| Course Title: | **Physics for CSE stream** | | |
|---|---|---|---|
| Course Code: | **22PHYS12/22** | CIE Marks | 50 |
| Course Type (Theory/Practical/Integrated ) | Integrated | SEE Marks | 50 |
| | | Total Marks | 100 |
| Teaching Hours/Week (L:T:P: S) | 2:2:2:0 | Exam Hours | 03+02 |
| Total Hours of Pedagogy | 40 hours Theory + 10-12 Lab slots | Credits | 04 |

**Course objectives**

- To study the essentials of photonics for engineering applications.
- To study the principles of quantum mechanics and its application in quantum computing.
- To study the study the electrical properties of materials
- To study the essentials of physics for computational aspects like design and data analysis.

**Teaching-Learning Process**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Flipped Class
2. Chalk and Talk
3. Blended Mode of Learning
4. Simulations, Interactive Simulations and Animations
5. NPTEL and Other Videos for theory topics
6. Smart Class Room
7. Lab Experiment Videos

**Module-1 (8 Hours)**

**Laser and Optical Fibers:**

**LASER** : Basic properties of a LASER beam, Interaction of Radiation with Matter, Einstein's A and B Coefficients, Laser Action, Population Inversion, Metastable State, Requisites of a laser system, Semiconductor Diode Laser, Applications: Bar code scanner, Laser Printer, Laser Cooling, Numerical Problems

**Optical Fiber** : Principle and structure, Acceptance angle and Numerical Aperture (NA) and derivation of Expression for NA, Classification of Optical Fibers, Attenuation and Fiber Losses, Applications: Fiber Optic networking, Fiber Optic Communication.

**Pre requisite:Properties of light**

**Self-learning: Total Internal Reflection & Propagation Mechanism (Optical Fibers)**

**Module-2 (8 Hours)**

**Quantum Mechanics:**

de Broglie Hypothesis and Matter Waves, de Broglie wavelength and derivation of expression by analogy, Phase Velocity and Group Velocity, Heisenberg's Uncertainty Principle and its application (Non existence of electron inside the nucleus-Non Relativistic), Principle of Complementarity, Wave Function, Time independent Schrodinger wave equation, Physical Significance of a wave function and Born Interpretation, Expectation value, Eigen functions and Eigen Values, Motion of a particle in a one dimensional potential well of infinite depth , Waveforms and Probabilities. Numerical Problems

**Pre requisite:Wave–Particle dualism**

**Self-learning: de Broglie Hypothesis**

**Module-3 (8 Hours)**

**Quantum Computing:**

**Wave Function in Ket Notation :** Matrix form of wave function, Identity Operator, Determination of I|0> and I|1>, Pauli Matrices and its operations on 0 and 1 states, Mention of Conjugate and Transpose, Unitary Matrix U, Examples : Row and Column Matrices and their multiplication (Inner Product), Probability, Orthogonality

**Principles of Quantum Information & Quantum Computing :** Introduction to Quantum Computing, Moore's law & its end. Single particle quantum interference, Classical & quantum information comparison. Differences between classical & quantum computing, quantum superposition and the concept of qubit.

**Properties of a qubit :** Mathematical representation. Summation of probabilities,Representation of qubit by Bloch sphere

**Quantum Gates :**

Single Qubit Gates: Quantum Not Gate , Pauli -Z Gate Hadamard Gate , Pauli Matrices, Phase Gate (or S Gate) , T Gate

Multiple Qubit Gates: Controlled gate, CNOT Gate, (Discussion for 4 different input states). Representation of, Swap gate, Controlled -Z gate , Toffoli gate,Accounting for the extra-ordinary capability of quantum computing, Model Realizations

**Pre requisites: Matrices**

**Self-learning: Moore's law**

**Module-4 (8 Hours)**

**Electrical Properties of Materials and Applications**

Electrical Conductivity in metals, Resistivity and Mobility, Concept of Phonon, Matheissen's rule. Introduction to Super Conductors, Temperature dependence of resistivity, Meissner Effect, Critical Current, Types of Super Conductors, Temperature dependence of Critical field, BCS theory (Qualitative), Quantum Tunneling, High Temperature superconductivity, Josephson Junction, DC and AC SQUIDs (Qualitative), Applications in Quantum Computing. Numerical Problems.

