J.J. COLLEGE OF ARTS AND SCIENCE (Autonomous)

DEPARTMENT OF PHYSICS

M.Sc. PHYSICS

Proposed Course Structure based on UGC - LOCF and TANSCHE

(Choice Based Credit System)
(Applicable for the candidates admitted from academic year 2023-2024 onwards)

Sem	Course Code	Course Title	Ins. Hrs/ Week	Credit	Exam Hrs	Marks		
						Int.	Ext.	Total
I	P1R3PHCC1	Mathematical Physics	7	5	3	25	75	100
	P1R3PHCC2	Classical Mechanics	7	5	3	25	75	100
	P1R3PHCC3P	Practical-I(Covering CC1,CC2)	6	4	3	40	60	100
	P1R3PHDSE1 (1:1 / 1:2)	Physics of Nanoscience and Nanotechnology / Analysis of Crystal Structures	5	3	3	25	75	100
	P1R3PHDSE2 (2:1 / 2:2)	Advanced Optics / Biophysics	5	3	3	25	75	100
			30	**20**				**500**
II	P2R3PHCC4	Statistical Mechanics	6	5	3	25	75	100
	P2R3PHCC5	Quantum Mechanics-I	6	5	3	25	75	100
	P2R3PHCC6P	Practical-II(Covering CC4,CC5)	6	4	3	40	60	100
	P2R3PHDSE3 (3:1 / 3:2)	Linear and Digital Electronics IC's and Applications / Communication electronics	4	3	3	25	75	100
	P2R3PHDSE4 (4:1 / 4:2)	Microprocessor 8085 and Micro controller 8051 / Characterization of materials	4	3	3	25	75	100
	P2R3PHSEC1 (1:1 / 1:2)	Soil Waste Management(SWM) / Sewage and Waste water Management	4	2	3	25	75	100
			30	**22**				**600**

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III	P3R3PHCC7	Electromagnetic Theory	6	5	3	25	75	100
	P3R3PHCC8	Quantum Mechanics-II	6	5	3	25	75	100
	P3R3PHCC9	Condensed Matter of Physics	6	5	3	25	75	100
	P3R3PHCC10P	Practical–III (Covering CC7, CC9)	6	5	4	40	60	100
	P3R3PHDSE5 (5:1/5:2)	**Crystal growth and Thin films / Medical Physics.**	4	3	3	25	75	100
	P3R3PHDSEC2 (2:1/2:2)	**Solar energy utilization/ Thin Films Physics**	2	2	3	25	75	100
	P3R3PHINT	**Internship**	-	3	-	-	-	100
			30	**28**				**700**
IV	P4R3PHCC11	Spectroscopy	6	5	3	25	75	100
	P4R3PHCC12	Nuclear and Particle Physics	6	5	3	25	75	100
	P4R3PHCC13PW	Project Work	18	10	***	***	***	100
		Total	**30**	**20**				**300**
		GRAND TOTAL		**90**				**2100**

TITLE OF THE COURSE : MATHEMATICAL PHYSICS

CATEGORY : CORE COURSE

COURSE CODE : P1R3PHCC1

NATURE OF SKILL : SKILL DEVELOPMENT

MARKS : CIA:25 +EXT:75 =100 HOURS/WEEK :07

CREDITS : 05 TOTAL INST.HOURS :105

COURSEOBJECTIVES:

1.To understand the concept in vector analysis

2.To extend their manipulative skills to apply mathematical techniques in their fields

3.To enhance problem solving the skills in Matrices.

4.To enable students to formulate, Laplace and Fourier Transform .

5. To help students apply Mathematics in solving problems of Physics

UNIT-1:LINEAR VECTOR SPACE (Inst. Hrs : 21)

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

UNIT-2:COMPLEX ANALYSIS (Inst. Hrs : 21)

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 and coaxial cylinders (2) Heat problems - Parallel plates and coaxial cylinders

UNIT-3:MATRICES (Inst. Hrs : 21)

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

UNIT-4:FOURIER TRANSFORMS &LEPLACE TRANSFORMS (Inst. Hrs : 21)

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 ofheat in an infinite and in a semi - infinite medium.

