MARUDHAR KESARI JAIN COLLEGE FOR WOMEN (AUTONOMOUS)

Vaniyambadi – 635 751

PG & Research Department of Physics

for

Postgraduate Programme

Master of Physics

From the Academic Year 2024-25

CONTENT

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION

1. Preamble

Physics is the most of basic of sciences. It seeks to understand natural phenomena in a quantitative manner, and to answer some of the oldest and deepest questions ever asked by human beings: What are things made of? Is there a limit to the smallest things that we can think of? Did the world have a beginning? Will it have an end? At the same time, it provides the base of much of the technology that we take for granted in the 21 st century: computers, artificial satellites, mobile phones, TV, microwave oven. Indeed, it will not be an exaggeration to say that modern human life is shaped by technologies that are largely based on a foundation of physics. Physics as a discipline has existed for three hundred years and has a large 'core' body of knowledge. Our M.Sc. programme lays emphasis on the courses that constitute this core component, while providing students with a bouquet of optional papers covering almost all branches of physics. Those who wish to pursue higher studies in the subject are thereby well equipped to choose their branch of study. The programme also aims at equipping future teachers (at college as well school level) with a thorough grounding in the subject. Since physics is the base of much of modern technology, the programme also gives adequate hands-on experience to students who may go on to work in applied fields. Finally, viewing physics as a training ground for the mind the programme also aims to equip those who go into other fields of work with logical thinking and a critical attitude.

PROGRAMME OUTCOMES (PO)

Programme	**M.Sc., Physics**
Programme Code	**PS11**
Duration	**2 Years[PG]**
Programme Outcomes	**PO1:** Acquire knowledge in Physics to apply the knowledge in their day-to-day life for betterment of self and society. **PO2:** Develop critical, analytical thinking and problem-solving skills **PO3:** Develop research related skills in defining the problem, formulate and test the hypothesis, analyse, interpret, and draw conclusion from data. **PO4:** Address and develop solutions for societal and environmental needs of local regional and national development. **PO5:** Work independently and engage in lifelong learning and enduring proficient progress. **PO6:** Provoke employability and entrepreneurship among students along with ethics andcommunication skills. **PO7:** Understand the importance of ethical behavior in business contexts and be able to recognize and address ethical dilemmas they may encounter in their professional careers. **PO8:** Prepared for lifelong learning and professional development, including the ability to adapt to changes in technology, business practices, and economic conditions throughout their careers.
Programme Specific Outcomes:	**PSO1: Placement**: Acquire the ability to critically analyze complex real life problems using the laws of Physics with appropriate mathematical tools and thereby preparing the students to face various state/national level competitive exams. **PSO2: Entrepreneur:** Acquire employability and entrepreneurial skills through hands-on training in basic as well as advanced areas of Physics and to develop innovative scientific solutions for industrial and societal needs at local, regional, national and global levels. **PSO3: Contribution to the Society:** Create skills required for identifying socially relevant research problems, collection of data, analyze and interpret data leading to knowledge enhancement in addressing the societal challenges.

Eligibility for Admission:

Candidates for admission to the first year of the **Master of Physics** course shall be required to have passed the **Bachelor of Physics** by the Government of TamilNadu or any equivalent.

Methods of Evaluation and Assessment

Methods of Evaluation		
Internal Evaluation		25 Marks
External Evaluation	End Semester Examination	75 Marks
	Total	**100 Marks**
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand / Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview	
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate Between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Semester - I						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24PPHC11	CC - Mathematical Physics	4	1	0	0	4
24PPHC12	CC - Classical Mechanics and Relativity	4	1	0	0	4
24PPHP13P	CC – Practical I – Electronics	0	0	5	0	3
24PPHE11	DSEC - 1 Linear and Digital ICs and Applications	3	0	1	0	3
24PPHE12	EC – 1. Crystal growth and Thin Films/ **2.**Analysis of Crystal Structures	3	0	1	0	3
24PPHA11	AECC - Solar energy utilization	1	1	0	0	3
24PCHR11	VE - 1 Human Rights	1	1	0	0	3
TOTAL					**30**	**21**

Semester - II						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24PPHC21	CC-Statistical Mechanics	5	0	0	0	4
24PPHC23	CC - Quantum Mechanics – I	5	0	0	0	4
24PPHC24	CC - Electromagnetic Theory	5	0	0	0	4
24PPHC22P	CC - Practical II - General Experiments	0	0	5	0	3
24PPHE21	DSEC I - Advanced Optics	4	0	0	0	3
24PPHE22	DSEC II - Physics of Nanoscience and Technology	4	0	0	0	3
24PPHS21	SEC /NM- Renewable Energy and Energy Harvesting	2	0	0	0	2
TOTAL					**30**	**23**

L-Lecture **T-Tutorial** **P-Practical** **S-Seminar** **C-Credit**

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Nanmudalvan within the fifth semester. Additionally, engaging in a specified Self-learning Course is mandatory to qualify for the degree, and successful participation will be acknowledged with an extra credit of 2*.

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC11	MATHEMATICAL PHYSICS	Core	4	1	0	0	4	6	25	75	100

Learning Objectives	
LO1	To equip students with the mathematical techniques needed for understanding theoretical treatment in different courses taught in their program.
LO2	To extend their manipulative skills to apply mathematical techniques in their fields.
LO3	To help students apply Mathematics in solving problems of Physics.
LO4	To give a basic idea about different methods of mathematics, used in Physics.
LO5	To Understand the linear equations, vector spaces, matrices, linear transformations, determinants, eigen values, eigen vectors, etc.

Unit	Content	Hours
1	Basic concepts – Definitions- examples of vector space – Linear independence - Scalar product- Orthogonality – Gram-Schmidt orthogonalization procedure – linear operators – Dual space- ket and bra notation – orthogonal basis – change of basis – Isomorphism of vector space – projection operator –Eigen values and Eigen functions – Direct sum and invariant subspace – orthogonal transformations and rotation.	15
2	Review of Complex Numbers -de Moivre's theorem-Functions of a Complex Variable- Differentiability -Analytic functions- Harmonic Functions- Complex Integration- Contour Integration, Cauchy – Riemann conditions – Singular points – Cauchy's Integral Theorem and integral Formula -Taylor's Series - Laurent's Expansion- Zeros and poles – Residue theorem and its Application: Potential theory - (1) Electrostatic fields and complex potentials - Parallel plates, coaxial cylinders and an annular region (2) Heat problems - Parallel plates and coaxial cylinders.	15
3	Types of Matrices and their properties, Rank of a Matrix -Conjugate of a matrix - Adjoint of a matrix - Inverse of a matrix - Hermitian and Unitary Matrices -Trace of a matrix- Transformation of matrices - Characteristic equation - Eigen values and Eigen vectors - Cayley–Hamilton theorem –Diagonalization.	15
4	Definitions -Fourier transform and its inverse - Transform of Gaussian function and Dirac delta function -Fourier transform of derivatives - Cosine and sine transforms - Convolution theorem. Application: Diffusion equation: Flow of heat in an infinite and in a semi - infinite medium - Wave equation: Vibration of an infinite string and of a semi - infinite string. Laplace transform and its inverse - Transforms of derivatives and integrals –	15

	Differentiation and integration of transforms - Dirac delta functions - Application - Laplace equation: Potential problem in a semi - infinite strip.	
5	Second order differential equation- Sturm-Liouville's theory - Series solution with simple examples - Hermite polynomials - Generating function - Orthogonality properties - Recurrence relations – Legendre polynomials - Generating function - Rodrigue formula – Orthogonality properties - Dirac delta function- One dimensional Green's function and Reciprocity theorem -Sturm-Liouville's type equation in one dimension & their Green's function.	15

