[As per Choice F	Applied P Based Credit Syst	•	S) & OBE Scheme]	
	SEMESTE			
Course Code:	P22PHCE10		CIE Marks	50
Course Type	Integrated		SEE Marks	50
(Theory/Practical/Integrated)	Integrated		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0 40 hours The		Exam Hours Credits	03
Total Hours of Pedagogy	04			
Course Objectives				
<ul> <li>To recall the concepts of physics reproperties of materials, fundamentation of the concepts of way.</li> <li>To understand the concepts of way.</li> <li>To realize the concepts of modern processing the concepts of materials.</li> <li>To study elastic properties of materials.</li> <li>To learn the fundamentals of LASE.</li> <li>To study the concepts and principle.</li> </ul>	als of LASER and o ves and oscillation physics and quant rials and factors in Rs and optical fibe	optical fibe as and their tum mecha nvolved for ers througl	rs used in the applicat r engineering applicat mics and their applica r the failure of enginee n photonics related to	tions ions tions ering materials engineering field
Pedagogy: Techniques and strategies which teac				
<ol> <li>Chalk and Talk</li> <li>Flipped Class</li> <li>Blended mode of learning</li> </ol>		5. (	nteractive simulation Online learning videos Jands-on and open en	on theory topics
Unit-I: Oscillations and Shock wave	es			8 Hours
Oscillations- Simple Harmonic motions stiffness factor and its physical signific of spring and their applications. Free (Graphical Approach). Engineering a resonance. Shock waves- Mach number and Ma waves, Construction and working of problems. <b>Pre requisites:</b> Basics of Oscillations <b>Self-learning component:</b> Conservate <b>Practical component:</b> Spring Constant	cance, series and j , damped and for applications of d ch Angle, Mach f Reddy shock and waves ion of energy in S	parallel co rced oscill lamped os Regimes, tube, App SHM	mbination of springs ations (Qualitative), cillations, resonance definition and charac	(derivation), Types Types of damping and sharpness of cteristics of Shock
Unit-II: Quantum Physics:				8 Hours
Matter Waves - de Broglie Hypothesi derivation of expression by group vel- application (Non existence of electron Wave Mechanics - Wave Function, Pr equation, Eigen functions and Eigen V dimensional potential well of infinite <b>Pre requisites:</b> Quantum theory of Ra <b>Self-learning component:</b> Blackbody	ocity concept, He i inside the nucle robability and no Values, Application depth. Numerical adiation	eisenberg's us) rmalization on: Energy l Problems	s Uncertainty Principl n, Time independent y and wave function of	le and its Schrodinger wave

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	stic Moduli,
Poisson's ratio and its limiting values. Relation between q, n, k and $\sigma$ (derivation), Beau	ms, bending
moment of rectangular beam (derivation), I-section girder and their Engineering Application	ns. Twisting
couple per unit twist of a cylinder (derivation), Failures of engineering materials - stress co	oncentration,
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, Ex	pression for
energy density (derivation). Requisites of a Laser system. Conditions for Laser action	n. Principle,
construction and working of carbon dioxide laser. Applications: Lasers as Range finder, Roa	d 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: Nondestructive 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	Туре
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

C01	Apply the fundamental concepts of physics to understand advanced principles of oscillations,
01	waves, quantum mechanics, materials properties, photonics and acoustics.
C02	<b>Identify</b> the engineering applications of oscillations and shock waves, quantum mechanics,
602	properties of materials, photonics and acoustics with basic knowledge of physics.
C03	Formulate the mathematical expressions for an advanced physical quantity related to
603	engineering field using theoretical knowledge of physics.
C04	Solve the numerical problems related to engineering field in quantum mechanics, materials
C04	properties, photonics and acoustics by the knowledge of mathematics.
C05	Analyze the experimental results with theory by Constructing the circuit/Setting up the
605	experiment related to Applied physics.