Laplace transform and its inverse - Transforms of derivatives and integrals – Differentiation and integration of transforms - Dirac delta functions – Application,

UNIT-5:DIFFERENTIAL EQUATIONS **(Inst. Hrs : 21)**

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.

TEXT BOOKS

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. A W Joshi, 2017, Matrices and Tensors in Physics, 4th Edition (Paperback), New Age International Pvt. Ltd., India
4. B. D. Gupta, 2009, *Mathematical Physics* (4th edition), Vikas Publishing House, New Delhi.
5. H. K. Dass and Dr. Rama Verma, 2014, Mathematical Physics, 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 East West, New Delhi.
5. C. R. Wylie and L. C. Barrett, 1995, Advanced Engineering Mathematics, 6 th Edition, International Edition, McGraw-Hill, New York

WEB SOURCES

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/

COURSE OUTCOMES:

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

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	**K1, K2**
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.	**K2, K3**
CO3	Analyze characteristics of matrices and its different types, and the process of diagonalization.	**K4**
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	**K4, K5**
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	**K2, K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	3	3	3	2	2	2
CO3	3	3	3	2	2	3	3	2	3	2
CO4	3	3	3	3	2	3	3	2	2	2
CO5	3	2	3	3	2	3	3	2	2	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	3	3	3	2	2	2
CO3	3	3	3	2	2	3	3	2	3	2
CO4	3	3	3	3	2	3	3	2	2	2
CO5	3	2	3	3	2	3	3	2	2	3

TITLE OF THE COURSE	**:**	**CLASSICAL MECHANICS**
CATEGORY	**:**	**CORE COURSE**
COURSE CODE	**:**	**P1R3PHCC2**
NATURE OF SKILL	**:**	**SKILL DEVELOPMENT**

MARKS : CIA:25 + Ext:75=100 **HOURS/WEEK : 7**

CREDITS : 5 **TOTAL INST. HOURS: 105**

COURSE OBJECTIVES:

1. To understand fundamentals of classical mechanics.
2. To understand Lagrangian formulation of mechanics and apply it to solve equation of motion.
3. To understand Hamiltonian formulation of mechanics and apply it to solve equation of motion.
4. To discuss the theory of small oscillations of a system.
5. To learn the relativistic formulation of mechanics of a system.

UNIT I: PRINCIPLES OF CLASSICAL MECHANICS (Inst. Hrs. : 21)

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.

UNIT II: LAGRANGIAN FORMULATION (Inst. Hrs. : 21)

D'Alembert's principle – Lagrangian equations of motion for conservative systems – applications: (i) simple pendulum (ii) Atwood's machine (iii) projectile motion.

UNIT III:HAMILTONIAN FORMULATION (Inst. Hrs. : 21)

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.

UNIT IV:SMALL OSCILLATIONS (Inst. Hrs. : 21)

Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – linear triatomic molecule.

UNIT V:RELATIVITY **(Inst. Hrs. : 21)**

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-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

TEXT BOOKS

1. H. Goldstein, 2002, *Classical Mechanics*, 3rd Edition, Pearson Edu.
2. J. C. Upadhyaya, *Classical Mechanics*, Himalaya Publshing. 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 SOURCES

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

https://nptel.ac.in/courses/122/106/122106027/

4. https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/
5. https://www.britannica.com/science/relativistic-mechanics

COURSE OUTCOMES:

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

CO1	Understand the fundamentals of classical mechanics.	**K2**
CO2	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.	**K3**
CO3	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.	**K3, K5**
CO4	Analyze the small oscillations in systems and determine their normal modes of oscillations.	**K4, K5**
CO5	Understand and apply the principles of relativistic kinematics to the mechanical systems.	**K2, K3**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	3	3	3	2	2	2	3	2	2
CO2	2	3	3	3	2	2	2	3	2	2
CO3	2	3	3	3	2	2	2	3	2	2
CO4	2	3	3	3	2	2	2	3	2	2
CO5	2	3	3	3	2	2	2	3	2	2

