Course Name	Physics
Course Code	PH(EE)201
Course Credit	4
Contact Hour	3L-1T
Prerequisite	

Course Objective

The course objectives are:

1. To provide an adequate exposure and develop insight about the basic physics principles along with the possible applications.
2. The acquaintance of basic physics principles would help engineers to understand the tools and techniques used in the industry and provide the necessary foundations for inculcating innovative approaches.
3. To create awareness about the vital role played by science and engineering in the development of new technologies.
4. Necessary exposure to the practical aspects, which is an essential component for learning science.

Course Outcome

On completion of the course students will be able to

1. Define, understand and explain
   - the limitation of classical mechanics,
   - Maxwellian wave equations,
   - basic principles physical optics,
   - basic principles LASER, Optical Fibre,
   - structure of solids, Miller indices,
   - theory of Matter wave, equation of motion of Matter wave
   - wave function and its role in representing wave nature of matter
2. Apply the knowledge of
   - Lagangian Mechanics in solving problems of simple, damped and forced harmonic motion
   - Superposition principle in Newton's ring experiment, Fresnel's biprism experiment, double slit diffraction experiment
   - Bosonic nature of light quantum for production of laser
   - Total internal reflection in transmitting light through optical fibres
   - Mathematical Operators to obtain various physical principles such as Uncertainty principle
3. Analyze
   - The limitations of Newtonian Mechanics and need of Lagrangian mechanics
   - Grating as many slit system
   - Why one at least need a three level system for lasing action
   - Importance of light as a carrier of information
   - The failures of classical physics in microscopic situation and need of a separate physics
   - The inability of direct measurement technique in quantum mechanics and role of operators
4. Design and realize
   - Multi-Slit system using diffraction grating
   - Crystals suitable for double refraction
   - Atomic planes as slits of X-ray diffraction
   - Solution for microscopic systems showing wave nature
   - Mathematical frame work for making measurements in quantum mechanical situation
5. Conduct experiments using
   - LASER, Optical fibre

- Interference by division of wave front, division of amplitude, diffraction grating, polarization of light
- Quantization of electronic energy inside an atom Torsional pendulum

6. Communicate effectively, write reports and make effective presentation using available technology on topics allied to the subject particularly in areas of applications shared in student seminar
7. Engage in independent self-study to formulate, design, enhance, demonstrate
   - application of quantum mechanics in some known physical situation such as junction diode
   - application of quantum mechanics in electronic transition within energy levels inside an atom

CO Mapping with departmental POs

H: High, M: Medium, L: Low

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	√											
CO 2		√										
CO 3			√									
CO 4				√								
CO 5	√	√	√	√		√			√	√		
CO6			√							√		
CO7			√	√	√	√			√			√

Course Content:

Module I: Oscillations **8L**

Simple harmonic motion: Concepts with examples, Superposition of SHMs in two mutually perpendicular directions: Lissajous' figures, Engineering Applications and related Numerical problems **2L**

Damped vibration: Differential equation and its solution, Logarithmic decrement, quality factor, Engineering Applications and related Numerical problems. **3L**

Forced vibration: Differential equation and solution, Amplitude and Velocity resonance, Sharpness of resonance, relevant applications including LCR circuits, Numerical problems.**3L**

Module II: Classical Optics **9L**

Interference of light: Wave nature of light (Huygen's principle), Conditions of sustained interference double slit as an example; qualitative idea of spatial and temporal coherence, conservation of energy and intensity distribution; Newton's ring (qualitative descriptions of working principles and procedures-no deduction required). Engineering applications, Numerical Problems. **3L**

Diffraction of light: Fresnel and Fraunhofer class, Fraunhofer diffraction for plane transmission grating (elementary treatment of intensity distribution for N-slits), single slit and double slits as examples, missing order, Rayleigh criterion, resolving power of grating and microscope (Definition and formula; no deduction required). Engineering Applications, Numerical Problems. **4L**

Polarization: Definition, plane of polarization, plane of vibration, Malus law, fundamental concepts of plane, circular and elliptical polarizations (only qualitative idea) with examples, Brewster's law, Double refraction: ordinary and extraordinary rays, Nicol's prism, Engineering applications, Numerical problems. **3L**

Module III: Quantum Physics **9L**

Quantum Theory: Inadequacy of classical physics; Planck's quantum hypothesis-Qualitative (without deductions), particle concept of electromagnetic wave (example: photoelectric and

Compton effect; qualitative discussions only), wave particle duality; phase velocity and group velocity; de Broglie wave; Davisson and Germer experiment. **4L**

Quantum Mechanics 1: Concept of wave function, Physical significance of wave function, Probability interpretation; wave function normalization condition and its simple numerical applications; uncertainty principle-applications, Schrödinger equation (no mathematical derivation). **4L**

