I/II Semester

Engineering Physics			
Course Code	**21PHY12/22**	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: This course(21PHY12/22) will enable the students to

- Learn the basic concepts of Physics which are essential in understanding and solving Engineering related challenges.
- Gain the knowledge of problem solving and its practical applications.
- Signify the application of sensitive instrumentation for Nano-scale system.

Pedagogy (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 concepts 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. Inspire the students towards the studies by giving new ideas and examples.

Module-1

Oscillations and Waves: **08 Hours**

Free Oscillations: Basics of SHM, derivation of differential equation for SHM, Mechanical simple harmonic oscillators (spring constant by series and parallel combination), Equation of motion for free oscillations, Natural frequency of oscillations.

Damped Oscillations: Theory of damped oscillations (derivation), over damping, critical & under damping (only graphical representation), quality factor.

ForcedOscillations: Theory of forced oscillations (derivation) and resonance, sharpness of resonance.

Shock waves: Mach number, Properties of Shock waves, Construction and working of Reddy shock tube, applications of shock waves, Numerical problems.

Pedagogy	Chalk and talk, Power point presentation, Videos **Practical Topics**: 1.Spring in series and parallel combination **Self-study Component:** Basics of SHM

Module-2

Modern Physics & Quantum Mechanics: **08 Hours**

Introduction to blackbody radiation spectrum- Wien's law, Rayleigh Jean's law, Stefan -Boltzmann law and Planck's law (qualitative), Deduction of Wien's law and Rayleigh Jeans law from Planck's law. Wave-Particle dualism, de-Broglie hypothesis, de-Broglie wavelength. Heisenberg's uncertainty principle and its physical significance, Application of uncertainty principle-Non-existence of electron in the nucleus (relativistic case), Wave function-Properties, Physical significance, Probability density, Normalization, Eigen values and Eigen functions. Time independent Schrödinger wave equation. Particle in a box- Energy Eigen values and probability densities, Numerical problems.

Pedagogy	Chalk and talk, Power point presentation, Videos **Practical Topics:** 1.Verification of Stefan's Law **Self-study Component:** Wave- Particle dualism, de-Broglie hypothesis , de- Broglie wavelength.

Module-3

Lasers & Optical Fibers: **08 Hours**

Lasers: Interaction of radiation with matter, Einstein's coefficients (derivation of expression for energy density). Requisites of a Laser system. Conditions for Laser action. Principle, Construction and working of CO_2 and semiconductor Lasers. Application of Lasers in Defence (Laser range finder) and medical applications- Eye surgery and skin treatment.

Optical Fibers: Propagation mechanism, angle of acceptance, Numerical aperture, Modes of propagation, Types of optical fibers, Attenuation and Mention of expression for attenuation coefficient. Discussion of block diagram of point to point communication, Optical fiber sensors- Intensity based displacement sensor and Temperature sensor based on phase modulation, Merits and demerits, Numerical problems.

Pedagogy	Chalk and talk, Power point presentation, Videos **Practical Topics:** 1. wavelength of LASER source 2. Optical fiber **Self-study Component:** Properties of Laser and comparison with ordinary source

Module-4

Electrical Conductivity in Solids: **08 Hours**

Classical free electron theory: Drude- Lorentz theory & Assumptions, Expression for electrical conductivity (no derivation), Failures of classical free-electron theory.

Quantum free electron theory: Assumptions, Density of states (no derivation), Fermi-energy, Fermi factor & its temperature dependence, Fermi - Dirac Statistics, Expression for electrical conductivity (derivation), Merits of Quantum free electron theory.

Physics of Semiconductors: Fermi level in intrinsic semiconductors, Expression for concentration of electrons in conduction band, Holes concentration in valance band (only mention the expression), Conductivity of semiconductors (derivation), Hall effect, Expression for Hall coefficient (derivation).

Dielectrics: Electric dipole, Dipole moment, Polarization of dielectric materials, Types of polarizations. Qualitative treatment of Internal field in solids for one dimensional infinite array of dipoles (Lorentz field). Claussius-Mossotti equation (derivation), Numerical problems.

