SYLLABUS AT A GLANCE

Subject: Engineering Physics (21PHY12/22) Total Teaching Hours: 40	
Module 1	**Oscillations and Waves:** Free oscillations, Damped oscillations, Forced oscillations and Shock waves
Module 2	**Modern Physics & Quantum Mechanics:** Black body radiation, Wave particle dualism, Heisenberg's uncertainty principle, Wave function, Schrödinger wave equation and Energy Eigen values
Module 3	**Lasers & Optical Fibers:** Conditions for laser action, Types and applications of lasers, Ray propagation in optical fibers, Construction and its working, Attenuation and applications of optical fibers
Module 4	**Electrical Conductivity in Solids:** Classical free electron theory, Quantum free electron theory, Physics of semiconductors and Dielectric properties of materials
Module 5	**Material Characterization Techniques and Instrumentation:** Nanomaterials, Nanocomposites, X-ray Diffractometer, Scherrer equation, Atomic Force Microscope, X-ray Photoelectron Spectroscope, Scanning Electron Microscope, Transmission Electron Microscope

Subject: Engineering Physics Laboratory (21PHYL16/26) Total number of experiments: 12	
1	Determination of spring constants by Series and Parallel combination.
2	Determination of rigidity modulus of the material by torsional pendulum.
3	Series and parallel LCR resonance circuits.
4	Verification of Stefan's Law
5	I-V Characteristics of Photodiode.
6	Acceptance angle and numerical aperture of an optical fiber.
7	Wavelength of laser using diffraction grating experiment.
8	Determine the Fermi energy of a metal (copper).
9	Resistivity of a semiconductor using Four Probe method.
10	Dielectric constant by charging and discharging of capacitor.
11	Magnetic field intensity along the axis of a circular coil carrying current.
12	Forced mechanical oscillations and resonance.

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.

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 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.

Teaching-Learning Process	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.

Teaching-Learning Process	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.

Teaching-Learning Process	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.

Teaching-Learning Process	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 Microscope (AFM), X-ray Photoelectron *S*pectroscope (XPS), Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) Numerical problems.

Teaching-Learning Process	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)

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.

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

I/II Semester

ENGINEERING PHYSICS LABORATORY			
Course Code	21PHYL16/26	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	3 Hours

Course objectives:

1. Understand the measurement techniques and usage of instruments in physics.
2. Demonstrate competency and understanding of the basic concepts found in experimental Physics.
3. Construct andanalyse the electronic circuits.
4. Estimate the error in measurements and the ability to prepare a valid laboratory record.

List of Experiments: Any Ten Experiments to be performed

Sl.NO	Experiments
1	Determination of spring constants by Series and Parallel combination.
2	Determination of rigidity modulus of the material by the torsional pendulum.
3	Study series and parallel LCR resonance and hence calculate inductance, bandwidth, and quality factor.
4	To verify Stefan's Law
5	I-V Characteristics of Photodiode.
6	Determine acceptance angle and numerical aperture of an optical fiber.
7	Determine the wavelength of the laser source using a diffraction grating elements.
8	Determine the Fermi energy of metal (copper).
9	To find the resistivity of a semiconductor using the Four Probe method.
10	To determine the dielectric constant by charging and discharging the capacitor.
11	Determination of Magnetic field intensity along the axis of a circular coil carrying current.
12	Forced mechanical oscillations and resonance.

Course outcomes (Course Skill Set):

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

1. Understand the measuring techniques
2. Operate different instruments and be capable to analyse the experimental results.
3. Construct the circuits and theiranalysis.

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 50% of the maximum marks (25 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), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning

Semester End Evaluation (SEE Students):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the internal and external examiners appointed by the University

1. All laboratory experiments are to be included for practical examination.
2. (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by internal and external examiners.
3. Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
4. Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by Internal and external examiners.
5. General rubrics for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated

for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

6. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

7. Rubrics suggested in **Annexure-II of Regulation book**

Suggested Learning Resources:

Reference books.

1. Engineering Lab Manual by WBUT-New Age International Publishers.
2. Applied Physics Lab Manual by Anoop Sing Yadav.

Weblinks, Video lectures, and e-resources.

https://vlab.amrita.edu/?sub=1&brch=282&sim=1512&cnt=1
https://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1
https://vlab.amrita.edu/index.php?sub=1&brch=189&sim=343&cnt=1
https://bop-iitk.vlabs.ac.in/basics-of-physics/List%20of%20experiments.html
https://virtuallabs.merlot.org/vl_physics.html
https://phet.colorado.edu
https://www.myphysicslab.com