CO	**Course Outcomes**
CO1	Understand use of bra-ket vector notation and explain the meaning of complete orthonormal set of basis vectors, and transformations and be able to apply them.
CO2	Able to understand analytic functions, do complex integration, by applying Cauchy Integral Formula. Able to compute many real integrals and infinite sums via complex integration.
CO3	Analyze characteristics of matrices and their different types, and the process of diagonalization.
CO4	Solve equations using Laplace transform and analyze the Fourier transformations of different function, grasp how these transformations can speed up analysis and correlate their importance in technology.
CO5	To find the solutions for physical problems using linear differential equations and to solve boundary value problems using Green's function. Apply special functions in computation of solutions to real world problems.
Textbooks:	
1	George Arfken and Hans J Weber, 2012, Mathematical Methods for Physicists–A Comprehensive Guide (7th edition), Academic press.
2	P.K. Chattopadhyay, 2013, Mathematical Physics (2nd edition), New Age, New Delhi.
3	Satyaprakash, Mathematical Physics -Sultan Chand & sons, New Delhi, 2016.
4	B.D. Gupta, Mathematical Physics (4th edition) 2009, Vikas Publishing House, New Delhi.
5	K. Dass and Dr. Rama Verma, Mathematical Physics, 2014, Seventh Revised Edition, S. Chand & Company Pvt. Ltd., New Delhi.
Reference Books:	
1	E. Kreyszig, 1983, Advanced Engineering Mathematics, Wiley Eastern, New Delhi.
2	D. G. Zill and M. R. Cullen, 2006, Advanced Engineering Mathematics, 3rd Ed. Narosa, New Delhi.
3	S. Lipschutz, 1987, Linear Algebra, Schaum's Series, McGraw - Hill, New York 3. E. Butkov, 1968, Mathematical Physics Addison - Wesley, Reading, Massachusetts.
4	P. R. Halmos, 1965, Finite Dimensional Vector Spaces, 2nd Edition, Affiliated EastWest, New Delhi.
5	C. R. Wylie and L. C. Barrett, 1995, Advanced Engineering Mathematics, 6th Edition, International Edition, McGraw-Hill, New York.

Web resources:	
1	www.khanacademy.org
2	https://youtu.be/LZnRlOA1_2I
3	http://hyperphysics.phy-astr.gsu.edu/hbase/hmat.html#hmath
4	https://www.youtube.com/watch?v=_2jymuM7OUU&list=PLhkiT_RYTEU27vS_SlED56gNjVJGO2qaZ
5	https://archive.nptel.ac.in/courses/115/106/115106086/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	2	3	3	3
CO2	2	3	3	3	3	3	3	2	3	3	3
CO3	3	3	3	2	2	3	3	2	3	3	3
CO4	3	3	3	3	2	3	3	2	3	3	3
CO5	3	2	3	3	2	3	3	2	3	3	3
Total	13	14	15	14	12	15	15	10	15	15	15
Average	**2.6**	**2.8**	**3**	**2.8**	**2.4**	**3**	**3**	**2**	**3**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC12	CLASSICAL MECHANICS AND RELATIVITY	Core	5	1	0	0	4	6	25	75	100

Learning Objectives

LO1	To understand fundamentals of Classical Mechanics.
LO2	To understand Lagrangian formulation of mechanics and apply it to solve equation of motion.
LO3	To understand Hamiltonian formulation of mechanics and apply it to solve equation of motion.
LO4	To discuss the theory of small oscillations of a system.
LO5	To learn the relativistic formulation of mechanics of a system.

Unit	Content	Hours
1	Mechanics of a single particle – mechanics of a system of particles – conservation laws for a system of particles – constraints – holonomic & non-holonomic constraints – generalized coordinates – configuration space – transformation equations – principle of virtual work.	15
2	D'Alembert's principle – Lagrangian equations of motion for conservative systems – applications: (i) simple pendulum (ii) Atwood's machine (iii) projectile motion.	15
3	Phase space – cyclic coordinates – conjugate momentum – Hamiltonian function – Hamilton's canonical equations of motion – applications: (i) simple pendulum (ii) one dimensional simple harmonic oscillator (iii) motion of particle in a central force field.	15
4	Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – linear triatomic molecule.	15
5	Inertial and non-inertial frames – Lorentz transformation equations – length contraction and time dilation – relativistic addition of velocities – Einstein's mass-energy relation – Minkowski's space – four vectors – position, velocity, momentum, acceleration and force in for vector notation and their transformations.	15

CO	Course Outcomes
CO1	Understand the fundamentals of classical mechanics.
CO2	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.
CO3	Students learn about motion of a particle under central force field.
CO4	Analyze the small oscillations in systems and determine their normal modes of oscillations.
CO5	Understand and apply the principles of relativistic kinematics to the mechanical systems.
Textbooks:	
1	H. Goldstein, 2002, Classical Mechanics, 3rd Edition, Pearson Edu.
2	J. C. Upadhyaya, Classical Mechanics, Himalaya Publishing. Co. New Delhi.
3	R. Resnick, 1968, Introduction to Special Theory of Relativity, Wiley Eastern, New Delhi.
4	R. G. Takwala and P.S. Puranik, Introduction to Classical Mechanics –Tata – McGraw Hill, New Delhi, 1980.
5	N. C. Rana and P.S. Joag, Classical Mechanics - Tata McGraw Hill, 2001
Reference Books:	
1	K. R. Symon, 1971, Mechanics, Addison Wesley, London.
2	S. N. Biswas, 1999, Classical Mechanics, Books & Allied, Kolkata.
3	Gupta and Kumar, Classical Mechanics, KedarNath.
4	T.W.B. Kibble, Classical Mechanics, ELBS.
5	Greenwood, Classical Dynamics, PHI, New Delhi.
Web resources:	
1	http://poincare.matf.bg.ac.rs/~zarkom/Book_Mechanics_Goldstein_Classical_Mechanics_optimized.pdf
2	https://pdfcoffee.com/classical-mechanics-j-c-upadhyay-2014-editionpdf-pdf-free.html
3	https://nptel.ac.in/courses/122/106/122106027/
4	https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecturenotes/
5	https://www.britannica.com/science/relativistic-mechanics

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	2	3	3	3	3
CO2	2	3	3	3	2	2	2	3	2	3	3
CO3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	2	2	2	3	3	3	3
CO5	2	3	3	3	2	2	2	3	3	2	3
Total	10	15	15	15	10	10	10	15	14	14	15
Average	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**2.8**	**2.8**	**3**

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHP13P	**Linear and Digital ICs and Applications**	P	0	0	5	0	3	5	25	75	100

Learning Objectives

LO1	To observe the applications of FET and UJT.
LO2	To study the different applications of operational amplifier circuits.
LO3	To learn about Combinational Logic Circuits and Sequential Logic Circuits
LO4	To study the applications of Timer IC
LO5	Exposure to digital ICs

Unit	Content	Hours
	(Minimum of Ten Experiments from the list) 1. Construction of (a) Relaxation oscillator using UJT (2N2646), (b) FET as amplifier using (BFW10/BFW11) - Frequency response curve. 2. To study (a) The important electrical characteristics of IC 741 (i/p and o/p impedance, Voltage Gain, CMRR). (b) V-I Characteristics of different colours of LED. 3. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp. 4. Study of attenuation characteristics of phase shift network and design of phase shift oscillator using Op-Amp. 5. Construction of Schmidt triggers circuit using IC 741 for a given hysteresis (both AC & DC Mode) - Application as squarer. 6. Construction of square wave and triangular wave generator using IC741 7. Construction of pulse generator using the IC741–Application as frequency Divider Study of (a) Arithmetic operations using IC 7483- 4-bit binary addition & subtraction and (b) Arithmetic Logic Unit using IC 74181. 8. Construction of current to voltage and voltage to current conversion using IC741. 9. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193 10. Construction of Schmidt trigger circuit using IC 555 for a given hysteresis (both AC & DC Mode)– Application as Squarer 11. Construction of pulse generator using the IC 555–Application as frequency divider	60

	12. Study of 4-bit binary Up / Down counters, Ring counter and Johnson counter- IC 7476/IC 7473 13. IC 7490 as scalar /Modulus counter and seven segment display using IC 7447 / IC 7448 14. Solving simultaneous equations – IC 741/ IC LM 324 15. Op-Amp–Active filters: Butter worth filter Low pass, High pass and band pass filters (2ndorder) 16. Construction of Op-Amp-4-bit D/A converter (Binary weighted and R-2R Ladder type) 17. Construction of square wave generator using IC 555–Study of VCO 18. Study of asynchronous parallel 4-bit binary Up/Down counter using IC 7493 19. Construction of multiplexer and demultiplexer using ICs.	

CO	**Course Outcomes**
CO1	Understand the applications of FET and UJT.
CO2	Apply the applications of operational amplifier circuits.
CO3	Analysis the Combinational Logic Circuits and Sequential Logic Circuits
CO4	Understand the apply the applications of Timer IC
CO5	Analysis the digital ICs
Textbooks:	
1	R.Srinivasan K.R Priolkar, Kit Developed for doing experiments in PhysicsInstruction manual, Indian Academy of Sciences.
2	S. Poornachandra, B.Sasikala,Electronic Laboratory Primer a design approach, Wheeler Publishing, New Delhi.
3	K ANavas Electronic lab manual Vol I, Rajath Publishing.
4	K ANavas, Electronic lab manual Vol II, PHI eastern Economy Edition
Reference Books:	
1	Ramakanth A Gaykwad, Op-Amp and linear integrated circuit, Eastern Economy Edition.
2	R.S. Sirohi, A course on experiment with He-Ne Laser, John Wiley & Sons (Asia) Pvt. Ltd.
3	Kuriachan T.D, Syam Mohan, Electronic lab manual Vol II, Ayodhya Publishing.

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	2	3	3	3	3
CO2	2	3	3	3	2	2	2	3	2	3	3
CO3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	2	2	2	3	3	3	3
CO5	2	3	3	3	2	2	2	3	3	2	3
Total	10	15	15	15	10	10	10	15	14	14	15
Average	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**2.8**	**2.8**	**3**

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHE11	**LINEAR AND DIGITAL ICs AND APPLICATIONS**	DSEC	4	0	1	0	3	5	25	75	100

Learning Objectives	
LO1	To introduce the basic building blocks of linear integrated circuits.
LO2	To teach the linear and non-linear applications of operational amplifiers.
LO3	To introduce the theory and applications of PLL.
LO4	To introduce the concepts of waveform generation and introduce one special function ICs.
LO5	Exposure to digital ICs

Unit	Content	Hours
1	Introduction, Classification of ICs, basic information of Op-Amp 741 and its features, the ideal Operational amplifier, Op-Amp internal circuit. Characteristics and parameters, Inverting and and Non-inverting amplifier, adder, subtraction, differentiator and Integrator.	12
2	**Linear Applications of Op-Amp:** Solution to simultaneous equations, Instrumentation amplifiers, V to I and I to V converters. **Non-Linear Applications of Op-Amp:** Sample and Hold circuit, Log and Antilog amplifier, Comparators, Schmitt trigger, Multivibrators, Triangular and Square waveform generators.	12
3	**Active Filters:** Introduction, Butterworth filters – 1st order, 2nd order low pass and high pass filters. **Timer And Phase Locked Loops:** Introduction to IC 555 timer, description of functional diagram, monostable and astable operations and applications, Schmitt trigger, PLL - introduction, basic principle, voltage-controlled oscillator (IC 566), applications of PLL	12
4	**Voltage Regulator:** Introduction, Series Op-Amp regulator, IC Voltage Regulators, Switching Regulator. **D To A And A To D Converters**: Introduction, basic DAC techniques - weighted resistor DAC, R-2R ladder DAC, A to D converters - counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.	12
5	**Cmos Logic:** CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates. **Combinational Circuits Using Ttl 74xx Ics**: Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483), Comparator (IC 7485), Decoder (IC 74138, IC 74154), BCD to 7-segment decoder (IC7447), Encoder (IC74147), Multiplexer (IC74151), Demultiplexer (IC 74154). **Sequential Circuits Using Ttl 74xx Ics:** Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194), 4-bit asynchronous binary counter (IC 7493).	12

CO	Course Outcomes
CO1	Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve problems.
CO2	Develop skills to design linear and non-linear applications circuits using Op-Amp and design the active filters circuits.
CO3	Gain knowledge about PLL, and develop the skills to design the simple circuits using IC 555 timer and can solve problems related to it.
CO4	Learn about various techniques to develop A/D and D/A converters.
CO5	Acquire the knowledge about the CMOS logic, combinational and sequential circuits.
Textbooks:	
1	D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt. Ltd., New Delhi, India
2	Ramakant A. Gayakwad, (2012), OP-AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, New Delhi.
3	V. Vijayendra, 2008, Introduction to Integrated electronics (Digital & Analog), S. Viswanathan Printers & Publishers Private Ltd, Reprint. V.
4	D. Roy Choudhary, Sheil B. Jani, "Linear Integrated Circuits", II edition, New Age, 2010.
5	David A. Bell, "Op-amp & Linear ICs", Prentice Hall of India, 5th edition, 1998.
Reference Books:	
1	B. L. Theraja and A. K. Theraja, 2004, A textbook of electrical technology, S. Chand & Co
2	V. K. Mehta and Rohit Mehta, 2008, Principles of Electronics, S. Chand & Co, 12th Edition.
3	Malvino and Leach (2005), Digital Principles and Applications 5th Edition, Tata McGraw Hill, New Delhi.
4	Floyd, Jain (2009), Digital Fundamentals, 8th edition, Pearson Education, New Delhi.
5	Integrated Electronics, Millman & Halkias, Tata McGraw Hill, 17th Reprint (2000).
Web resources:	
1	https://nptel.ac.in/course.html/digital circuits/
2	https://nptel.ac.in/course.html/electronics/operational amplifier/
3	https://www.allaboutcircuits.com/textbook/semiconductors/chpt-7/field-effectcontrolled-thyristors/
4	https://www.electrical4u.com/applications-of-op-amp/
5	https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	3	3	3	3	3
CO2	3	3	3	3	1	3	3	3	2	3	3
CO3	3	3	3	3	1	3	3	3	3	3	3
CO4	3	3	3	3	1	3	3	3	3	3	3
CO5	3	3	3	2	1	1	2	3	3	2	2
Total	15	15	15	14	6	12	14	15	14	14	14
Average	**3**	**3**	**3**	**2.8**	**1.2**	**2.4**	**2.8**	**3**	**2.8**	**2.8**	**2.8**

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHE12	CRYSTAL GROWTH AND THIN FILMS	ELE - II	4	0	1	0	3	5	25	75	100

Learning Objectives	
LO1	To acquire the knowledge on Nucleation and Kinetics of crystal growth.
LO2	To understand the Crystallization Principles and Crystal Growth techniques.
LO3	To study various methods of Crystal growth techniques.
LO4	To understand the thin film deposition methods.
LO5	To understand the different characterization techniques.

Unit	Content	Hours
1	Introduction to crystal growth – Solubility – Unsaturation - Saturation – Supersaturation –Metastable Zone width – Nucleation – homogeneous and heterogeneous nucleation – Classical theory of nucleation: Gibbs Thomson equation for Vapour - Gibbs Thomson equation for solution – Energy of formation of a nucleus – Spherical nucleus – Cylindrical nucleus – Cap-Shaped nucleus - BCF theory.	12
2	Crystal Growth Mechanisms – Solid phase – Liquid Phase and Vapour Phase crystal growth - Bridgman technique - Czochralski method – zone melting - Skull Melting process - Verneuil technique –Methods of Crystallization: Slow cooling method – Slow evaporation method – Temperature gradient method - Gel growth – Vapour growth: PVD – CVD – Epitaxial Techniques: LPE - MOCVD – MBE – Hydrothermal Growth.	12
3	Symmetry operations, elements – Combination of symmetry elements (Point group) –Symmetry properties of the energy function – Common crystal structures – Voids in close packing - Pauling‘s rule - Defects in crystals – Polycrystalline - Amorphous - Polymorphism.	12
4	Thin Films – Basic of Thin films and Nanostructures: Chemical deposition – Spin coating – Electron beam gun - Spray pyrolysis - Sputtering – RF Sputtering - Reactive Sputtering - Cathodic arc deposition - Pulsed Laser Deposition Technique - Ion implantation.	12
5	Powder X – Ray Diffraction (XRD) – Single crystal XRD – Laue pattern – Spectrometry: UV-Vis-NIR Spectrometer - Fourier transform Infrared analysis (FT-IR) – Elemental analysis: Nuclear Magnetic Resonance (NMR) – Elemental dispersive X-ray analysis (EDAX) - Scanning Electron Microscopy (SEM) – Transmission Electron Microscopy (TEM) – Atomic Force Microscopy (AFM) – Luminescence: Thermo Luminescence – Photoluminescence – Etching Studies (Chemical) – Micro hardness tests – Vickers – Brinells– TGA – DTA - Dielectric studies –SHG tests.	12

CO	Course Outcomes
CO1	Acquire the Basic Concepts, Nucleation and Kinetics of crystal growth.
CO2	Understand the Crystallization Principles and Growth techniques.
CO3	Study various methods of Crystal growth techniques.
CO4	Understand the Thin film deposition methods.
CO5	Apply the techniques of Thin Film Formation and thickness Measurement.
Textbooks:	
1	V. Markov Crystal growth for beginners: Fundamentals of Nucleation, Crystal Growth and Epitaxy (2004) 2nd edition
2	A. Goswami, Thin Film Fundamentals (New Age, New Delhi, 2008)
3	M. Ohora and R. C. Reid, "Modeling of Crystal Growth Rates from Solution"
4	D. Elwell and H. J. Scheel, "Crystal Growth from High Temperature Solution"
5	Heinz K. Henish, 1973, "Crystal Growth in Gels", Cambridge University Press. USA.
Reference Books:	
1	J.C. Brice, Crystal Growth Process (John Wiley, New York, 1986)
2	P. Ramasamy and F. D. Gnanam, 1983, "UGC Summer School Notes".
3	P. SanthanaRaghavan and P. Ramasamy, "Crystal Growth Processes", KRU Publications.
4	H.E. Buckley, 1951, Crystal Growth, John Wiley and Sons, New York
5	B.R. Pamplin, 1980, Crystal Growth, Pergman Press, London.
Web resources:	
1	https://www.youtube.com/playlist?list=PLbMVogVj5nJRjLrXp3kMtrIO8kZl1D1Jp
2	https://www.youtube.com/playlist?list=PLFW6lRTa1g83HGEihgwcy7KeTLUuBu3WF
3	https://www.youtube.com/playlist?list=PLADLRin7kNjG1Dlna9MDA53CMKFHPSi9m
4	https://www.youtube.com/playlist?list=PLXHedI-xbyr8xIl_KQFs_R_oky3Yd1Emw
5	https://www.electrical4u.com/thermal-conductivity-of-metals/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	3	2	2	3	2	1
CO2	3	3	1	3	1	2	3	2	3	3	1
CO3	3	2	1	3	1	2	3	3	3	2	1
CO4	3	2	1	2	1	2	3	3	3	2	1
CO5	2	3	3	3	1	3	3	3	2	3	3
Total	14	12	7	13	5	12	14	13	14	12	7
Average	**2.8**	**2.4**	**1.4**	**2.6**	**1**	**2.4**	**2.8**	**2.6**	**2.8**	**2.4**	**1.4**

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHA11	**SOLAR ENERGY UTILIZATION**	**AEC**	1	1	0	0	2	2	25	75	100

Learning Objectives

LO1	To impart fundamental aspects of solar energy utilization.
LO2	To give adequate exposure to solar energy related industries.
LO3	To harness entrepreneurship skills.
LO4	To understand the different types of solar cells and channelizing them to the different sectors of society.
LO5	To develop an industrialist mindset by utilizing renewable source of energy.

Unit	Content	Hours
1	Conduction, Convection and Radiation – Solar Radiation at the earth's surface - Determination of solar time – Solar energy measuring instruments.	6
2	Physical principles of conversion of solar radiation into heat flat plate collectors - General characteristics – Focusing collector systems – Thermal performance evaluation of optical loss.	6
3	Types of solar water heater - Solar heating system – Collectors and storage tanks – Solar ponds – Solar cooling systems.	6
4	Photo Voltaic principles – Types of solar cells – Crystalline silicon/amorphous silicon and Thermo - electric conversion – process flow of silicon solar cells- different approaches on the process texturization, diffusion, Antireflective coatings, metallization.	6
5	Use of nanostructures and nanomaterials in fuel cell technology - high and low temperature fuel cells, cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts. Use of Nano technology in hydrogen production and storage. Industrial visit – data collection and analysis – presentation.	6

CO	Course Outcomes
CO1	Gained knowledge in fundamental aspects of solar energy utilization
CO2	Equipped to take up related job by gaining industry exposure.
CO3	Develop entrepreneurial skills.
CO4	Skilled to approach the needy society with different types of solar cells.
CO5	Gained industrialist mindset by utilizing renewable source of energy.
Textbooks:	
1	Solar energy utilization -G.D. Rai –Khanna publishers – Delhi 1987.
2	Maheshwar Sharon, Madhuri Sharon, Carbon "Nano forms and Applications", Mc Graw-Hill, 2010.
3	Soteris A. Kalogirou, Solar Energy Engineering: Processes and Systems", 92
4	Tiwari G.N, "Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002
5	Sukhatme S.P. Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
Reference Books:	
1	Energy – An Introduction to Physics – R.H.Romer, W.H.Freeman.(1976)
2	Solar energy thermal processes – John A.Drife and William. (1974)
3	John W. Twidell& Anthony D.Weir, 'Renewable Energy Resources,2005
4	John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes, 4th Edition, john Wiley and Sons, 2013
5	Edition, john Wiley and Sons, 2013 5. Duffie, J.A., Beckman, W.A. , "Solar Energy Thermal Process", John Wiley and Sons,2007.
Web resources:	
1	https://pdfs.semanticscholar.org/63a5/a69421b69d2ce9f359bbfc86c63556f9a4fb
2	https://books.google.vg/books?id=l-XHcwZo9XwC&sitesec=buy&source=gbs_vpt_read
3	www.nptel.ac.in/courses/112105051
4	www.freevideolectures.com
5	http://www.e-booksdirectory

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	2	2	1	2	2	2
CO2	2	3	3	2	2	2	2	1	2	2	2
CO3	2	3	2	2	2	2	2	2	2	2	2
CO4	1	3	2	3	2	3	2	2	2	2	2
CO5	2	3	2	2	2	2	2	2	2	2	2
Total	9	15	12	11	10	11	10	8	10	10	10
Average	1.8	3	2.4	2.2	2	2.2	2	1.6	2	2	2

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PCHR101	**HUMAN RIGHTS**	COMPULSORY	1	1	0	0	2	2	25	75	100

Learning Objectives	
LO1	To provide a comprehensive idea of English literature and language over the ages
LO2	To help student trace English literature dating from seventh century to present era
LO3	To help them to understand the structural development of the English language
LO4	To inform them about the various external linguistic influences
LO5	To create the ability of critically examining a text

Unit	Content	Hours
1	Human rights- Concepts and Nature	6
2	Human Rights – The International Perspective International human rights	6
3	Regional Human Rights	6
4	Human Rights in India	6
5	Human Right Violations and Redressal Mechanism	6

CO	Course Outcomes
CO1	The student will be able to know the nature of human rights its origin, the theories, the movements in the march of human rights and the facets of future of human rights.
CO2	The student will be able to know the international dimension of human rights, the role of UN and the global effort in formulating conventions and declarations
CO3	The student will be able to Perceive the regional developments of human rights in Europe, Africa and Asia and the enforceable value of human rights in international arena.
CO4	The student will be able to have knowledge on the human rights perspectives in India, more developed by its constitution and special legislations
CO5	The student will be able to know the redressal mechanism made available in case of human rights violation confined to India.

Textbooks:	
1	Human Rights Lalit Parmar, Anmol Publications Pvt. Limited, 1998
2	Alston, Philip, And Frederic Megret, Eds. The United Nations And Human Rights: A Critical Appraisal. Second Edition. Oxford University Press, 2014.
3	Rebecce Wallace, International Human Rights, Text And Materials 1997
4	Human Rights Bharatiya Values, Mandagadde Rama Jois, Bharatiya Vidya Bhavan, 2015
5	G S Bhargave and R M Pal Human Rights of Dalit Societal Violation 1999

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	3	3	3	2
CO2	2	3	3	2	2	3	2	2	2	3	2
CO3	3	3	2	2	3	2	3	2	3	2	2
CO4	3	3	3	3	2	3	3	2	3	2	2
CO5	3	2	3	3	3	3	2	2	2	3	3
Total	14	14	14	13	13	13	13	11	13	13	11
Average	**2.8**	**2.8**	**2.8**	**2.6**	**2.6**	**2.6**	**2.6**	**2.2**	**2.6**	**2.6**	**2.2**

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC21	**STATISTICAL MECHANICS**	Core	5	0	0	0	4	5	25	75	100

Learning Objectives	
LO1	To acquire the knowledge of thermodynamic potentials and to understand phase transition in thermodynamics
LO2	To identify the relationship between statistic and thermodynamic quantities
LO3	To comprehend the concept of partition function, canonical and grand canonical ensembles
LO4	To grasp the fundamental knowledge about the three types of statistics
LO5	To get in depth knowledge about phase transitions and fluctuation of thermodynamic properties that vary with time

Unit	Content	Hours
1	Phase transitions - Conditions for phase equilibrium - Clausius Clayperon equation - Gibbs Phase rule - order parameters - Landau theory - critical indices. Thermodynamic potentials, Maxwells relations, chemical potential -Phase Equilibrium - Gibb's phase rule - Phase transitions and Ehrenfest's classifications – Third law of Thermodynamics. Order parameters – Landau's theory of phase transition –critical indices – scale transformation and dimensional analysis.	15
2	Foundations of statistical mechanics –- micro and macro states of a system - Micro canonical ensemble - Phase space – Entropy - Connection between statistics and thermodynamics – Entropy of an ideal gas using the micro canonical ensemble - Entropy of mixing and Gibb's paradox.	15
3	Trajectories and density of states - Liouville's theorem – Canonical and grand canonical ensembles - canonical distribution - Partition function - Calculation of statistical quantities - Energy and density fluctuations.	15
4	Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Postulates of classical Statistics - Maxwell-Boltzmann statistics - Postulates of quantum statistics Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics – Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.	15
5	Cluster expansion for a classical gas - Virial equation of state – Calculation of the first Virial coefficient in the cluster expansion - Ising model – definition - Mean-field theories of the Ising model in three, two and one dimensions - Exact solutions in one dimension. Correlation of space-time dependent fluctuations - Fluctuations and transport phenomena - Brownian motion - Langevin's theory – Fluctuation dissipation theorem - The Fokker-Planck equation	15

CO	Course Outcomes
CO1	To examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition
CO2	To analyze the macroscopic properties such as pressure, volume, temperature, specific heat, elastic moduli etc. using microscopic properties like intermolecular forces, chemical bonding, atomicity etc. Describe the peculiar behaviour of the entropy by mixing two gases Justify the connection between statistics and thermodynamic quantities
CO3	Differentiate between canonical and grand canonical ensembles and to interpret the relation between thermodynamical quantities and partition function
CO4	To recall and apply the different statistical concepts to analyze the behaviour of ideal Fermi gas and ideal Bose gas and also to compare and distinguish between the three types of statistics
CO5	To discuss and examine the thermodynamical behaviour of gases under fluctuation and also using Ising model
Textbooks:	
1	S. K. Sinha, 1990, Statistical Mechanics, Tata McGraw Hill, New Delhi.
2	Sathya Prakash and J.P Agarwal, Statistical Mechanics, 7th Edition, Kedar Nath and Ram Nath& Co, Meerut, 1994
3	B. K. Agarwal and M. Eisner, 1998, Statistical Mechanics, Second Edition New Age International, New Delhi.
4	J. K. Bhattacharjee, 1996, Statistical Mechanics: An Introductory Text, Allied Publication, New Delhi.
5	F. Reif, 1965, Fundamentals of Statistical and Thermal Physics, McGraw -Hill, New York.
Reference Books:	
1	R. K. Pathria, 1996, Statistical Mechanics, 2nd edition, Butter Worth Heinemann, New Delhi.
2	L. D. Landau and E. M. Lifshitz, 1969, Statistical Physics, Pergamon Press, Oxford
3	K. Huang, 2002, Statistical Mechanics, Taylor and Francis, London
4	M. K. Zemansky, 1968, Heat and Thermodynamics, 5th edition, McGraw-Hill New York.
5	W. Greiner, L. Neiseand H.Stoecker, Thermodynamics and Statistical Mechanics, Springer Verlang, New York.
Web resources:	
1	https://byjus.com/chemistry/third-law-of-thermodynamics/
2	https://web.stanford.edu/~peastman/statmech/thermodynamics
3	https://en.wikiversity.org/wiki/Statistical_mechanics_and_thermodynamics
4	https://en.wikipedia.org/wiki/Grand_canonical_ensemble
5	https://en.wikipedia.org/wiki/Ising_model

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	2	3	1	3	3	3
CO2	3	3	3	1	1	2	3	1	3	3	3
CO3	3	3	3	1	1	2	3	2	3	3	3
CO4	3	3	3	1	1	2	3	2	3	3	3
CO5	3	3	3	1	1	2	3	1	3	3	3
Total	15	15	15	5	5	10	15	7	15	15	15
Average	3	3	3	1	1	2	3	1.4	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC23	**Quantum Mechanics -I**	CC	5	0	0	0	4	5	25	75	100

Learning Objectives	
LO1	To develop the physical principles and the mathematical background important to quantum mechanical descriptions.
LO2	To describe the propagation of a particle in a simple, one-dimensional potential.
LO3	To formulate and solve the Schrodinger's equation to obtain eigenvectors and energies for particle in a three-dimensional potential.
LO4	To explain the mathematical formalism and the significance of constants of motion, and see their relation to fundamental symmetries in nature.
LO5	To discuss the Approximation methods like perturbation theory, Variational and WKB methods forsolving the Schrödinger equation.

Unit	Content	Hours
1	Interpretation of the wave function – Time dependent Schrodinger equation – Time independent Schrodinger equation – Stationary states – Ehrenfest's theorem – Linear vector space – Linear operator – Eigen functions and Eigen Values – Hermitian Operator – Postulates of Quantum Mechanics – Uncertainty relation.	15
2	Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier – Alpha emission – square–well periodic potential – Linear harmonic oscillator: Operator method – Particle moving in a spherically symmetric potential – System of two interacting particles – Hydrogen atom – Rigid rotator.	15
3	Dirac notation – Equations of motions – Schrodinger representation – Heisenberg representation – Interaction representation – Coordinate representation – Momentum representation – Symmetries and conservation laws – Unitary transformation.	15
4	Time independent perturbation theory for non-degenerate energy levels – Degenerate energy levels – Stark effect in Hydrogen atom – Ground and excited state – Variation method – Helium atom – WKB approximation - WKB quantization – Application to simple harmonic oscillator.	15
5	Eigen value spectrum of general angular momentum – Ladder operators–Matrix representation–Spin angular momentum–Addition of angular momenta–CG Coefficients–Symmetry and anti–symmetry of wave functions–Pauli's exclusion principle.	15

CO	Course Outcomes
CO1	Demonstrates a clear understanding of the basic postulates of quantum mechanics which serve to formalize the rules of quantum Mechanics.
CO2	Is able to apply and analyze the Schrodinger equation to solve one dimensional problems and three dimensional problems.
CO3	Can discuss the various representations, space time symmetries and formulations of time evolution.
CO4	Can formulate and analyze the approximation methods for various quantum mechanical problems.
CO5	To apply non-commutative algebra for topics such as angular and spin angular momentum and hence explain spectral line splitting.
Textbooks:	
1	P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, 2nd edition(37th Reprint),Tata McGraw-Hill, New Delhi, 2010.
2	G. Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 2009.
3	David J Griffiths, Introduction to Quantum Mechanics. 4th edition, Pearson, 2011.
4	SL Gupta and ID Gupta Advanced Quantum Theory and Fields, 1st Edition, S. Chand & Co., New Delhi, 1982.
5	Sathya prakash & Swati saluja, Quantum Mechanics edition 2013.
Reference Books:	
1	E. Merzbacher, Quantum Mechanics, 2nd Edition, John Wiley and Sons, New York, 1970
2	V. K. Thankappan, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, NewDelhi, 1985
3	L. D. Landau and E. M. Lifshitz, Quantum Mechanics, 1st edition, Pergomon Press, Oxford, 1976.
4	S. N. Biswas, Quantum Mechanics, Books and Allied Ltd., Kolkata, 1999.
5	V. Devanathan, Quantum Mechanics, 2nd edition, Alpha Science International Ltd, Oxford , 2011.
Web resources:	
1	www.its.caltec.edu/feyman/plenty.html
2	http://www.library.ualberta.ca/subject/nanoscience/guide/index.cfm
3	http://www.understandingnano.com
4	http://www.nano.gov
5	http://www.nanotechnology.com

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	3	3	3
CO2	3	3	3	3	3	3	3	2	3	3	3
CO3	2	3	3	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	2	3	3	3	3	3	3	3
Total	14	15	15	13	15	12	15	12	15	15	15
Average	2.8	3	3	2.6	3	2.4	3	2.4	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC24	**Electromagnetic Theory**	CC	5	0	0	0	4	5	25	75	100

Learning Objectives	
LO1	To acquire knowledge about boundary conditions between two same media or different media and the technique of method of separation of variables
LO2	To understand Biot – Savart's law , Ampere's circuital law and Magnetic induction
LO3	To comprehend the physical ideas contained in Maxwell's equations, Coulomb & Lorentz gauges, conservation laws
LO4	To assimilate the concepts of propagation, polarization, reflection and refraction of electromagnetic waves
LO5	To grasp the concept of plasma as the fourth state of matter and Debye shielding

Unit	Content	Hours
1	Boundary value problems and Laplace equation – Boundary conditions and uniqueness theorem – Laplace equation in three dimension – Solution in Cartesian and spherical polar coordinates – Examples of solutions for boundary value problems. Polarization, polarization vector, relation between poarisation vector and Electric field , displacement vectors - Boundary conditions – Dielectric sphere in a uniform field – Molecular polarizability and electrical susceptibility – Electrostatic energy in the presence of dielectric – Multipole expansion	15
2	Biot-Savart's Law - Ampere's law - Magnetic vector potential and magnetic field of a localized current distribution - Magnetic moment, force and torque on a current distribution in an external field - Magneto static energy - Magnetic induction and magnetic field in macroscopic media – Boundary conditions - Uniformly magnetized sphere.	15
3	Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations - Vector and scalar potentials - Gauge invariance - Wave equation and plane wave solution- Coulomb and Lorentz gauges - Energy and momentum of the field - Poynting's theorem –conservation of energy - Lorentz force in the resence of electric field and magnetic field- Conservation laws for a system of charges and electromagnetic fields.	15
4	Plane waves in non-conducting media - Linear and circular polarization, reflection and refraction at a plane interface - Waves in a conducting medium - Propagation of waves in a rectangular wave guide. Inhomogeneous wave equation and retarded potentials - Radiation from a localized source - Oscillating electric dipole	15
5	The Boltzmann Equation - Simplified magneto-hydrodynamic equations-Electron plasma oscillations - The Debye shielding problem – Plasma confinement in a magnetic field - Magneto-hydrodynamic waves – Alfven waves and magnetosonic waves.	15

CO	Course Outcomes
CO1	Solve the differential equations using Laplace equation three dimensional as well as one dimension and to find solutions for boundary value problems
CO2	Use Biot-Savart's law and Ampere circuital law to find the magnetic induction & magnetic vector potential for various physical problems
CO3	Apply Maxwell's equations to describe how electromagnetic field behaves in different media for example isotropic, dielectric and medium
CO4	Apply the concept of propagation of EM waves through wave guides in optical fiber communications and also in radar installations, calculate the transmission and reflection coefficients of electromagnetic waves and retarded potentials
CO5	Investigate the interaction of ionized gases with self-consistent electric and magnetic fields
Textbooks:	
1	D.J.Griffiths, Introduction to Electrodynamics, 2002, 3rd Edition, Prentice-Hall of India, New Delhi.
2	J. R. Reitz, F. J. Milford and R. W. Christy, 1986, Foundations of Electromagnetic Theory, 3rd edition, Narosa Publishing House, New Delhi.
3	B. Chakraborty, 2002, Principles of Electrodynamics, Books and Allied, Kolkata
4	P. Feynman, R. B. Leighton and M. Sands, 1998, The Feynman Lectures on Physics, Vols. 2, Narosa Publishing House, New Delhi.
5	Andrew Zangwill, 2013, Modern Electrodynamics, Cambridge University Press, USA.
Reference Books:	
1	W. Panofsky and M. Phillips, 1962, Classical Electricity and Magnetism, Addison Wesley, London.
2	J. D. Kraus and D. A. Fleisch, 1999, Electromagnetics with Applications, 5th Edition, WCB McGraw-Hill, New York
3	L. D. Landau and E. M. Lifshitz, Quantum Mechanics, 1st edition, Pergomon Press, Oxford, 1976.
4	S. N. Biswas, Quantum Mechanics, Books and Allied Ltd., Kolkata, 1999.
5	V. Devanathan, Quantum Mechanics, 2nd edition, Alpha Science International Ltd, Oxford , 2011.
Web resources:	
1	http://www.plasma.uu.se/CED/Book/index.html
2	http://www.thphys.nuim.ie/Notes/electromag/frame-notes.html
3	http://www.thphys.nuim.ie/Notes/em-topics/em-topics.html
4	http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/
5	https://www.cliffsnotes.com/study-guides/physics/electricity-andmagnetism/electrostatics

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	3	3	3
CO2	3	3	3	3	3	3	3	2	3	3	3
CO3	2	3	3	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	2	3	3	3	3	3	3	3
Total	14	15	15	13	15	12	15	12	15	15	15
Average	2.8	3	3	2.6	3	2.4	3	2.4	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC22P	**Practical II - General Experiments**	CC - P	0	0	5	0	3	5	25	75	100

Learning Objectives

LO1	To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations. To calculate the thermodynamic quantities and physical properties of materials. To analyze the optical and electrical properties of materials
LO2	To describe the propagation of a particle in a simple, one-dimensional potential.
LO3	To understand the working of LASER light
LO4	Learn the principles of magneto-optic and electro-optic effects and its applications.
LO5	To impart an extensive understanding of fiber and non-linear optics.

Unit	Content	Hour
1	**(Minimum of Eight Experiments from the list)** 1. Determination of Young's modulus by Hyperbolic fringes-Cornu's Method 2. Determination of Young's modulus by Elliptical fringes - Cornu's Method 3. Determination of Viscosity of the given liquid – Meyer's disc 4. Measurement of Coefficient of linear expansion- Air wedge Method 5. Determination of Rydberg's Constant - Hydrogen Spectrum 6. Thickness of air film - FP Etalon 7. Measurement of Band gap energy- Thermistor 8. Determination of Specific charge of an electron – Thomson's method. 9. Determination of e/m - Millikan's method 10. Determination of Wavelength, Separation of wavelengths - Michelson Interferometer 11. Measurement of Resistivity/Conductivity - Four probe method. 12. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating. 13. Determination of Stefan's constant of radiation from a hot body 14. Measurement of Susceptibility of liquid - Quincke's method 15. Determination of Numerical Apertures and Acceptance angle of optical fibers using Laser Source. 16. Determination of I-V Characteristics and efficiency of solar cell	

CO	Course Outcomes
CO1	Understand the strength of material using Young's modulus
CO2	Acquire knowledge of thermal behavior of the materials
CO3	Understand theoretical principles of magnetism through the experiments.
CO4	Acquire knowledge about arc spectrum and applications of laser
CO5	Improve the analytical and observation ability in Physics Experiments
Textbooks:	
1	Gupta and Kumar, Practical Physics, Pragati Prakasan
2	R.Srinivasan K.R Priolkar, Kit Developed for doing experiments in Physics Instruction manual, Indian Academy of Sciences
Reference Books:	
1	D.Chattopadhayay, C.R. Rakshit, An advanced course in Practical Physics, New Central Book Agency Pvt. Ltd
2	S.P Singh, Advanced Practical Physics, Pragati Prakasan
3	R.S. Sirohi, A course on experiment with He-Ne Laser, John Wiley & Sons (Asia) Pvt.ltd.

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	3	3	3
CO2	3	3	3	3	3	3	3	2	3	3	3
CO3	2	3	3	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	2	3	3	3	3	3	3	3
Total	**14**	**15**	**15**	**13**	**15**	**12**	**15**	**12**	**15**	**15**	**15**
Average	**2.8**	**3**	**3**	**2.6**	**3**	**2.4**	**3**	**2.4**	**3**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHE21	**Advanced Optics**	DSEC	3	0	0	0	3	3	25	75	100

Learning Objectives	
LO1	To know the concepts behind polarization and could pursue research work on application aspects of laser.
LO2	To impart an extensive understanding of fiber and non-linear optics.
LO3	To study the working of different types of LASERS
LO4	To differentiate first and second harmonic generation.
LO5	Learn the principles of magneto-optic and electro-optic effects and its applications.

Unit	Content	Hours
1	**POLARIZATION AND DOUBLE REFRACTION:** Classification of polarization –Polarizer and analyzer – Malus law – Production of polarized light – Polaroid – Polarization by reflection – Polarization by double refraction – Polarization by scattering – The phenomenon of double refraction –Quarter and half wave plates – Analysis of polarized light – Optical activity.	12
2	**LASERS:** Basic principles –Spontaneous and stimulated emissions –Types of lasers and its applications –Solid state lasers– Ruby laser –Nd:YAG laser –gas lasers –He-Ne laser – CO2 laser – Chemical lasers – HCl laser – Semiconductor laser	12
3	**FIBER OPTICS:** Introduction – Total internal reflection – The optical fiber – Glass fibers – The coherent bundle – The numerical aperture – Attenuation in optical fibers – Single and multi-mode fibers – Pulse dispersion in multimode optical fibers – Ray dispersion in multimode step index fibers – Parabolic-index fibers.	12
4	**NON-LINEAR OPTICS :** Basic principles – Harmonic generation – Second harmonic generation – Phase matching – Optical mixing – Parametric generation of light – Self-focusing of light	12
5	**MAGNETOOPTICS AND ELECTRO-OPTICS:** Magneto-optical effects– Zeeman effect–Inverse Zeeman effect–Faraday effect –Voigt effect–Cotton-mouton effect –Kerr magneto-optic effect – Electro-optical effects–Stark effect– Inverse stark effect–Electric double refraction –Kerr electro-optic effect.	12

CO	Course Outcomes
CO1	Discuss the transverse character of light waves and different polarization phenomenon
CO2	Discriminate all the fundamental processes involved in laser devices and to analyze the design and operation of the devices
CO3	Demonstrate the basic configuration of a fiber optic – communication system and advantages.
CO4	Identify the properties of nonlinear interactions of light and matter
CO5	Interpret the group of experiments which depend for their action on an applied magnetics and electric field
Textbooks:	
1	B. B. Laud, 2017, Lasers and Non – Linear Optics, 3rd Edition, New Age International (P) Ltd.
2	Ajoy Ghatak, 2017, Optics, 6th Edition, McGraw – Hill Education Pvt. Ltd.
3	William T. Silfvast, 1996, Laser Fundamentals Cambridge University Press, New York
4	J. Peatros, Physics of Light and Optics, a good (and free!) electronic book
5	B. Saleh, and M. Teich, Fundamentals of Photonics, Wiley-Interscience
Reference Books:	
1	F. S. Jenkins and H. E. White, 1981, Fundamentals of Optics, (4th Edition), McGraw – Hill International Edition.
2	Dieter Meschede, 2004, Optics, Light and Lasers, Wiley – VCH, Varley GmbH
3	Lipson, S. G. Lipson and H. Lipson, 2011, Optical Physics, 4th Edition, Cambridge University Press, New Delhi, 2011
4	Y. B. Band, Light and Matter, Wiley and Sons (2006)
5	R. Guenther, Modern Optics, Wiley and Sons (1990)
Web resources:	
1	https://www.youtube.com/watch?v=WgzynezPiyc
2	https://www.youtube.com/watch?v=ShQWwobpW60
3	https://www.ukessays.com/essays/physics/fiber–optics–and–it-applications.php
4	https://www.youtube.com/watch?v=0kEvr4DKGRI
5	http://optics.byu.edu/textbook.a

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	3	3	3	3	3
CO2	3	3	3	2	3	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	15	15	12	15	15	15	15	15	15	15
Average	3	3	3	2.4	3	3	3	3	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHE22	**Physics of Nanoscience and Technology**	DSEC	4	0	1	0	3	4	25	75	100

Learning Objectives	
LO1	Physics of Nanoscience and Technology is concerned with the study, creation, manipulation and applications at nanometer scale.
LO2	To provide the basic knowledge about nanoscience and technology.
LO3	To learn the structures and properties of nanomaterials.
LO4	To acquire the knowledge about synthesis methods and characterization techniques.
LO5	To obtain the knowledge about the nanomaterials applications.

Unit	Content	Hours
1	**FUNDAMENTALS OF NANOSCIENCE AND TECHNOLOGY:** Introduction of Nanoscience and Nanotechnology, Historical Perspective on Nanomaterial and Nanotechnology - Nanomaterials and its applications – Classification of nanoscale dimensions: 0D, 1D, 2D - Quantum dots – Quantum wires – Quantum wells - Classification of Metals, Semiconductors, and Insulators.	12
2	**PROPERTIES OF NANOMATERIALS: Physical properties of Nanomaterials:** Melting points, specific heat capacity and lattice constant - **Mechanical behavior:** Elastic properties – strength – ductility - **Optical properties:** Surface Plasmon Resonance - **Electrical properties:** Conductivity, Ferroelectrics and dielectrics **Magnetic properties**: Diluted magnetic semiconductor (DMS).	12
3	**SYNTHESIS AND FABRICATION:** Physical vapour deposition - Chemical vapour deposition - sol-gel – Wet deposition techniques - Electrochemical deposition method – Plasma arching - Electrospinning method - Ball milling technique – Nanolithography - Photolithography.	12
4	**CHARACTERIZATION TECHNIQUES:** Powder X-ray diffraction – X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) - Scanning probe microscopy (SPM) - Scanning tunneling microscopy (STM) – Vibration sample magnetometer (VSM).	12
5	**APPLICATIONS OF NANOMATERIALS: Sensors:** Nanosensors – Different types of Nanosensors - **Nano Electronics:** Nanobots - Display screens - GMR read/write heads – Carbon Nanotube Emitters (CNT) – **Photocatalytic application:** Air purification, water purification - **Medicine**: Imaging of cancer cells – biological tags - drug delivery - photodynamic therapy - **Energy:** Batteries - Fuel Cells - Electrochemical Capacitors	12

CO	Course Outcomes
CO1	Understand the basic of nanoscience and explore the different types of nanomaterials and Should comprehend the surface effects of the nanomaterials.
CO2	Explore various physical, mechanical, optical, electrical and magnetic properties nanomaterials.
CO3	Understand the process and mechanism of synthesis and fabrication of nanomaterials.
CO4	Analyze the various characterization of Nano-products through diffraction, spectroscopic, microscopic and other techniques.
CO5	Apply the concepts of nanoscience and technology in the field of sensors, robotics, purification of air and water and in the energy devices.
Textbooks:	
1	A textbook of Nanoscience and Nanotechnology, Pradeep.T, Tata McGraw-Hill Publishing Co. (2012).
2	Principles of Nanoscience and Nanotechnology, M.A.Shah, Tokeer Ahmad, Narosa Publishing House Pvt Ltd., (2010).
3	Introduction to Nanoscience and Nanotechnology, K.K.Chattopadhyay and A.N.Banerjee, PHI Learning Pvt. Ltd., New Delhi, (2012).
4	Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, Academic Press, (2002).
5	Nanotechnology and Nanoelectronics, D.P.Kothari, V.Velmurugan and Rajit Ram Singh, Narosa Publishing House Pvt. Ltd, New Delhi. (2018).
Reference Books:	
1	Nanostructures and Nanomaterials– HuozhongGao–Imperial College Press (2004).
2	Richard Booker and Earl Boysen, (2005) Nanotechnology, Wiley Publishing Inc. USA
3	Nano particles and Nano structured films; Preparation, Characterization and Applications, J.H.Fendler John Wiley and Sons. (2007)
4	Textbook of Nanoscience and Nanotechnology, B.S.Murty, et al., Universities Press. (2012)
5	The Nanoscope (Encyclopedia of Nanoscience and Nanotechnology), Dr. Parag Diwan and Ashish Bharadwaj (2005) Vol. IV - Nanoelectronics Pentagon Press,New Delhi.
Web resources:	
1	www.its.caltec.edu/feyman/plenty.html
2	http://www.library.ualberta.ca/subject/nanoscience/guide/index.cfm
3	http://www.understandingnano.com
4	http://www.nano.gov
5	http://www.nanotechnology.com

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	3	3	3	3	3
CO2	3	3	3	2	1	1	3	3	3	3	3
CO3	3	3	2	2	1	1	3	3	3	3	2
CO4	3	3	3	2	1	1	3	3	3	3	3
CO5	3	3	2	2	1	1	3	3	3	3	2
Total	**15**	**15**	**13**	**10**	**5**	**5**	**15**	**15**	**15**	**15**	**13**
Average	**3**	**3**	**2.6**	**2**	**1**	**1**	**3**	**3**	**3**	**3**	**2.6**

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHS21	**Renewable Energy and Energy Harvesting**	SEC/ NM	2	0	0	0	2	2	25	75	100

Learning Objectives

LO1	To learn about alternate sources of energy.
LO2	To know the ways of effectively utilizing the solar energy.
LO3	To study the method of harvesting wind energy and ocean energy.
LO4	To learn the techniques useful for the conversion of hydro energy and piezo energy harvesting.
LO5	To know about utilization of electromagnetic energy harvesting.

Unit	Content	Hours
1	**Fossil fuels and Alternate Sources of energy**-Fossil fuels and nuclear energy, their limitation, need of renewable energy. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Thermal Energy Conversion, biomass, biochemical conversion, biogas generation, geo thermal energy.	6
2	**Solar energy**-Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems.	6
3	**Wind Energy harvesting**: Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid inter connection topologies. **Ocean Energy**: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass	6
4	**Hydro Energy**: Hydropower resources, hydropower technologies, environmental impact of hydro power sources, **Piezoelectric Energy harvesting**: Introduction characteristic, parameter of piezoelectricity, materials and mathematical description of piezoelectricity, modeling piezoelectric generators, Piezoelectric energy harvesting applications	6
5	**Electromagnetic Energy Harvesting**: Linear generators, physics mathematicalmodels,recentapplications-Carboncapturedtechnologies, cell, batteries, power consumption	6

CO	Course Outcomes
CO1	Explore the Principles, various types of renewable energy sources and technologies behind energy harvesting
CO2	Evaluate the economic factors influencing the adoption of renewable energy and energy harvesting, including cost-benefit analysis and return on investment.
CO3	Analyze the environmental benefits and challenges associated with different renewable energy technologies and energy harvesting methods.
CO4	Design integrated renewable energy systems that incorporate energy harvesting solutions for improved efficiency and sustainability.
CO5	Identify and analyze real-world applications of renewable energy and energy harvesting in various sectors, such as residential, commercial, and industrial.
Textbooks:	
1	Non-conventional energy sources-G. D Rai–Khanna Publishers ,New Delhi
2	Solar energy –MP Agarwal –S chand and Co.Ltd.
3	Solar energy - Suhas P Sukhative Tata Mc Graw-Hill Publishing Company Ltd.
4	Godfrey Boyle,"Renewable Energy ,Power for a sustainable future",2004, Oxford University Press, in association with the Open University.
5	Dr. P Jayakumar, Solar Energy: ResourceAssesmentHandbook,2009
Reference Books:	
1	Energy – An Introduction to Physics – R.H.Romer, W.H.Freeman.(1976)
2	Solar energy thermal processes – John A.Drife and William. (1974)
3	John W. Twidell& Anthony D.Weir, 'Renewable Energy Resources,2005
4	John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes, 4th Edition, john Wiley and Sons, 2013
5	Duffie, J.A., Beckman, W.A. , "Solar Energy Thermal Process", John Wiley and Sons,2007.
Web resources:	
1	https://pdfs.semanticscholar.org/63a5/a69421b69d2ce9f359bbfc86c63556f9a4fb
2	https://books.google.vg/books?id=l-XHcwZo9XwC&sitesec=buy&source=gbs_vpt_read
3	www.nptel.ac.in/courses/112105051
4	www.freevideolectures.com
5	http://www.e-booksdirectory.com

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	3	3	3	3	3
CO2	3	3	3	2	1	1	3	3	3	3	3
CO3	3	3	2	2	1	1	3	3	3	3	2
CO4	3	3	3	2	1	1	3	3	3	3	3
CO5	3	3	2	2	1	1	3	3	3	3	2
Total	15	15	13	10	5	5	15	15	15	15	13
Average	3	3	2.6	2	1	1	3	3	3	3	2.6

3 – Strong, 2- Medium, 1- Low