Pedagogy	Chalk and talk, Power point presentation, Videos **Practical Topics:** 1.Fermi Energy of a material 2. Resistivity of a material **Self-study Component:** Electric dipole, Dipole moment, Polarization of dielectric materials

Module-5

Material Characterization Techniques and Instrumentation: **08 Hours**

Introduction to materials: Nanomaterials and nanocomposites. Principle, construction and working of X-ray Diffractometer, crystal size determination by Scherrer equation. Principle, construction, working and applications of -Atomic Force Microscopy (AFM), X-ray Photoelectron *S*pectroscopy(XPS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) Numerical problems.

Pedagogy	Chalk and talk, Power point presentation, Videos **Self study Component:**X-ray diffractometer.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Interpret the types of mechanical vibrations and their applications, the role of Shock waves in various fields.
2. Demonstrate the quantisation of energy for microscopic system.
3. App[y LASER and Optical fibers in opto electronic system.
4. Illustrate merits of quantum free electron theory and applications of Hall effect.
5. Analyse the importance of XRD and Electron Microscopy in Nano material characterization.

Assessment Details (both CIE and SEE)

(methods of CIE need to be define topic wise i.e.- MCQ, Quizzes, Open book test, Seminar or micro project)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

1. Methods suggested: Test, Open Book test, Written Quiz, Seminar, report writing etc.
2. The class teacher has to decide the topic for closed book test, open book test, Written Quiz and Seminar. In the beginning only teacher has to announce the methods of CIE for the subject.

Semester End Examination:

Theory SEE will be conducted by University as per scheduled time table, with common question papers for subject

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.
3. The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. A Text book of Engineering Physics- M.N. Avadhanulu and P.G. Kshirsagar, 10th revised Ed, S. Chand. & Company Ltd, New Delhi.
2. An Introduction to Lasers theory and applications by M.N.Avadhanulu and P.S.Hemne revised Edition 2012 . S. Chand and company Ltd -New Delhi.
3. Engineering Physics-Gaur and Gupta-Dhanpat Rai Publications-2017.
4. Concepts of Modern Physics-Arthur Beiser: 6th Ed;Tata McGraw Hill Edu Pvt Ltd- New Delhi 2006.
5. X-ray diffraction- B E Warren published by Courier Corporation.
6. Nano Composite Materials-Synthesis, Properties and Applications, J. Parameswaranpillai,, N.Hameed, T.Kurian, Y. Yu, CRC Press.
7. Fundamentals of Fibre Optics in Telecommunication & Sensor Systems, B.P. Pal, New Age International Publishers.

Reference Books:

1. Introduction to Mechanics — M.K. Verma: 2nd Ed, University Press(India) Pvt Ltd, Hyderabad 2009.
2. Lasers and Non Linear Optics – B.B. Laud, 3rd Ed, New Age International Publishers 2011.
3. LASERS Principles, Types and Applications by K.R. Nambiar-New Age International Publishers.
4. Solid State Physics-S O Pillai, 8th Ed- New Age International Publishers-2018.
5. Shock waves made simple- Chintoo S Kumar, K Takayama and KPJ Reddy: Willey India Pvt. Ltd. New Delhi2014.
6. Materials Characterization Techniques-Sam Zhang, Lin Li, Ashok Kumar, CRC Press, First Edition, 2008.
7. Characterization of Materials- Mitra P.K . Prentice Hall India Learning Private Limited.
8. Nanoscience and Nanotechnology: Fundamentals to Frontiers – M.S.Ramachandra Rao & Shubra Singh, Wiley India Pvt Ltd .

Web links and Video Lectures (e-Resources):

https://www.britannica.com/technology/laser,k
https://nptel.ac.in/courses/115/102/115102124/
https://nptel.ac.in/courses/115/104/115104096/
http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
https://onlinecourses.nptel.ac.in/noc20_mm14/preview

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

http://nptel.ac.in
https://swayam.gov.in
https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham