr> <td>1. Midterm test<br/>(covering reading assignments* and basic science concepts)</td> <td>20%</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>2. Report Writing</td> <td>40%</td> <td></td> <td>✓</td> <td>✓</td> <td>✓</td> <td></td> </tr> <tr> <td>3. Group presentation</td> <td>15%</td> <td></td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>4. Homework</td> <td>15%</td> <td>✓</td> <td>✓</td> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>5. Laboratory</td> <td>10%</td> <td>✓</td> <td></td> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>Total</td> <td>100%</td> <td colspan="5"></td> </tr> </tbody> </table>  | Specific assessment methods/tasks | % weighting | Intended subject learning outcomes to be assessed |   |   |  |  | a | b | c | d | e | 1. Midterm test<br>(covering reading assignments* and basic science concepts) | 20% | ✓ | ✓ | ✓ | ✓ | ✓ | 2. Report Writing | 40% |  | ✓ | ✓ | ✓ |  | 3. Group presentation | 15% |  | ✓ | ✓ | ✓ | ✓ | 4. Homework | 15% | ✓ | ✓ | ✓ |  |  | 5. Laboratory | 10% | ✓ |  | ✓ |  |  | Total | 100% |  |  |  |  |  |
| Specific assessment methods/tasks   | % weighting   |                                   |             | Intended subject learning outcomes to be assessed |   |   |  |  |   |   |   |   |   |   |     |   |   |   |   |   |                   |     |  |   |   |   |  |                       |     |  |   |   |   |   |             |     |   |   |   |  |  |               |     |   |  |   |  |  |       |      |  |  |  |  |  |
|   |   | a                                 | b           | c   | d | e |  |  |   |   |   |   |   |   |     |   |   |   |   |   |                   |     |  |   |   |   |  |                       |     |  |   |   |   |   |             |     |   |   |   |  |  |               |     |   |  |   |  |  |       |      |  |  |  |  |  |
| 1. Midterm test<br>(covering reading assignments* and basic science concepts) | 20%   | ✓                                 | ✓           | ✓   | ✓ | ✓ |  |  |   |   |   |   |   |   |     |   |   |   |   |   |                   |     |  |   |   |   |  |                       |     |  |   |   |   |   |             |     |   |   |   |  |  |               |     |   |  |   |  |  |       |      |  |  |  |  |  |
| 2. Report Writing   | 40%   |                                   | ✓           | ✓   | ✓ |   |  |  |   |   |   |   |   |   |     |   |   |   |   |   |                   |     |  |   |   |   |  |                       |     |  |   |   |   |   |             |     |   |   |   |  |  |               |     |   |  |   |  |  |       |      |  |  |  |  |  |
| 3. Group presentation   | 15%   |                                   | ✓           | ✓   | ✓ | ✓ |  |  |   |   |   |   |   |   |     |   |   |   |   |   |                   |     |  |   |   |   |  |                       |     |  |   |   |   |   |             |     |   |   |   |  |  |               |     |   |  |   |  |  |       |      |  |  |  |  |  |
| 4. Homework   | 15%   | ✓                                 | ✓           | ✓   |   |   |  |  |   |   |   |   |   |   |     |   |   |   |   |   |                   |     |  |   |   |   |  |                       |     |  |   |   |   |   |             |     |   |   |   |  |  |               |     |   |  |   |  |  |       |      |  |  |  |  |  |
| 5. Laboratory   | 10%   | ✓                                 |             | ✓   |   |   |  |  |   |   |   |   |   |   |     |   |   |   |   |   |                   |     |  |   |   |   |  |                       |     |  |   |   |   |   |             |     |   |   |   |  |  |               |     |   |  |   |  |  |       |      |  |  |  |  |  |
| Total   | 100%  |                                   |             |   |   |   |  |  |   |   |   |   |   |   |     |   |   |   |   |   |                   |     |  |   |   |   |  |                       |     |  |   |   |   |   |             |     |   |   |   |  |  |               |     |   |  |   |  |  |       |      |  |  |  |  |  |

|                                      |  |          |
|--------------------------------------|--|----------|
|                                      | * The reading assignments are to fulfill the University's English Reading and Writing Requirements and enhance the reading and writing skills of students  |          |
| <b>Student Study Effort Expected</b> | Class contact:   |          |
|                                      | Lectures   | 36 Hrs.  |
|                                      | Laboratory   | 3 Hrs.   |
|                                      | Other student study effort:  |          |
|                                      | Self/guided studies, group projects and assignments  | 66 Hrs.  |
|                                      | Total student study effort   | 105 Hrs. |
| <b>Reading List and References</b>   | <ol style="list-style-type: none"> <li>1. G. Waldman, "<i>Introduction to Light: The Physics of Light, Vision, and Color</i>," Prentice-Hall, 1983.</li> <li>2. A. Montwill and A. Breslin, "<i>Let There Be Light</i>," Imperial College Press</li> <li>3. Erik qualman, "<i>Socialnomics</i>" John Wiley and Sons, 2011</li> <li>4. L. Macdonald and A. C. Lowe, "<i>Display Systems: Design and Applications</i>" Wiley Press.</li> <li>5. T. Bradford, "Solar Revolution: The Economic Transformation of the Global Energy Industry" SPI Publisher Services.</li> <li>6. S. Perkowitz, "<i>Empire of Light: A History of Discovery in Science and Art</i>," Henry Holt and Company.</li> <li>7. K. Kirkland, "<i>Light and Optics</i>," Facts on File, Inc., 2007.</li> <li>8. S. Gibilisco, "<i>Optics Demystified</i>," McGraw-Hill, 2009.</li> <li>9. D. Kennedy, "Rooftop Revolution -- How Solar Power can Save our Economy -- and Our Planet from Dirty Energy,"</li> <li>10. Paul Kurtz, "<i>Science and Religion: Are They Compatible?</i>" Prometheus Books, 2003.</li> <li>11. P. Jayarama Reddy, Solar Power Generation: Technology, New Concepts and Policy, CRC Press 2012</li> </ol> <p><b>Required readings for ER:</b></p> <ol style="list-style-type: none"> <li>1. Erik qualman, "Socialnomics" 2nd edition, John Wiley and Sons, 2013, Ch. 1-3, 6, 8</li> <li>2. Paul Kurtz, "Science and Religion: Are They Compatible?" Prometheus Books, 2003, pg. 83 - 170</li> <li>3. P. Jayarama Reddy, Solar Power Generation: Technology, New Concepts and Policy, CRC Press 2012, Ch. 7</li> </ol> |          |