Semester

Optics and Photonics			
Course Code	**21PHY652**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03 Hours

Course Objectives :

1. To understand the sources of light, the properties and interaction light with the matter.
2. To understand the different types of LED light sources and various photonic components

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Apart from conventional lecture methods various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills in physics.
2. State the necessity of physics in engineering studies and offer real life examples.
3. Seminars and Quizzes may be arranged for students in respective subjects to develop skills.
4. Encourage the students for group learning to improve their creativity and analytical skills.
5. While teaching show how every concept can be applied to the real world. This helps the students to expand understanding level.
6. Support and guide the students for self-study.
7. Ask some higher order thinking questions in the class, which promotes critical thinking.
8. 8. Inspire the students towards the studies by giving new ideas and examples.

Module-1

: Sources of Light **08 Hours.**

Classical radiation processes: radiation from an accelerated charge; the Hertzian dipole. Free– free radiation. Cyclotron and synchrotron radiation. Free electron lasers. Cerenkov radiation. The formation of spectral lines: the Bohr model; nuclear mass; quantum mechanics; angular momentum and electron spin. Light from the Sun and Stars. Thermal sources. Fluorescent lights. Luminescence sources. Electroluminescence.

Pedagogy	Chalk and talk, Power point presentation, Videos **Self-study Component:** The sources of light and the formation of spectral lines.

Module-2

Interaction of Light with Matter **08 Hours**

The classical resonator. Rayleigh scattering. Polarization and refractive index in dielectrics. Free electrons. Faraday rotation in a plasma. Resonant atoms in gases. The refractive index of dense gases, liquids and solids. Anisotropic refraction. Brillouin scattering. Raman scattering. Thomson and Compton scattering by electrons. A summary of scattering processes.

Pedagogy	Chalk and talk, Power point presentation, Videos **Self study Component: The classical resonator ,Rayleigh Scattering, Polarization and refractive index.**

Module-3

Nature of light and Detection **08 Hours.**

The nature of light. Waves and rays. Total internal reflection. The light wave. Electromagnetic waves. The electromagnetic spectrum. Stimulated emission: the laser. Photons and material particles. Photo emissive detectors. Semiconductor detectors. Semiconductor junction photo diodes. Imaging detectors. Noise in photo-detectors. Image intensifiers. Photography. Thermal detectors.

Concept of Charge Carriers, Phonons and Scattering Mechanism:
Origin of Charge Carriers, Electron Dispersion Relation, Electron Distribution Function, Phonon, Dispersion Relation, Electron/Hole-Phonon Scattering, Charge Impurity Scattering, Grain Boundary Scattering, Point Defect and Alloy Scattering, Phonon Electron/Hole Scattering, Grain Boundary Scattering and Microstructure.

Pedagogy	Chalk and talk, Power point presentation, Videos **Self-study Component: Total internal reflection, electromagnetic waves and spectrum, Origin of charge carriers.**

Module-4

LED photonics **08 Hours.**
LED, Homojunction and Hetero-structure high intensity LEDs, LED output spectrum, Quantum Well High Intensity LEDs, LED Materials and Structures, LED Efficiencies and Luminous Flux, LEDs for Optical fiber communications, Phosphors and White LEDs. Super luminescent and Resonant Cavity LEDs: SLD and RCLED.

Pedagogy	Chalk and talk, Power point presentation, Videos **Self study Component: LED, Homo and hetero structure LEDs.**

Module-5

Photonic Components **08 Hours.**
Micro-optic Lenses, Mirrors, Prisms, Polarizers Diffraction Gratings, Optical isolators, Graded Index Rod lenses, Wave-guide Couplers, Wave-guide Electro-optic Devices: Pockels Effect Devices, Phase Modulators, Amplitude Modulators, Polarization Control, Acousto-optic Devices: The Bragg Cell, Thin-Strip Acoustic Transducer, Tunable Acousto-optic Filter, Acousto-optic Modulator, Magneto-optical switches.

Pedagogy	Chalk and talk, Power point presentation, Videos **Practical Topics:** **Self study Component:** Micro-Optic Lenses ,mirrors, prisms, Polarizers and diffraction gratings, Optical isolators.

Course Outcomes
After the completion of the course student should be able to :

After the completion of this course the student will be able to
1. Summarize the various origin of light qualitatively.
2. Describe the types of interaction of radiation with matter.
3. Apprehend the wave, ray and particle nature of light and the detection mechanisms.
4. Illustrate the types of LED sources used in photonics.
5. Demonstrate the principles of essential photonic components.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE).

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(To have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text books:

Reference books:

1. Applied Photonics by Chai Yeh, ACADEMIC PRESS
2. Optoelectronics and Photonics: Principles and Practices, S.O. Kasap, PEARSON
3. Optics and Photonics: An Introduction, F Graham Smith, Terry A King, Dan Wilkins, WILEY
4. Fundamentals of Photonics: B E A Saleh, M C Teich, Wiley Series in Pure and Applied Optics, WILEY.

Web links and Video Lectures (e-Resources):

1. https://youtu.be/Ug7UpitvczU
2. https://youtu.be/7Wq83fRDHOk
3. https://youtu.be/L-cA4gBCxHs
4. https://youtu.be/ZD7QayuwkQU

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

http://nptel.ac.in

https://swayam.gov.in