Module VI: X-ray & Crystallography **6L**

X-rays – Origin of Characteristic and Continuous X-ray, Bragg's law (No derivation), Determination of lattice constant, Applications, Numerical problems. **2L**

Elementary ideas of crystal structure - lattice, basis, unit cell, Fundamental types of lattices – Bravais lattice, Simple cubic, fcc and bcc, hcp lattices, (use of models in the class during teaching is desirable) Miller indices and miller planes, Co-ordination number and Atomic packing factor, Applications, Numerical problems. **4L**

Module V: Modern Optics-I **8L**

Laser: Concepts of various emission and absorption process, working principle of laser, metastable state, Population Inversion, condition necessary for active laser action, optical resonator, ruby laser, He-Ne laser, semiconductor laser, Einstein A and B coefficients and equations, industrial and medical applications of laser. **5L**

Fibre optics and Applications: Principle and propagation of light in optical fibres- Numerical aperture and Acceptance angle, V number, Types of optical fibres (material, refractive index, mode), Losses in optical fibre- attenuation, dispersion, bending, Numerical problems. **3L**

Text Books

Oscillations:

1. Classical Mechanics- J. C. Upadhyay (Himalya Publishers)
2. Classical Mechanics-Shrivastav
3. Classical Mechanics-Takwal & Puranik (TMH)
4. Sound-N. K. Bajaj (TMH)
5. Advanced Acoustics-D. P. Roy Chowdhury (Chayan Publisher)
6. Principles of Acoustics-B.Ghosh (Sridhar Publisher)
7. A text book of sound-M. Ghosh (S. Chand publishers)
8. Electricity Magnetism-Chattopadhyay & Rakshit (New Central Book Agency)
9. A text book of Light- K.G. Mazumder & B.Ghoshs, (Book & Allied Publisher)
10. R.P. Singh (Physics of Oscillations and Waves)
11. A.B. Gupta (College Physics Vol. II)
12. Chattopadhya and Rakshit (Vibration, Waves and Acoustics)

Classical Optics & Modern Optics-I:

13. A text book of Light- K.G. Mazumder & B.Ghoshs (Book & Allied Publisher)
14. A text book of Light-Brijlal & Subhramanium, (S. Chand publishers)
15. Modern Optics-A. B. Gupta (Book & Allied Publisher)
16. Optics-Ajay Ghatak (TMH)
17. Optics-Hecht

18. Optics-R. Kar, Books Applied Publishers
19. Möler (Physical Optics)
20. E. Hecht (Optics)
21. E. Hecht (Schaum Series)
22. F.A. Jenkins and H.E White
23. C.R. Dasgupta (Degree Physics Vol 3)

Quantum Physics

24. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
25. Quantum Mechanics-Bagde Singh (S. Chand Publishers)
26. Perspective of Quantum Mechanics-S. P. Kuilla (New Central Book Agency)
27. Quantum Mechanics-Binayak Datta Roy (S. Chand Publishers)
28. Quantum Mechanics-Bransden (Pearson Education Ltd.)
29. Perspective of Modern Physics-A. Beiser (TMH)
30. Eisberg & Resnick is published by Wiley India
31. A.K. Ghatak and S Lokenathan
32. E.E. Anderson (Modern Physics)
33 .Haliday, Resnick & Krane : Physics Volume 2 is Published by Wiley India
34. Binayak Dutta Roy [Elements of Quantum Mechanics]

X-ray & Crystallography

35. Solid state physics-Puri & Babbar (S. Chand publishers)
36. Materials Science & Engineering-Kakani Kakani
37. Solid state physics- S. O. Pillai
38. Introduction to solid state physics-Kittel (TMH)
39. Solid State Physics and Electronics-A. B. Gupta, Nurul Islam (Book & Allied Publisher)
40. S.O. Pillai (a. Solid state physics b. Problem in Solid state physics)

General Reference:

1. Refresher courses in physics (Vol. 1, Vol. 2 & Vol. 3)-C. L. Arora (S. Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt. Ltd.)
3. Basic Engineering Physics-I -Sujoy Bhattacharya, Saumen Paul (TMH)
4. Engineering Physics Vol: 1-Sudipto Roy, Tanushri Ghosh, Dibyendu Biswas (S. Chand).
5. Engineering Physics Vol:1-S. P. Kuila (New Central)
4. University Physics-Sears & Zemansky (Addison-Wesley)
5. B. Dutta Roy (Basic Physics)
6. R.K. Kar (Engineering Physics)
7. Mani and Meheta (Modern Physics)
8. Arthur Baiser (Perspective & Concept of Modern Physics)