Applied Physics
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – I/II

Course Code:	**P22PHCE102/202**	**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**
Total Hours of Pedagogy	**40 hours Theory + 10 to12 Lab slots**	**Credits**	**04**

Course Objectives

- To **recall** the concepts of physics related to waves and oscillations, quantum mechanics, elastic properties of materials, fundamentals of LASER and optical fibers used in the applications
- To **understand** the concepts of waves and oscillations and their engineering applications
- To **realize** the concepts of modern physics and quantum mechanics and their applications
- To **study** elastic properties of materials and factors involved for the failure of engineering materials
- To **learn** the fundamentals of LASERs and optical fibers through photonics related to engineering field
- To **study** the concepts and principles of sound and ultrasonics to understand architectural acoustics

Pedagogy:
Techniques and strategies which teachers may adopt to achieve maximum attainment of the objectives.

1. Chalk and Talk	4. Interactive simulations and animations
2. Flipped Class	5. Online learning videos on theory topics
3. Blended mode of learning	6. Hands-on and open ended experiments

Unit-I: Oscillations and Shock waves **8 Hours**

Oscillations- Simple Harmonic motion (SHM), differential equation for SHM (derivation), Springs - stiffness factor and its physical significance, series and parallel combination of springs (derivation), Types of spring and their applications. Free, damped and forced oscillations (Qualitative), Types of damping (Graphical Approach). Engineering applications of damped oscillations, resonance and sharpness of resonance.

Shock waves**-** Mach number and Mach Angle, Mach Regimes, definition and characteristics of Shock waves, Construction and working of Reddy shock tube, Applications of Shock Waves. Numerical problems.

Pre requisites: Basics of Oscillations and waves

Self-learning component: Conservation of energy in SHM

Practical component: Spring Constant and Reddy Shock Tube

Unit-II: Quantum Physics: **8 Hours**

Matter Waves - de Broglie Hypothesis, Phase Velocity and Group Velocity, de Broglie wavelength and derivation of expression by group velocity concept, Heisenberg's Uncertainty Principle and its application (Non existence of electron inside the nucleus)

Wave Mechanics **-** Wave Function, Probability and normalization, Time independent Schrodinger wave equation, Eigen functions and Eigen Values, Application: Energy and wave function of particle in a one dimensional potential well of infinite depth. Numerical Problems

Pre requisites: Quantum theory of Radiation

Self-learning component: Blackbody Radiation Spectrum

Practical component: Stefan-Boltzmann law and Planck's Constant
Unit-III: Elastic properties of materials: 8 Hours
Elastic materials (qualitative). Stress-Strain Curve, strain hardening and softening. Elastic Moduli, Poisson's ratio and its limiting values. Relation between q, n, k and σ (derivation), Beams, bending moment of rectangular beam (derivation), I-section girder and their Engineering Applications. Twisting couple per unit twist of a cylinder (derivation), Failures of engineering materials - stress concentration, fatigue and factors affecting fatigue (qualitative). Numerical problems **Pre requisites:** Elasticity, Stress & Strain **Self-learning:** Single Cantilever **Practical component:** Rigidity modulus and Young's modulus
Unit-IV: Photonics: 8 Hours
Lasers-Definition and Characteristics of LASER, Interaction of radiation with matter, Expression for energy density (derivation). Requisites of a Laser system. Conditions for Laser action. Principle, construction and working of carbon dioxide laser. Applications: Lasers as Range finder, Road profiling. Optical Fibers- Propagation mechanism, angle of acceptance and numerical aperture (derivation), fractional index change, modes of propagation, Number of modes and V-parameter, Types of optical fibers. Attenuation and expression for attenuation coefficient (no derivation), Applications: Detect damages and faults at remotely accessible places. Numerical problems. **Pre requisite:** Introduction on LASER and Optical fibres **Self-learning component:** Construction and working of Semiconductor LASER **Practical component:** Diffraction Grating and Optical fiber
Unit-V: Architectural Acoustics 8 Hours
Acoustics- Reflection of sound, echo, reverberation and reverberation time, absorption power and absorption coefficient. Types of Acoustics, Requisites for acoustics in auditorium, Sabine's formula (derivation), measurement of absorption coefficient, factors affecting the acoustics and remedial measures, Impact of Noise in Multi-storied buildings Ultrasonics- Introduction, Principle, Measurement of ultrasonic velocity in liquids. Application: Non-destructive method of testing the materials. **Pre requisites:** Basics of Sound **Self-learning:** Eyring's equation **Practical component:** Ultrasonic interferometer

Practical Component:

The laboratory experiments are classified as Exercise/hands on, open ended, demonstration and structured inquiry. From the list of experiments given below, student must perform **minimum of 10 experiments**.

Sl. No.	Name of the experiment	Type
1	Spring Constant – Series and Parallel arrangement	Hands on
2	Spring Constant – Oscillation method	Hands on
3	Verification of Stefan - Boltzmann law	Hands on

4	Verification of Planck's Constant	Hands on
5	Rigidity modulus – Torsional method	Hands on
6	Young's modulus – Uniform bending	Hands on
7	Moment of Inertia – Searl's double bar method	Hands on
8	Wavelength of Laser - Diffraction Grating	Hands on
9	Numerical aperture and angle of acceptance of an optical fiber	Open ended
10	Velocity of Ultrasonic – Ultrasonic interferometer	Open ended
11	Determination of Mach number – Reddy's shock tube	Demonstration
12	PHET interactive simulations	Demonstration
13	GNU step interactive simulations (Self activity)	Structured inquiry
14	Study of motion using spreadsheet (Self activity)	Structured inquiry

Course Outcomes: Students will be able to	
CO1	**Apply** the fundamental concepts of physics to understand advanced principles of oscillations, waves, quantum mechanics, materials properties, photonics and acoustics.
CO2	**Identify** the engineering applications of oscillations and shock waves, quantum mechanics, properties of materials, photonics and acoustics with basic knowledge of physics.
CO3	**Formulate** the mathematical expressions for an advanced physical quantity related to engineering field using theoretical knowledge of physics.
CO4	**Solve** the numerical problems related to engineering field in quantum mechanics, materials properties, photonics and acoustics by the knowledge of mathematics.
CO5	**Analyze** the experimental results with theory by Constructing the circuit/Setting up the experiment related to Applied physics.

COs – POs mapping

COs	**POs**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										1
CO2	3	2										1
CO3	3	1										1
CO4	3	2										
CO5	3			2	1				1			1

Levels: 3-Highly mapped; 2- Moderately mapped; 1 – Fairly mapped; 0 – Not mapped

Suggested Learning Resources:

Text Books

1. Materials Science and Engineering by R Balasubramaniam, second edition, Wiley India Pvt. Ltd. Ansari Road,Daryaganj, New Delhi-110002.
2. 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.
3. John Wiley & Sons: Engineering Physics - Wiley India Pvt. Ltd, New Delhi.

4. R.K. Gaur, S. L. Gupta ; Engineering Physics – Dhanpat Rai Publications; 2011 Edition

Reference Books

5. Building Science: Lighting and Accoustics, B. P. Singh and Devaraj Singh, Dhanpat Rai Pub. (P) Ltd.,
6. Building Acoustics: Tor Eric Vigran, Taylor and Francis, 2008 Edition.
7. Photometry Radiometry and Measurements of Optical Losses, Micheal Bukshtab, Springer, 2nd ed.
8. Materials Science for Engineers by James F. Shackelford and Madanapalli K Muralidhara, sixth edition, PearsonEducation Asia Pvt. Ltd., New Delhi.
9. Lasers and Non Linear Optics, B B Loud, New Age Internationals, 2011 ed.

Web links and Video Lectures (e-Resources):

Web links:
Simple Harmonic motion:https://www.youtube.com/watch?v=k2FvSzWeVxQ
Shock waves:https://physics.info/shock/
Shock waves and its applications:https://www.youtube.com/watch?v=tz_3M3v3kxk
Stress- strain curves:https://web.mit.edu/course/3/3.11/www/modules/ss.pdf
Stress curves:https://www.youtube.com/watch?v=f08Y39UiC-o
Oscillations and waves :https://openstax.org › books › college-physics-2e
Uniform Bending: https://youtu.be/AiwnWoeVhrU
Diffraction Grating: https://youtu.be/th9-Ylp0FcU
Spring Constant: https://youtu.be/7Ar04wffp08
Fermi Energy: https://youtu.be/i2bf3_X4h74
Stefan-Boltzmann Constant: https://youtu.be/pBwn1TMkmJ8
Planck's constant: https://youtu.be/nWcejb3S2zY
Torsional Pendulum: https://youtu.be/hteYgW9pT6w

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

Scheme of Evaluation

Marks distribution for the Evaluation of I/II Sem Applied Physics Course

Assessment Method	Component	Type of Assessment	Assessment Type used	Max. Marks Assigned	Evaluated for Total Marks	Reduced Marks to 50%	Min. Eligible marks	Min. Marks Required	Max. Marks Allotted
CIE	Theory	AAT	Assignments	10	50	25	10	20	50
		Test - 1	Theory + Quiz	40					
		Test - 2	Theory + Quiz						
	Lab	Conduction of Experiments	Performance with Record	25	50	25	10		
		Lab test	Evaluation & Viva-Voce	25					
SEE	Theory	End Exam	Part - A	10	100	50	35/100	20	50
			Part - B	90					
Note: *Min. marks from SEE shall be **35/100**, but the aggregate marks from CIE & SEE must be **40/100***								**40**	**100**

Applied Physics
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – I

Course Code:	**P22PHCS102/202**	**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**
Total Hours of Pedagogy	**40 hours Theory + 10 to12 Lab slots**	**Credits**	**04**

Course Objectives

- To **recall** the concepts of physics related to waves and oscillations, quantum mechanics, elastic properties of materials, fundamentals of LASER and optical fibers.
- To **realize** the concepts of modern physics and quantum mechanics used in their applications.
- To **study** the dielectric and superconducting properties of materials and their applications.
- To **explore** the rudimental concepts of semiconductors and their advanced applications.
- To **learn** the basics of photonics in LASERs and optical fibers, and their applications.
- To **perceive** the idea of quantum computing and its mathematical requirements in engineering.

Pedagogy:
Techniques and strategies which teachers may adopt to achieve maximum attainment of the objectives.

1. Chalk and Talk
2. Flipped Class
3. Blended mode of learning
4. Interactive simulations and animations
5. Online learning videos on theory topics
6. Hands-on and Open ended experiments

Unit-I: Quantum Physics: **8 Hours**

Matter Waves - de Broglie Hypothesis, Phase Velocity and Group Velocity, relation between phase velocity and group velocity, relation between group velocity and particle velocity, de Broglie wavelength and its derivation by group velocity concept, Heisenberg's Uncertainty Principle and its application (Non existence of electron inside the nucleus).

Wave Mechanics - Wave Function, Probability density and normalization, Time independent Schrodinger wave equation (derivation), Eigen functions and Eigen Values, Application: Eigen values and Eigen functions of particle in a one dimensional potential well of infinite depth (derivation). Numerical Problems.

Pre requisites: Quantum theory of Radiation

Self-learning component: Blackbody Radiation Spectrum

Practical Component: Stefan-Boltzmann law and Planck's Constant.

Unit-II: Properties of Materials **8 Hours**

Dielectric Materials - Polar and non-polar dielectrics, Types of Polarization and their mechanism, internal fields in solid (derivation), Clausius-Mossotti equation (derivation). Application of dielectrics in transformers, Capacitors.

Superconducting Materials - Superconductors, Temperature dependence of resistivity, Meissner Effect (diamagnetic property), Critical field, Critical Current, Types of Superconductors, BCS theory (Qualitative), High Temperature superconductors, Applications: Maglev vehicles, SQUIDs (Qualitative).

Numerical problems.
Pre requisites: Introduction on Dielectrics.
Self-learning component: Dielectrics in Electrical Insulation and Super conducting magnets
Practical component: Dielectric Constant and LCR Resonance Circuits

Unit-III: Semiconductor and their applications **8 Hours**

Semiconductors, Types of semiconductors, Fermi level, variation of Fermi level in intrinsic and extrinsic semiconductors with temperature, Fermi factor and density of states (qualitative), derivation for electron concentration (N_e) and mention the expression for hole concentration (N_h) of an intrinsic semiconductor, Relation between Fermi level and energy gap of an intrinsic semiconductor, Law of mass action, Expression for intrinsic charge carrier concentration (N_i). Electrical conductivity and resistivity of an intrinsic semiconductor (derivation).Variation of conductivity and resistivity with temperature in an intrinsic semiconductor. Applications: Photodiode, LED (construction and working). Hall effect: measurement of hall coefficient, hall voltage and its applications. Numerical problems.
Pre requisites: Introduction on semiconductors, Band theory of solids.
Self-learning component: Expression for hole concentration of an intrinsic semiconductor.
Practical component: Four probe method, Transistor Characteristics and Fermi Energy

Unit-IV: Photonics **8 Hours**

Lasers - Definition and Characteristics of LASER, Interaction of radiation with matter, Expression for energy density (derivation). Requisites of a Laser system. Conditions for Laser action. Principle, Construction and working of Semiconductor LASER. Applications: Bar code scanner, Laser Printer
Optical Fibers - Propagation mechanism, angle of acceptance and Numerical aperture (derivation), fractional index change, modes of propagation, Number of modes and V-parameter, Types of optical fibers. Attenuation and expression for attenuation coefficient (no derivation), Applications: Point to point telecommunication. Numerical problems.
Pre requisite: Introduction on LASER and Optical fibers.
Self-learning component: Construction and working of carbon dioxide laser
Practical component: Diffraction Grating and Optical fiber

Unit-V: Quantum Computing **8 Hours**

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.
Quantum computers: Difference between classical and quantum computers, Moore's law and its end. Qubits and working principle of their different types, Dirac bracket notations, Bloch sphere, quantum logic gates, single qubit logic gates - Quantum Not Gate, Pauli - Z Gate, Hadamard Gate, Pauli Matrices, Phase Gate (or S Gate), T Gate and multi qubit logic gates - Controlled gate, CNOT Gate, (Discussion for 4 different input states). Representation of Swap gate, Controlled -Z gate, Toffoli gate.
Pre requisites: Introduction to Quantum Computing and quantum gates.
Self-learning: Operation of logic gates on single and multi – qubits
Practical component:

Practical Component:

The laboratory experiments are classified as Exercise/hands on, open ended, demonstration and structured inquiry. From the list of experiments given below, student must perform **minimum of 10 experiments**.

Sl. No.	Name of the experiment	Type
1	Spring Constant – Series and Parallel arrangements	Hands on
2	Verification of Stefan - Boltzmann law	Hands on
3	Dielectric constant - Charging and discharging of a capacitor	Hands on
4	LCR resonance – Series and parallel circuits	Hands on
5	output and transfer characteristics of a Transistor	Hands on
6	Wavelength of Laser - Diffraction Grating	Hands on
7	Determination of Fermi energy of copper	Hands on
8	Energy gap of a semiconductor - Four probe	Hands on
9	Velocity of Ultrasonic – Ultrasonic interferometer	Open ended
10	Numerical aperture and acceptance angle of an Optical fiber	Open ended
11	GNU step interactive simulations	Demonstration
12	PHET interactive simulations	Demonstration
13	GNU step interactive simulations (Self activity)	Structured inquiry
14	Study of motion using spreadsheet (Self activity)	Structured inquiry

Course Outcomes: Students will be able to	
CO1	**Apply** the fundamental concepts of physics to understand advanced principles of quantum mechanics, properties of materials, semiconductors, photonics and quantum computing
CO2	**Identify** the engineering applications of quantum mechanics, properties of materials, semiconductors, photonics and quantum computing with basic knowledge of physics
CO3	**Formulate** the mathematical expressions for an advanced physical quantity related to engineering field using theoretical knowledge of physics.
CO4	**Solve** the numerical problems related to engineering field in quantum mechanics, materials properties, photonics and quantum computing with the knowledge of mathematics.
CO5	**Analyze** the experimental results with theory by Constructing the circuit/Setting up the experiment related to Applied physics.

COs – POs mapping

COs	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										1
CO2	3	2										1
CO3	3	1										1
CO4	3	2										
CO5	3			2	1				1			1

Levels: 3-Highly mapped; 2- Moderately mapped; 1 – Fairly mapped; 0 – Not mapped

Suggested Learning Resources:

Text Books:

10. John Wiley & Sons: Engineering Physics - Wiley India Pvt. Ltd, New Delhi.
11. R.K. Gaur, S. L. Gupta ; Engineering Physics – Dhanpat Rai Publications; 2011 Edition

Reference Books:

1. N.H. Ayachit, P. K. Mittal: Engineering Physics – I. K. International Publishing House Pvt. Ltd. New Delhi
2. Materials Science and Engineering by R Balasubramaniam, second edition, Wiley India Pvt. Ltd. Ansari Road, Daryaganj, New Delhi-110002.
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5. Photometry Radiometry and Measurements of Optical Losses, Micheal Bukshtab, Springer, 2^{nd} edition.
6. Materials Science for Engineers by James F. Shackelford and Madanapalli K Muralidhara, sixth edition, Pearson Education Asia Pvt. Ltd., New Delhi.
7. Lasers and Non Linear Optics, B B Loud, New Age Internationals, 2011 edition

Web links and Video Lectures (e-Resources):

Web links:

Diffraction Grating: https://youtu.be/th9-Ylp0FcU
Transistor Characteristics: https://youtu.be/tCnNAyHv0s0
LCR Resonance Circuit: https://youtu.be/5qbr-F4H7n0
Four Probe Method: https://youtu.be/OAybDK0T68k
Fermi Energy: https://youtu.be/i2bf3_X4h74
Stefan-Boltzmann Constant: https://youtu.be/pBwn1TMkmJ8
Planck’s constant: https://youtu.be/nWcejb3S2zY
Dielectric Constant: https://youtu.be/vOTbXNs34j8

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

Scheme of Evaluation

Marks distribution for the Evaluation of I/II Sem Applied Physics Course

<table>
<tr><th>Assessment Method</th><th>Component</th><th>Type of Assessment</th><th>Assessment Type used</th><th>Max. Marks Assigned</th><th>Evaluated for Total Marks</th><th>Reduced Marks to 50%</th><th>Min. Eligible marks</th><th>Min. Marks Required</th><th>Max. Marks Allotted</th></tr>
<tr><td rowspan="5">CIE</td><td rowspan="3">Theory</td><td>AAT</td><td>Assignments</td><td>10</td><td rowspan="3">50</td><td rowspan="3">25</td><td rowspan="3">10</td><td rowspan="5">20</td><td rowspan="5">50</td></tr>
<tr><td>Test - 1</td><td>Theory + Quiz</td><td rowspan="2">40</td></tr>
<tr><td>Test - 2</td><td>Theory + Quiz</td></tr>
<tr><td rowspan="2">Lab</td><td>Conduction of Experiments</td><td>Performance with Record</td><td>25</td><td rowspan="2">50</td><td rowspan="2">25</td><td rowspan="2">10</td></tr>
<tr><td>Lab test</td><td>Evaluation & Viva-Voce</td><td>25</td></tr>
<tr><td rowspan="2">SEE</td><td rowspan="2">Theory</td><td rowspan="2">End Exam</td><td>Part - A</td><td>10</td><td rowspan="2">100</td><td rowspan="2">50</td><td rowspan="2">35/100</td><td rowspan="2">20</td><td rowspan="2">50</td></tr>
<tr><td>Part - B</td><td>90</td></tr>
<tr><td colspan="8">Note: Min. marks from SEE shall be 35/100, but the aggregate marks from CIE & SEE must be 40/100</td><td>40</td><td>100</td></tr>
</table>

Applied Physics
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – I/II

Course Code:	**P22PHEE102/202**	**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**
Total Hours of Pedagogy	**40 hours Theory + 10 to12 Lab slots**	**Credits**	**04**

Course Learning Objectives:

- To **recall** the concepts of physics related to waves and oscillations, quantum mechanics, elastic properties of materials, fundamentals of LASER and optical fibers
- To **realize** the concepts of modern physics and quantum mechanics in engineering applications
- To **study** the dielectric and superconducting properties of materials and their applications.
- To **understand** the electrical and magnetic properties of materials and their applications
- To **learn** the basics of photonics in understanding the applications of LASERs and optical fibers
- To **explore** the rudimental concepts of semiconductors in construction of electronic devices

Pedagogy:
Techniques and strategies which teachers may adopt to achieve maximum attainment of the objectives.

7. Chalk and Talk	10. Interactive simulations and animations
8. Flipped Class	11. Online learning videos on theory topics
9. Blended mode of learning	12. Hands-on and open ended experiments

Unit-I: Quantum Physics: **8 Hours**

Matter Waves - de Broglie Hypothesis, Phase Velocity and Group Velocity, relation between phase velocity and group velocity, relation between group velocity and particle velocity, de Broglie wavelength and its derivation by group velocity concept, Heisenberg's Uncertainty Principle and its application (Non existence of electron inside the nucleus).
Wave Mechanics - Wave Function, Probability density and normalization, Time independent Schrodinger wave equation (derivation), Eigen functions and Eigen Values, Application: Eigen values and Eigen functions of particle in a one dimensional potential well of infinite depth (derivation). Numerical Problems.
Pre requisites: Quantum theory of Radiation
Self-learning component: Blackbody Radiation Spectrum
Practical Component: Stefan-Boltzmann law and Planck's Constant.

Unit-II: Properties of Materials **8 Hours**

Dielectric Materials - Polar and non-polar dielectrics, Types of Polarization and their mechanism, internal fields in solid (derivation), Clausius-Mossotti equation (derivation). Application of dielectrics in transformers, Capacitors.
Superconducting Materials - Superconductors, Temperature dependence of resistivity, Meissner Effect (diamagnetic property), Critical field, Critical Current, Types of Superconductors, BCS theory (Qualitative), High Temperature superconductors, Applications: Maglev vehicles, SQUIDs (Qualitative). Numerical problems.
Pre requisites: Introduction on Dielectrics.

Self-learning component: Dielectrics in Electrical Insulation and Superconducting magnets
Practical component: Dielectric constant of a material

Unit-III: Electric and Magnetic properties of materials **8 Hours**

Electrical properties – Failures of classical free electron theory, Quantum free electron theory, Assumptions, Fermi-Dirac Statistics (Qualitative). Fermi level, Fermi-energy, Fermi temperature, Fermi velocity and Fermi factor, Variation of Fermi factor with energy and temperature, Expression for density of states (derivation), Mention the expression for Fermi energy and electron density. Merits of quantum free electron theory.

Magnetic properties - Classification of magnetic materials, ferromagnetic materials – Weiss domain theory, hysteresis in ferromagnetic materials, explanation of hysteresis using domain theory, soft and hard magnetic materials, ferrites, Applications: magnetic recording and readout, storage of magnetic data.

Pre requisites: Classical free electron theory
Self-learning: Expression for electron and hole concentration of an intrinsic semiconductor
Practical component: Fermi-energy and Hysteresis curve

Unit-IV: Photonics **8 Hours**

Lasers - Definition and Characteristics of LASER, Interaction of radiation with matter, Expression for energy density (derivation). Requisites of a Laser system. Conditions for Laser action. Principle, Construction and working of Semiconductor LASER. Applications: LASER spectroscopy and Holography.

Optical Fibers - Propagation mechanism, angle of acceptance and Numerical aperture (derivation), fractional index change, modes of propagation, Number of modes and V - parameter, Types of optical fibers. Attenuation and expression for attenuation coefficient (no derivation), Applications: Communication, Point to point telecommunication. Numerical problems.

Pre requisite: Introduction on LASER and Optical fibers.
Self-learning component: Construction and working of carbon dioxide laser
Practical component: Diffraction Grating and Optical fiber

Unit-V: Semiconductors and devices **8 Hours**

Semiconductors, Types of semiconductors, Fermi level, variation of Fermi level in intrinsic and extrinsic semiconductors with temperature, Fermi factor and density of states (qualitative), derivation for electron concentration (N_e) and mention the expression for hole concentration (N_h) of an intrinsic semiconductor, Relation between Fermi level and energy gap of an intrinsic semiconductor, Law of mass action, Expression for intrinsic charge carrier concentration (N_i). Electrical conductivity and resistivity of an intrinsic semiconductor (derivation). Applications: BJT, FET, MOSFET; IC's: Digital integrated circuits. Numerical problems.

Pre requisites: Introduction on semiconductors, Band theory of solids.
Self-learning component: Expression for hole concentration of an intrinsic semiconductor.
Practical component: Four probe method, Transistor Characteristics and LCR Circuit

Practical Component:

The laboratory experiments are classified as Exercise/hands on, open ended, demonstration and structured inquiry. From the list of experiments given below, student must perform **minimum of 10**

experiments.

Sl. No.	Name of the Experiment	Type
1	Verification of Stefan - Boltzmann law	Hands on
2	Verification of Planck's Constant	Hands on
3	Charging and discharging of a capacitor - Dielectric Constant	Hands on
4	Wavelength of Laser - Diffraction Grating	Hands on
5	output and transfer characteristics of a Transistor	Hands on
6	Series and parallel circuits - LCR Resonance	Hands on
7	Determination of Fermi energy of copper	Hands on
8	Energy gap of a semiconductor - Four probe	Hands on
9	Velocity of Ultrasonic – Ultrasonic interferometer	Open ended
10	Numerical aperture and acceptance angle of an Optical fiber	Open ended
11	GNU step interactive simulations	Demonstration
12	PHET interactive simulations (Hysteresis)	Demonstration
13	GNU step interactive simulations (Self activity)	Structured inquiry
14	Study of motion using spreadsheet (Self activity)	Structured inquiry

Course Outcomes: Students will be able to	
CO1	**Apply** the fundamental concepts of physics to understand advanced principles of quantum mechanics, dielectric, superconducting, electric and magnetic properties of materials, photonics and semiconductors.
CO2	**Identify** the engineering applications of quantum mechanics, properties of materials, photonics and semiconductors with basic knowledge of physics.
CO3	**Formulate** the mathematical expressions for an advanced physical quantity related to engineering field using theoretical knowledge of physics.
CO4	**Solve** the numerical problems related to engineering field in quantum mechanics, materials properties, photonics and semiconductors by the knowledge of mathematics.
CO5	**Analyze** the experimental results with theory by Constructing the circuit/Setting up the experiment related to Applied physics.

COs – POs mapping

COs	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										1
CO2	3	2										1
CO3	3	1										1
CO4	3	2										
CO5	3			2	1				1			1

Levels: 3-Highly mapped; 2- Moderately mapped; 1 – Fairly mapped; 0 – Not mapped

Suggested Learning Resources:

Books

12. Materials Science and Engineering by R Balasubramaniam, second edition, Wiley India Pvt. Ltd. Ansari Road,Daryaganj, New Delhi-110002.
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2. N.H. Ayachit, P. K. Mittal: Engineering Physics – I. K. International Publishing House Pvt. Ltd. New Delhi
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Web links and Video Lectures (e-Resources):

Web links:
Diffraction Grating: https://youtu.be/th9-Ylp0FcU
Transistor Characteristics: https://youtu.be/tCnNAyHv0s0
LCR Resonance Circuit: https://youtu.be/5qbr-F4H7n0
Four Probe Method: https://youtu.be/OAybDK0T68k
Fermi Energy: https://youtu.be/i2bf3_X4h74
Stefan-Boltzmann Constant: https://youtu.be/pBwn1TMkmJ8
Planck's constant: https://youtu.be/nWcejb3S2zY
Dielectric Constant: https://youtu.be/vOTbXNs34j8

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

Scheme of Evaluation
Marks distribution for the Evaluation of I/II Sem Applied Physics Course

Assessment Method	**Component**	**Type of Assessment**	**Assessment Type used**	**Max. Marks Assigned**	**Evaluated for Total Marks**	**Reduced Marks to 50%**	**Min. Eligible marks**	**Min. Marks Required**	**Max. Marks Allotted**
CIE	Theory	AAT	Assignments	10	50	25	10	20	50
		Test - 1	Theory + Quiz	40					
		Test - 2	Theory + Quiz						
	Lab	Conduction of Experiments	Performance with Record	25	50	25	10		
		Lab test	Evaluation & Viva-Voce	25					
SEE	Theory	End Exam	Part - A	10	100	50	35/100	20	50
			Part - B	90					
Note: *Min. marks from SEE shall be* ***35/100****, but the aggregate marks from CIE & SEE must be* ***40/100***								**40**	**100**

<table>
<tr><td colspan="4">Applied Physics
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – I/II</td></tr>
<tr><td>Course Code:</td><td>P22PHME102/202</td><td>CIE Marks</td><td>50</td></tr>
<tr><td rowspan="2">Course Type (Theory/Practical/Integrated)</td><td rowspan="2">Integrated</td><td>SEE Marks</td><td>50</td></tr>
<tr><td>Total Marks</td><td>100</td></tr>
<tr><td>Teaching Hours/Week (L:T:P: S)</td><td>2:2:2:0</td><td>Exam Hours</td><td>03</td></tr>
<tr><td>Total Hours of Pedagogy</td><td>40 hours Theory +
10 to12 Lab slots</td><td>Credits</td><td>04</td></tr>
</table>

Course Objectives

- To **recall** the concepts of physics related to waves and oscillations, quantum mechanics, elastic properties of materials, fundamentals of LASER and optical fibers
- To **understand** the concepts of waves and oscillations and their engineering applications
- To **realize** the concepts of modern physics and quantum mechanics in engineering applications
- To **study** elastic properties of materials and factors involved for the failure of engineering materials
- To **learn** the fundamentals of LASERs and optical fibers through photonics related to engineering field
- To **study** the electrical and thermal conductivity of materials by the principles of applied physics

Pedagogy:

Techniques and strategies which teachers may adopt to achieve maximum attainment of the objectives.

7. Chalk and Talk	10. Interactive simulations and animations
8. Flipped Class	11. Online learning videos on theory topics
9. Blended mode of learning	12. Hands-on and open ended experiments

Unit-I: Oscillations and Shock waves **8 hours**

Oscillations - Simple Harmonic motion (SHM), differential equation for SHM (derivation), Springs - Stiffness Factor and its Physical Significance, series and parallel combination of springs (derivation), Types of spring and their applications. Free, damped and forced oscillations (qualitative), Types of damping (Graphical Approach). Engineering applications: damped oscillations, resonance and sharpness of resonance.

Shock waves - Mach number and Mach Angle, Mach Regimes, definition and characteristics of Shock waves, Construction and working of Reddy shock tube, Applications of Shock Waves, Numerical problems.

Pre requisites: Basics of Oscillations and Waves

Self-learning component: Conservation of energy in SHM

Practical component: Spring Constant and Reddy shock tube

Unit-II: Quantum Physics **8 hours**

Matter Waves - de Broglie Hypothesis, Phase Velocity and Group Velocity, relation between phase velocity and group velocity, relation between group velocity and particle velocity, de Broglie wavelength and its derivation by group velocity concept, Heisenberg's Uncertainty Principle and its application (Non existence of electron inside the nucleus).

Wave Mechanics - Wave Function, Probability density and normalization, Time independent Schrodinger wave equation (derivation), Eigen functions and Eigen Values, Application: Eigen values and Eigen functions of particle in a one dimensional potential well of infinite depth (derivation). Numerical Problems.

Pre requisites: Quantum theory of Radiation

Self-learning component: Blackbody Radiation Spectrum

Practical component: Stefan-Boltzmann law and Planck's Constant.

Unit-III: Elastic properties of materials: 8 hours
Elastic materials (qualitative). Stress-Strain Curve, Strain hardening and softening. Elastic Moduli, Poisson's ratio and its limiting values. Relation between q, n, k and σ (derivation), Beams, bending moment of rectangular beam (derivation), I-section girders and their Engineering Applications. Twisting couple per unit twist of a cylinder (derivation), Failures of engineering materials - ductile fracture, brittle fracture, stress concentration (qualitative). Numerical problems **Pre requisites:** Elasticity, Stress & Strain **Self-learning:** Single Cantilever **Practical component:** Rigidity modulus and Young's modulus
Unit-IV: Photonics 8 hours
Lasers - Definition and Characteristics of LASER, Interaction of radiation with matter, Expression for energy density (derivation). Requisites of a Laser system. Conditions for Laser action. Principle, construction and working of carbon dioxide laser. Applications: Lasers drilling, cutting, welding. Optical Fibers - Propagation mechanism, angle of acceptance and numerical aperture (derivation), fractional index change, modes of propagation, Number of modes and V - parameter, Types of optical fibers. Attenuation and expression for attenuation coefficient (no derivation), Applications: Industries and mechanical inspections. Numerical problems. **Pre requisite:** Introduction on LASER and Optical fibers **Self-learning component:** Construction and working of Semiconductor LASER **Practical component:** Diffraction Grating and Optical fiber
Unit-V: Electrical and Thermal conductivity of materials 8 hours
Electrical conductivity - Failures of classical free electron theory (Qualitative), Quantum free electron theory - Assumptions, density of states (derivation), Fermi level, Fermi-energy, Fermi factor, variation of Fermi factor with energy and temperature. Expression for electrical conductivity (no derivation), merits of quantum free electron theory. Thermal conductivity - Thermal conductivity of good conductor by Searle's method, thermal conductivity of bad conductor by Lee and Charlton method, Wideman-Franz law. **Pre requisites:** Introduction on classical free electron theory **Self-learning component:** Free electron density in a metal **Practical component:** Fermi energy of a metal and Lee & Charlton method

Practical Component:

The laboratory experiments are classified as Exercise/hands on, open ended, demonstration and structured inquiry. From the list of experiments given below, student must perform **minimum of 10 experiments**.

Sl. No.	Name of the experiment	Type
1	Spring Constant – Series and Parallel arrangements	Hands on
2	Verification of Stefan - Boltzmann law	Hands on
3	Verification of Planck's Constant	Hands on
4	Rigidity modulus – Torsional method	Hands on
5	Young's modulus – Uniform bending	Hands on
6	Wavelength of Laser - Diffraction Grating	Hands on
7	Thermal Conductivity - Lee and Charlton method	Hands on
8	Determination of Fermi energy of copper	Hands on
9	Velocity of Ultrasonic – Ultrasonic interferometer	Open ended

10	Young's modulus – Single Cantilever	Open ended
11	Determination of Mach number - Reddy's shock tube	Demonstration
12	PHET Simulation (Spring constant by oscillation method)	Demonstration
13	GNU step interactive simulations (Self activity)	Structured inquiry
14	Study of motion using spreadsheet (Self activity)	Structured inquiry

Course Outcomes: Students will be able to

CO1	**Apply** the fundamental concepts of physics to understand advanced principles of oscillations, waves, quantum mechanics, materials properties, photonics, electrical and thermal conductivity of materials.
CO2	**Identify** the engineering applications of oscillations, waves, quantum mechanics, dielectric and superconducting properties of materials, photonics , electrical and thermal conductivity of the materials with basic knowledge of physics
CO3	**Formulate** the needed mathematical expressions to answer advanced engineering problems using theoretical knowledge of applied physics.
CO4	**Solve** the numerical problems related to engineering field in quantum mechanics, materials properties, photonics and acoustics by the knowledge of mathematics.
CO5	**Analyze** the experimental results with theory by **constructing** the circuit/**Setting** up the experiment related to Applied physics.

COs – POs mapping

COs	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										1
CO2	3	2										1
CO3	3	1										1
CO4	3	2										
CO5	3			2	1				1			1

Levels: 3-Highly mapped; 2- Moderately mapped; 1 – Fairly mapped; 0 – Not mapped

Suggested Learning Resources:

Text Books

14. Materials Science and Engineering by R Balasubramaniam, second edition, Wiley India Pvt. Ltd. Ansari Road, Daryaganj, New Delhi-110002.
15. 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.
16. John Wiley & Sons: Engineering Physics - Wiley India Pvt. Ltd, New Delhi.
17. R.K. Gaur, S. L. Gupta ; Engineering Physics – Dhanpat Rai Publications; 2011 Edition

Reference Books:

18. Engineering Physics by R. K. Gaur and S. L. Gupta, 2010 edition, Dhanpat Rai Publications Ltd., New Delhi
19. Building Science: Lighting and Accoustics, B. P. Singh and Devaraj Singh, Dhanpat Rai Publications (P) Ltd.,
20. Building Acoustics : Tor Eric Vigran, Taylor and Francis, 2008 Edition.
21. Photometry Radiometry and Measurements of Optical Losses, Micheal Bukshtab, Springer, 2nd edition.
22. Materials Science for Engineers by James F. Shackelford and M K Muralidhara, 6th ed, Pearson Ed. Pvt. Ltd
23. Lasers and Non Linear Optics, B B Loud, New Age Internationals, 2011 edition

Web links and Video Lectures (e-Resources):

Web links:
Simple Harmonic motion:https://www.youtube.com/watch?v=k2FvSzWeVxQ
Stress- strain curves:https://web.mit.edu/course/3/3.11/www/modules/ss.pdf
Stress curves:https://www.youtube.com/watch?v=f08Y39UiC-o
Oscillations and waves :https://openstax.org › books › college-physics-2e
Uniform Bending: https://youtu.be/AiwnWoeVhrU
Diffraction Grating: https://youtu.be/th9-Ylp0FcU
Spring Constant: https://youtu.be/7Ar04wffp08
Fermi Energy: https://youtu.be/i2bf3_X4h74
Stefan-Boltzmann Constant: https://youtu.be/pBwn1TMkmJ8
Planck's constant: https://youtu.be/nWcejb3S2zY
Torsional Pendulum: https://youtu.be/hteYgW9pT6w

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