(	COs – POs mapping												
COs	POs												
COs	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	
C01	3	2										1	
CO2	3	2										1	
CO3	3	1										1	
CO4	3	2											
C05	3			2	1				1			1	
Levels	<b>s:</b> 3-Higl	hly map	ped; 2-	Modera	tely maj	oped; 1	– Fairly	mappe	d; 0 – No	t mappe	ed		

#### **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, 2<sup>nd</sup> 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:<u>https://www.youtube.com/watch?v=k2FvSzWeVxQ</u>

Shock waves: <a href="https://physics.info/shock/">https://physics.info/shock/</a>

Shock waves and its applications:<u>https://www.youtube.com/watch?v=tz\_3M3v3kxk</u>

Stress- strain curves:<u>https://web.mit.edu/course/3/3.11/www/modules/ss.pdf</u>

Stress curves:<u>https://www.youtube.com/watch?v=f08Y39UiC-o</u>

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			
		AAT	Assignments	10					50			
	Theory	Test - 1	Theory + Quiz	40	50	25	10	20				
		Test - 2	Theory + Quiz	40								
CIE	Lab	Conduction of Experiments	Performance with Record	25								
		Lab test	Evaluation & Viva-Voce	25	50	25	10					
SEE	Theory	End Exam	Part - A	10	100	50	25/100	20	50			
SEE	Theory	End Exam	Part - B	90	100	50	35/100	20	30			
Note: M	lin. marks from	SEE shall be 35/10	00, but the aggrege	ite marks fro	m CIE & SEE	E must be <b>40</b> /	/100	40	100			

			S) & OBE Scheme]	
Course Code:	P22PHCS1	<u>MESTER – I</u> 02/202	<b>CIE Marks</b>	50
Course Type	Integrated		SEE Marks	50
(Theory/Practical/Integrated)	gi uttu		Total Marks	100
<b>Feaching Hours/Week (L:T:P: S)</b>	2:2:2:0		Exam Hours	03
<b>Fotal Hours of Pedagogy</b>	40 hours T 10 to12 La		Credits	04
Course Objectives				
To recall the concepts of physic properties of materials, fundam			· 1	anics, elastic
<ul> <li>To realize the concepts of mod</li> </ul>		-		nnlications
<ul> <li>To study the dielectric and sup</li> </ul>	1 .	-		
<ul> <li>To explore the rudimental cond</li> </ul>				
<ul> <li>To learn the basics of photonic</li> </ul>				
✤ To perceive the idea of quantum		1	, <b>11</b>	
Pedagogy:				
Techniques and strategies which	teachers may	-		-
1. Chalk and Talk			e simulations and animat	
<ol> <li>Flipped Class</li> <li>Blended mode of learning</li> </ol>			arning videos on theory t	
3. Blended mode of learning Unit-I: Quantum Physics:		6. Hands-on	and Open ended experimental	8 Hours
- •		17.1 . 16	<u> </u>	
Matter Waves - de Broglie Hypot		•	- ·	-
velocity and group velocity relation	i between gr	oup velocity and	particle velocity, de B	
	-			
and its derivation by group velocity	concept, He			
and its derivation by group velocity existence of electron inside the nucl	concept, He eus).	isenberg's Unce	rtainty Principle and it	s application (No
and its derivation by group velocity	concept, He eus).	isenberg's Unce	rtainty Principle and it	s application (No
and its derivation by group velocity existence of electron inside the nucl	concept, He eus). Probability c	isenberg's Unce	rtainty Principle and its alization, Time indepe	s application (No ndent Schrodinge
and its derivation by group velocity existence of electron inside the nucl Wave Mechanics - Wave Function,	concept, He eus). Probability c functions a	isenberg's Unce lensity and norm nd Eigen Values	rtainty Principle and its alization, Time indepe s, Application: Eigen	s application (No ndent Schrodinge values and Eige
and its derivation by group velocity existence of electron inside the nucl Wave Mechanics - Wave Function, wave equation (derivation), Eigen	concept, He eus). Probability c functions a	isenberg's Unce lensity and norm nd Eigen Values	rtainty Principle and its alization, Time indepe s, Application: Eigen	s application (No ndent Schrodinge values and Eige
and its derivation by group velocity existence of electron inside the nucl Wave Mechanics - Wave Function, wave equation (derivation), Eigen functions of particle in a one dir	concept, He eus). Probability of functions a nensional p	isenberg's Unce lensity and norm nd Eigen Values otential well of	rtainty Principle and its alization, Time indepe s, Application: Eigen	s application (No ndent Schrodinge values and Eige
and its derivation by group velocity existence of electron inside the nucl Wave Mechanics - Wave Function, wave equation (derivation), Eigen functions of particle in a one dir Problems. <b>Pre requisites: Quantum theory o</b>	concept, He eus). Probability c functions a nensional p <b>f Radiation</b>	isenberg's Unce lensity and norm nd Eigen Values otential well of	rtainty Principle and its alization, Time indepe s, Application: Eigen	s application (No ndent Schrodinge values and Eige
and its derivation by group velocity existence of electron inside the nucl Wave Mechanics - Wave Function, wave equation (derivation), Eigen functions of particle in a one dir Problems. <b>Pre requisites: Quantum theory o</b> <b>Self-learning component:</b> Blackbo	concept, He eus). Probability of functions a nensional p <b>f Radiation</b> ody Radiation	isenberg's Unce lensity and norm nd Eigen Values otential well of n Spectrum	rtainty Principle and its alization, Time indepers, Application: Eigen infinite depth (deriv	s application (No ndent Schrodinge values and Eige
and its derivation by group velocity existence of electron inside the nucl Wave Mechanics - Wave Function, wave equation (derivation), Eigen functions of particle in a one dir Problems. <b>Pre requisites: Quantum theory o</b> <b>Self-learning component:</b> Blackbo <b>Practical Component:</b> Stefan-Bolt	concept, He eus). Probability of functions a nensional p <b>f Radiation</b> ody Radiation	isenberg's Unce lensity and norm nd Eigen Values otential well of n Spectrum	rtainty Principle and its alization, Time indepers, Application: Eigen infinite depth (deriv	s application (No ndent Schrodinge values and Eige ation). Numerica
and its derivation by group velocity existence of electron inside the nucl Wave Mechanics - Wave Function, T wave equation (derivation), Eigen functions of particle in a one dir Problems. <b>Pre requisites: Quantum theory o</b> <b>Self-learning component:</b> Blackbor <b>Practical Component:</b> Stefan-Bolt <b>Unit-II: Properties of Materials</b>	concept, He eus). Probability of functions a nensional p <b>f Radiation</b> ody Radiation zmann law a	isenberg's Uncer lensity and norm nd Eigen Values otential well of n Spectrum and Planck's Cor	rtainty Principle and its alization, Time indepers, Application: Eigen infinite depth (deriv	s application (No ndent Schrodinge values and Eige ation). Numerica <b>8 Hours</b>
and its derivation by group velocity existence of electron inside the nucl Wave Mechanics - Wave Function, wave equation (derivation), Eigen functions of particle in a one dir Problems. <b>Pre requisites: Quantum theory o</b> <b>Self-learning component:</b> Blackbo <b>Practical Component:</b> Stefan-Bolt	concept, He eus). Probability of functions a nensional p <b>f Radiation</b> dy Radiation zmann law a	isenberg's Uncer lensity and norm nd Eigen Values otential well of n Spectrum and Planck's Cor trics, Types of P	rtainty Principle and its alization, Time indepe s, Application: Eigen infinite depth (deriv	s application (No ndent Schrodinge values and Eige ation). Numerica <b>8 Hours</b> echanism, interna
and its derivation by group velocity existence of electron inside the nucl Wave Mechanics - Wave Function, T wave equation (derivation), Eigen functions of particle in a one dir Problems. <b>Pre requisites: Quantum theory of Self-learning component:</b> Blackbor <b>Practical Component:</b> Stefan-Bolt <b>Unit-II: Properties of Materials</b> Dielectric Materials - Polar and non- fields in solid (derivation), Claus	concept, He eus). Probability of functions a nensional p <b>f Radiation</b> dy Radiation zmann law a	isenberg's Uncer lensity and norm nd Eigen Values otential well of n Spectrum and Planck's Cor trics, Types of P	rtainty Principle and its alization, Time indepe s, Application: Eigen infinite depth (deriv	s application (No ndent Schrodinge values and Eige ation). Numerica <b>8 Hours</b> echanism, interna
and its derivation by group velocity existence of electron inside the nucl Wave Mechanics - Wave Function, wave equation (derivation), Eigen functions of particle in a one dir Problems. <b>Pre requisites: Quantum theory o</b> <b>Self-learning component:</b> Blackboo <b>Practical Component:</b> Stefan-Bolt <b>Unit-II: Properties of Materials</b> Dielectric Materials - Polar and non-	concept, He eus). Probability of functions a nensional p <b>f Radiation</b> dy Radiation zmann law a -polar dielec sius-Mossott	isenberg's Uncer lensity and norm nd Eigen Values otential well of n Spectrum and Planck's Cor trics, Types of Pa i equation (der	rtainty Principle and its alization, Time indepe s, Application: Eigen infinite depth (deriv nstant.	s application (No ndent Schrodinge values and Eige ation). Numerica <b>8 Hours</b> echanism, interna of dielectrics i
and its derivation by group velocity existence of electron inside the nucl Wave Mechanics - Wave Function, Figure functions of particle in a one dir Problems. <b>Pre requisites: Quantum theory of Self-learning component:</b> Blackbor <b>Practical Component:</b> Stefan-Bolt <b>Unit-II: Properties of Materials</b> Dielectric Materials - Polar and non- fields in solid (derivation), Claus transformers, Capacitors.	concept, He eus). Probability of functions a nensional p <b>f Radiation</b> dy Radiation zmann law a -polar dielec sius-Mossott conductors,	isenberg's Uncer lensity and norm nd Eigen Values otential well of n Spectrum and Planck's Cor trics, Types of P i equation (der Temperature de	rtainty Principle and its alization, Time indepers, Application: Eigen infinite depth (deriv nstant. olarization and their m rivation). Application pendence of resistivity	s application (No ndent Schrodinge values and Eige ation). Numerica <b>8 Hours</b> echanism, interna of dielectrics i

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**

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

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

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	Туре
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

Cou	Course Outcomes: Students will be able to											
CO1		<b>Apply</b> the fundamental concepts of physics to understand advanced principles of quantum mechanics properties of materials semiconductors photonics and quantum computing										
		mechanics, properties of materials, semiconductors, photonics and quantum computing										
CO2	Identify the engineering applications of quantum mechanics, properties of materials,									aterials,		
semiconductors, photonics and quantum computing with basic knowledge of physic								ics				
<b>CO</b> 2	<b>Formulate</b> the mathematical expressions for an advanced physical quantity related to engineering										neering	
CO3	field us	field using theoretical knowledge of physics.										
004	<b>Solve</b> the numerical problems related to engineering field in quantum mechanics materials										aterials	
CO4	properti	ies, phot	onics an	d quantı	ım comp	outing w	ith the k	nowledg	ge of mat	thematics		
CO5	Analyz	Analyze the experimental results with theory by Constructing the circuit/Setting up the experiment										
COS	related	to Appli	ed physi	CS.								
	COs – P	Os map	ping									
COs						F	'Os					
LUS	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
C01	3	2										1
CO2	3	2										1
CO3	3	1										1
C04	3	2										
C05	3			2	1				1			1
Leve	<b>ls:</b> 3-Hig	hly map	ped; 2-	Modera	tely ma	pped; 1	– Fairly	mappe	d; 0 – No	ot mappe	ed	

#### **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. 3. 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. Engineering Physics by R. K. Gaur and S. L. Gupta, 2010 edition, Dhanpat Rai Publications Ltd., New 4. Delhi-110002, 5. Photometry Radiometry and Measurements of Optical Losses, Micheal Bukshtab, Springer, 2<sup>nd</sup> edition. Materials Science for Engineers by James F. Shackelford and Madanapalli K Muralidhara, sixth edition, 6. 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											
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			
		AAT	Assignments	10								
	Theory	Test - 1	Theory + Quiz	- 40	50	25	10	20	50			
CIE		Test - 2	Theory + Quiz									
CIE	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	25/100	20	50			
SEE	Theory		Part - B	90	100	50	35/100	20	50			
Note: Min. n	narks from SEI	E shall be <b>35/10</b>	<b>0</b> , but the aggre	gate marks	from CIE &	SEE must b	e 40/100	40	100			

[As per Cho		p <b>plied Physics</b> edit System (CBCS	S) & OBE Scheme]					
		MESTER – I/II						
Course Code:	P22PHE		CIE Marks	50				
Course Type	Integrate	d	SEE Marks	50				
Theory/Practical/Integrated)	-	u	Total Marks	100				
<b>Feaching Hours/Week (L:T:P: S</b>			Exam Hours Credits	03 04				
<b>Fotal Hours of Pedagogy</b>	urs of Pedagogy 40 hours Theory + Credits 10 to12 Lab slots							
Course Learning Objectives:	10 t012 Là							
<ul> <li>To recall the concepts of phy</li> </ul>	voice related t	o wayoo and occilla	tiona quantum machanica	olactic				
properties of materials, fund	•		-	elastic				
<ul> <li>To realize the concepts of materials, random</li> </ul>		-		lications				
To study the dielectric and s	uperconducti	ng properties of ma	aterials and their application	ons.				
<ul> <li>To understand the electrica</li> </ul>								
<ul> <li>To learn the basics of photo</li> <li>To explore the rudimental c</li> </ul>			-					
<ul> <li>To explore the rudimental of Pedagogy:</li> </ul>	oncepts of ser			lices				
Techniques and strategies whic	h teachers ma	y adopt to achieve	maximum attainment of th	e objectives.				
7. Chalk and Talk			e simulations and animatio					
8. Flipped Class			rning videos on theory top					
9. Blended mode of learning		12. Hands-on	and open ended experime	nts				
Unit-I: Quantum Physics:				8 Hours				
Matter Waves - de Broglie Hyp	othesis, Phas	e Velocity and G	roup Velocity, relation b	etween phase				
velocity and group velocity, relati	on between g	roup velocity and	particle velocity, de Brogl	ie wavelength				
and its derivation by group veloci	ty concept, H	eisenberg's Uncer	tainty Principle and its app	plication (Nor				
existence of electron inside the nu	icleus).							
Wave Mechanics - Wave Function	n, Probability	density and norma	alization, Time independer	nt Schrodinger				
wave equation (derivation), Eige	en functions	and Eigen Values	, Application: Eigen valu	es and Eiger				
functions of particle in a one dime	nsional potent	tial well of infinite	depth (derivation). Numer	ical Problems				
Pre requisites: Quantum theory	of Radiation	1						
Self-learning component: Black	body Radiatic	on Spectrum						
Practical Component: Stefan-Bo	oltzmann law	and Planck's Cons	stant.					
Unit-II: Properties of Materials				8 Hours				
Dielectric Materials - Polar and no	on-polar diele	ctrics, Types of Po	plarization and their mecha	anism, interna				
fields in solid (derivation), Cl								
transformers, Capacitors.								
Superconducting Materials - Sur	erconductors	Temperature den	endence of resistivity M	eissner Effec				

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

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

8 Hours

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** 

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** 

Sl. No.	Name of the Experiment	Туре
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

#### experiments.

#### Course Outcomes: Students will be able to

CO1	<b>Apply</b> 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
02	semiconductors with basic knowledge of physics.
CO3	Formulate the mathematical expressions for an advanced physical quantity related to engineering field
COS	using theoretical knowledge of physics.
CO4	Solve the numerical problems related to engineering field in quantum mechanics, materials properties,
C04	photonics and semiconductors by the knowledge of mathematics.
005	Analyze the experimental results with theory by Constructing the circuit/Setting up the experiment related
CO5	to Applied physics.

(	COs – POs mapping													
COG		POs												
COs	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012		
C01	3	2										1		
CO2	3	2										1		
CO3	3	1										1		
CO4	3	2												
C05	3			2	1				1			1		
Levels	s: 3-Higl	nly map	ped; 2-	Modera	tely map	oped; 1	– Fairly	mapped	1; 0 – No	t mappe	ed			

#### Suggested Learning Resources:

Books

- 12. Materials Science and Engineering by R Balasubramaniam, second edition, Wiley India Pvt. Ltd. Ansari Road, Daryaganj, New Delhi-110002.
- 13. 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.

#### **Reference Books**

1.	Engineering Physics by R. K. Gaur and S. L. Gupta, 2010 edition, Dhanpat Rai Publications Ltd.,								
	New Delhi-110002								
2.	2. N.H. Ayachit, P. K. Mittal: Engineering Physics – I. K. International Publishing House Pvt. Ltd.								
	New Delhi								
3.	3. Photometry Radiometry and Measurements of Optical Losses, Micheal Bukshtab, Springer, 2 <sup>nd</sup>								
	edition.								
4.	Materials Science for Engineers by James F. Shackelford and Madanapalli K Muralidhara,								
	sixth edition, PearsonEducation Asia Pvt. Ltd., New Delhi.								
5.	Lasers and Non Linear Optics, B B Loud, New Age Internationals, 2011 edition								
Web li	inks and Video Lectures (e-Resources):								
Web li	nks:								
Diffrac	ction Grating: https://youtu.be/th9-Ylp0FcU								
Transi	stor Characteristics: https://youtu.be/tCnNAyHv0s0								
LCR R	Resonance Circuit: https://youtu.be/5qbr-F4H7n0								
Four P	robe 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								
Dielec	tric Constant: https://youtu.be/vOTbXNs34j8								
Activi	ty Based Learning (Suggested Activities in Class)/ Practical Based learning								
-	nptel.ac.in								
-	<u>/swayam.gov.in</u>								
-	/virtuallabs.merlot.org/vl_physics.html								
	/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	
		AAT	Assignments	10		25	10	20	50	
	Theory	Test - 1	Theory + Quiz	40	50					
		Test - 2	Theory + Quiz	40						
CIE		Conduction of Experiments	Performance with Record	25	50	25				
		Lab test	Evaluation & Viva-Voce	25			10			
CEE	TT1	End Enem	Part - A	10	100	50	25/100	20	50	
SEE	Theory	End Exam	Part - B	90	100	50	35/100	20	50	
Note: Min.	. marks from SH	EE shall be <b>35/10</b>	0, but the aggreg	gate marks f	rom CIE & SI	EE must be 4	40/100	40	100	

[As per Choice		edit System (CBCS) &	OBE Scheme]			
Course Code:		<u>CMESTER – I/II</u> /IE102/202	<b>CIE Marks</b>	50		
	Integrated		SEE Marks	50		
Course Type (Theory/Practical/Integrated)	integrat	cu	Total Marks	<u> </u>		
Teaching Hours/Week (L:T:P: S)	2:2:2:0		Exam Hours			
Total Hours of Pedagogy	40 hour	s Theory + Lab slots	Credits	04		
Course Objectives						
✤ To recall the concepts of physics r	elated to w	vaves and oscillations, qua	antum mechanics, elas	stic properties of		
materials, fundamentals of LASER				• •		
✤ To understand the concepts of wa	-		eering applications			
✤ To realize the concepts of modern		-		ons		
To study elastic properties of mate		•	0 0 11			
✤ To learn the fundamentals of LAS			<b>v v</b>			
✤ To study the electrical and thermal		<b>U</b>	•	•		
Pedagogy:			r in the second se			
Techniques and strategies which teach	hers may a	dopt to achieve maximun	n attainment of the obj	jectives.		
7. Chalk and Talk	•	10 Interactive sim	ulations and animatio	ns		
8. Flipped Class			g videos on theory top			
9. Blended mode of learning			open ended experimer			
Unit-I: Oscillations and Shock wa	ves			8 hours		
Oscillations - Simple Harmonic mo Stiffness Factor and its Physical Si	gnificanc	e, series and parallel c	combination of sprin	ngs (derivation)		
Types of spring and their applicat damping (Graphical Approach). Eng of resonance.						
Shock waves - Mach number and M waves, Construction and working	-	-				
problems.	1 ** *					
Pre requisites: Basics of Oscillation						
Self-learning component: Conserva						
Practical component: Spring Const	lant and R	eury snock lube				
Unit-II: Quantum Physics	•	** 1 • • •	<b></b>	8 hours		
Matter Waves - de Broglie Hypoth		•		-		
velocity and group velocity, relation				0 0		
and its derivation by group velocity	-	Heisenberg's Uncertain	ty Principle and its a	application (No		
existence of electron inside the nucle	· ·	u donaity and normali-	tion Time independence	lant Cabradina		
Wave Mechanics - Wave Function, I		-	_	-		
wave equation (derivation), Eigen functions of particle in a one dimensi						
<b>Pre requisites:</b> Quantum theory of I		inar wen of minnte dep		icitai i ioutelli		
The requisites. Quantum meory of I						
Self-learning component: Blackboo	dy Radiati	on 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 Modu Poisson's ratio and its limiting values. Relation between q, n, k and $\sigma$ (derivation), Beams, bending mome of rectangular beam (derivation), I-section girders and their Engineering Applications. Twisting couple p unit twist of a cylinder (derivation), Failures of engineering materials - ductile fracture, brittle fractur stress concentration (qualitative). Numerical problems <b>Pre requisites:</b> Elasticity, Stress & Strain <b>Self-learning:</b> Single Cantilever <b>Practical component:</b> Rigidity modulus and Young's modulus	ent per
Unit-IV: Photonics 8 hours	3
<ul> <li>Lasers - Definition and Characteristics of LASER, Interaction of radiation with matter, Expression tenergy density (derivation). Requisites of a Laser system. Conditions for Laser action. Princip construction and working of carbon dioxide laser. Applications: Lasers drilling, cutting, welding.</li> <li>Optical Fibers - Propagation mechanism, angle of acceptance and numerical aperture (derivatio fractional index change, modes of propagation, Number of modes and V - parameter, Types of optic fibers. Attenuation and expression for attenuation coefficient (no derivation), Applications: Industries a mechanical inspections. Numerical problems.</li> <li>Pre requisite: Introduction on LASER and Optical fibers</li> <li>Self-learning component: Construction and working of Semiconductor LASER</li> <li>Practical component: Diffraction Grating and Optical fiber</li> </ul>	ole, on), cal
Unit-V: Electrical and Thermal conductivity of materials 8 hour	rs
Electrical conductivity - Failures of classical free electron theory (Qualitative), Quantum free electric theory - Assumptions, density of states (derivation), Fermi level, Fermi-energy, Fermi factor, variation Fermi factor with energy and temperature. Expression for electrical conductivity (no derivation), merits 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.	of of
Pre requisites: Introduction on classical free electron theory	
Self-learning component: Free electron density in a metal Practical component: Formi energy of a metal and Lea & Charlton method	

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	Туре
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		ng's moo		-					C	)pen end	ed	
11		Determination of Mach number - Reddy's shock tubeDemonstrationPHET Simulation (Spring constant by oscillation method)Demonstration										
12		PHET Simulation (Spring constant by oscillation method)     Demonstration       CNUL step intersective simulations (Self estivity)     Step stude d in guilage										
13		GNU step interactive simulations (Self activity) Structured inquiry										
14	Study of motion using spreadsheet (Self activity)         Structured inquiry											
Cours	e Outco	omes: St	tudents	will be	able to	)						
		Apply the fundamental concepts of physics to understand advanced principles of										
C01	oscillations, waves, quantum mechanics, materials properties, photonics, electric								ectrical a	and		
		thermal conductivity of materials.										
	Identify the engineering applications of oscillations, waves, quantum mechanics,											
CO2										electrica	l and the	ermal
		activity o										
CO3									advanc	ced engi	neering	
		ems usii										
C04			-				•	0	-	um mech	•	
										nathema		
C05			-				y by <b>co</b>	nstruct	ing the	circuit/S	Setting ເ	ıp the
005	exper	iment re	elated to	o Applie	d physic	CS.						
	COs – P	Os map	ping									
COs		1	1	1	1	1	Os	1	1	1		<u> </u>
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
C01	3	2										1
CO2	3	2										1
CO3	3	1										1
CO4	3	2										
C05	3			2	1				1			1
Level	<b>s:</b> 3-Hig	hly map	ped; 2-1	Moderat	tely map	oped; 1	- Fairly	mapped	1; 0 – No	ot mappe	ed	
Sugge	sted Le	arning	Resour	ces:								
Text B	ooks											
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22	Lacore		Lincor	nting DI	Diaud		Intownot	ionala 2	011			

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:<u>https://www.youtube.com/watch?v=k2FvSzWeVxQ</u>
- Stress- strain curves:<u>https://web.mit.edu/course/3/3.11/www/modules/ss.pdf</u>

Stress curves:<u>https://www.youtube.com/watch?v=f08Y39UiC-o</u>

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	Ma Component	Type of Assessment	n for the Evalu Assessment Type used	ation of I/I Max. Marks Assigned	I Sem Appli Evaluated for Total Marks	ed Physics Reduced Marks to 50%	Course Min. Eligible marks	Min. Marks Required	Max. Marks Allotted			
		AAT	Assignments	10								
	Theory	Test - 1	Theory + Quiz	40	50	25	10	20	50			
CIE		Test - 2	Theory + Quiz									
CIE	Lab	Conduction of Experiments	Performance with Record	25	50	25	10		50			
		Lab test	Evaluation & Viva-Voce	25								
<b>SEE</b>	Ŧ	End Exam	Part - A	10	100	50	25/100	20	50			
SEE	Theory	End Exam	Part - B	90	100	50	35/100	20	50			
Note: Min. n	narks from SEI	E shall be <b>35/10</b>	<b>0</b> , but the aggre	gate marks	from CIE &	SEE must b	e <b>40/100</b>	40	100			