**Pre requisites:Basics of Electrical conductivity**

**Self-learning: Resistivity and Mobility**

**Module-5 (8 hours)**

**Application of Physics in computing:**

**Physics of Animation** :

Taxonomy of physics based animation methods, Frames, Frames per Second, Size and Scale, Motion and Timing in Animations, Constant Force and Acceleration, The Odd rule, Motion Graphs, Numerical Calculations based on Odd Rule, Examples of Character Animation : Jumping, Walking. Numerical Problems

**Statistical Physics for Computing** :Descriptive statistics and inferential statistics, Poisson distribution and Normal Distributions (Bell Curves), Monte Carlo Method. Numerical Problems.

**Pre requisites: Motion in one dimension**

**Self-learning: Frames, Frames per Second**

**Course outcome (Course Skill Set)**

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

| | |
|---|---|
| CO1 | **Describe** the principles of LASERS and Optical fibers and their relevant applications. |
| CO2 | **Discuss** the basic principles of the Quantum Mechanics and its application in Quantum Computing. |
| CO3 | **Summarize** the essential properties of superconductors and applications in Quantum Computing. |
| CO4 | **Illustrate** the application of physics in design and data analysis. |
| CO5 | **Practice** working in groups to conduct experiments in physics and **perform** precise and honest measurements. |

**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 out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). 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):**

**Two Unit Tests each of20 Marks (duration 01 hour)**

- First test after the completion of 30-40 % of the syllabus
- Second test after completion of 80-90% of the syllabus

One Improvement test before the closing of the academic term may be conducted if necessary. However best two tests out of three shall be taken into consideration.

**Two assignments each of 10 Marks**

The teacher has to plan the assignments and get them completed by the students well before the closing of the term so that marks entry in the examination portal shall be done in time. Formative (Successive) Assessments include Assignments/Quizzes/Seminars/ Course projects/Field surveys/ Case studies/ Hands-on practice (experiments)/Group Discussions/ others. . The Teachers shall choose the types of assignments depending on the requirement of the course and plan to attain the Cos and POs. (to have a 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 /test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

**The sum of two tests, two assignments, will be out of 60 marks and will be scaled down to 30 marks**

**CIE for the practical component of the Integrated Course**

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and **scaled down to 15 marks**.
- The laboratory test **(duration 02/03 hours)** at the end of the $14^{th}$ /$15^{th}$ week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and **scaled down to 05 marks.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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## Semester End Examination(SEE):

## SEE will have two component Theory Examination and Practical Examination

**Theory Examination;**

- Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**
- The question paper shall be set for 100 marks. The medium of the question paper shall be English). The duration of SEE is 03 hours.

The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 30 marks**

- 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.

**Practical Examination;**

- SEE marks for the practical course is **100 Marks.**
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (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 examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested 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 20 marks** (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
- The duration of SEE is 02 or 03 hours

**Note:**

1. Students have to appear in both theory and practical components of CIE and SEE and score a minimum of 40% of the maximum marks of CIE and a minimum of 35% of the maximum marks of SEE. An average of a minimum 40% of the maximum marks of course (100 marks) to pass the course.
2. Passing is CIE is compulsory to become eligible to appear for SEE
3. In SEE passing both theory and practical examinations is compulsory.

If a student fails in any one of the components (Theory/Practical) then he/she has to reappear in the next semester for both components (i.e theory and practical) and pass the both the components.

**Suggested Learning Resources:**

**Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)**


1. Solid State Physics, S O Pillai, New Age International Private Limited, 8th Edition, 2018,.
2. Engineering Physics by Gupta and Gour, Dhanpat Rai Publications, 2016 (Reprint).
3. Concepts of Modern Physics, Aurthur Beiser, McGrawhill, 6th Edition, 2009.
4. Lasers and Non Linear Optics, B B Loud, New age international, 2011 edition.
5. A text book of Engineering Physics by M .N. Avadhanulu, P G. Kshirsagar and T V S Arun Murthy, Eleventh edition, S Chand and Company Ltd. New Delhi-110055.
6. Quantum Computation and Quantum Information, Michael A. Nielsen & Isaac L. Chuang, Cambridge Universities Press, 2010 Edition.
7. Quantum Computing, Vishal Sahani, McGraw Hill Education, 2007 Edition.
8. Engineering Physics, S P Basavaraj, 2005 Edition,
9. Physics for Animators, Michele Bousquet with Alejandro Garcia, CRC Press, Taylor & Francis, 2016.
10. Quantum Computation and Logic : How Quantum Computers Have Inspired Logical Investigations,Maria Luisa Dalla Chiara, Roberto Giuntini, Roberto Leporini, Giuseppe Sergioli,TrendsinLogic, Volume 48, Springer.
11. Statistical Physics : Berkely Physics Course, Volume 5, F. Reif, McGraw Hill.


**Web links and Video Lectures (e-Resources):**

**LASER** : https://www.youtube.com/watch?v=WgzynezPiyc

**Superconductivity :** https://www.youtube.com/watch?v=MT5Xl5ppn48

**Optical Fiber :** https://www.youtube.com/watch?v=N_kA8EpCUQo

**Quantum Mechanics** : https://www.youtube.com/watch?v=p7bzE1E5PMY&t=136s

**Quantum Computing :** https://www.youtube.com/watch?v=jHoEjvuPoB8

**Physics of Animation :** https://www.youtube.com/watch?v=kj1kaA_8Fu4

**Statistical Physics Simulation** : https://phet.colorado.edu/sims/html/plinko-probability/latest/plinko-probability_en.html

**NPTEL Supercoductivity:**https://archive.nptel.ac.in/courses/115/103/115103108/

**NPTEL Quantum Computing :** https://archive.nptel.ac.in/courses/115/101/115101092

**Virtual LAB :**https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham

**Virtual LAB** : https://vlab.amrita.edu/index.php?sub=1&brch=189&sim=343&cnt=1

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

http://nptel.ac.in

https://swayam.gov.in

https://virtuallabs.merlot.org/vl_physics.html

https://phet.colorado.edu

https://www.myphysicslab.com

**Laboratory Component:**

Any Ten Experiments have to be completed from the list of experiments

**Note:** The experiments have to be classified into

a) Exercise
b) Demonstration
c) Structured Inquiry
d) Open Ended

Based on the convenience classify the following experiments into above categories selecting at least three experiments for each type. At least select one simulation/spreadsheet activity.

***List of Experiments:***

1. Wavelength of LASER using Grating
2. Numerical Aperture using optical fiber
3. Four Probe Method
4. Transistor Characteristics
5. Charging and Discharging of a Capacitor
6. Photo-Diode Characteristics
7. Series & Parallel LCR
8. Magnetic Field at any point along the axis of a circular coil
9. Plank's Constant using LEDs.
10. Fermi Energy
11. Black Box
12. Energy gap of a given semiconductor
13. GNU Step Interactive Simulations.
14. Study of motion using spread Sheets
15. Application of Statistic using Spread Sheets
16. PHET Interactive Simulations (https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype)

**COs and POs Mapping (Individual teacher has to fill up)**

| COs | POs | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | 8 | 9 | 10 | 11 | 12 |
| **CO1** | **3** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** |
| **CO2** | **3** | **3** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** |
| **CO3** | **3** | **3** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** |
| **CO4** | **3** | **2** | **1** | **-** | **1** | **-** | **-** | **-** | **-** | **-** | **-** | **2** |
| **CO5** | **3** | **2** | **1** | **-** | **2** | **-** | **-** | **3** | **3** | **-** | **-** | **2** |

**Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped**

**Note :** The CO-PO mapping values are indicative. The course coordinator can alter the mapping using **Competency and Performance Indicators** mentioned in the **AICTE Exam reforms.**