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	2	3	3	3	2	2	2	3	2	2
CO2	2	3	3	3	2	2	2	3	2	2
CO3	2	3	3	3	2	2	2	3	2	2
CO4	2	3	3	3	2	2	2	3	2	2
CO5	2	3	3	3	2	2	2	3	2	2

TITLE OF THE COURSE : PRACTICAL- I

CATEGORY : CORE COURSE

COURSE CODE : PIR3PHCC3P

NATURE OF SKILL : SKILL DEVELOPMENT

MARKS : CIA:40 + Ext:60=100 HOURS/WEEK : 06

CREDITS : 04 TOTAL INST. HOURS : 90

COURSE OBJECTIVES:

1. To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations.
2. To calculate the thermodynamic quantities and physical properties of materials.
3. To analyze the optical and electrical properties of materials.
4. To study about themultivibrator circuit.
5. To understand the basic concepts of semiconductor device.

(Any Twelve Experiments)

1. Determination of Young's modulus and Poisson's ratio by Hyperbolic fringes - Cornu's Method
2. Determination of Viscosity of the given liquid – Meyer's disc
3. Measurement of Coefficient of linear expansion- Air wedge Method
4. B-H loop using Anchor ring.
5. Determination of Thickness of the enamel coating on a wire by diffraction
6. Determination of Rydberg's Constant - Hydrogen Spectrum
7. FP Etalon
8. Determination of Thickness of air film. - Solar spectrum – Hartmann's formula. Edser and Butler fringes.
9. Measurement of Band gap energy- Thermistor
10. Determination of Planck Constant – LED Method
11. Determination of Specific charge of an electron – Thomson's method.
12. Determination of Compressibility of a liquid using Ultrasonics
13. Determination of Wavelength, Separation of wavelengths - Michelson Interferometer
14. GM counter – Characteristics, inverse square law and absorption coefficient.
15. Measurement of Conductivity - Four probe method.

16. Arc spectrum – Iron.
17. Molecular spectra – AlO band.
18. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.
19. Determination of Diffraction pattern of light with circular aperture using Diode/He-Ne laser.
20. Study the beam divergence, spot size and intensity profile of Diode/He-Ne laser.
21. Measurements of Standing wave and standing wave co-efficient, Law of Inverse square, Receiver end transmitter behavior, Radiation Pattern - Microwave test bench
22. UV-Visible spectroscopy – Verification of Beer-Lambert's law and identification of wavelength maxima – Extinction coefficient

23 Construction of relaxation oscillator using UJT

24 FET CS amplifier- Frequency response, input impedance, output impedance

25 Study of important electrical characteristics of IC741.

27 V- I Characteristics of different colours of LED.

28 Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.

29 Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.

30 Construction of Schmidt trigger circuit using IC 741 for a given hysteresis-application as squarer.

31 Construction of square wave Triangular wave generator using IC 741

32 Construction of a quadrature wave using IC 324

33.Construction of pulse generator using the IC 741 – application as frequency divider

34.Construction of Op-Amp- 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type)

35.Study of Binary to Gray and Gray to Binary code conversion.

36.Study of R-S, clocked R-S and D-Flip flop using NAND gates

37.Study of J-K, D and T flip flops using IC 7476/7473

38.Arithmetic operations using IC 7483- 4-bit binary addition and subtraction.

39.Study of Arithmetic logic unit using IC 74181.

Construction of Encoder and Decoder circuits using Ics

TEXT BOOKS

1. Practical Physics, Gupta and Kumar, PragatiPrakasan.
2. Kit Developed for doing experiments in Physics- Instruction manual, R. Srinivasan K.R Priolkar, Indian Academy of Sciences.
3. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.
4. Electronic lab manual Vol I, K ANavas, Rajath Publishing.
5. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition.

REFERENCE BOOKS

1. Advanced Practical Physics, S.P Singh, PragatiPrakasan.
2. An advanced course in Practical Physics, D. Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd
3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
4. A course on experiment with He-Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd.

5.Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing.

COURSE OUTCOMES:

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

CO1	Understand the strength of material using Young's modulus.	**K2**
CO2	Acquire knowledge of thermal behaviour of the matetials.	**K1**
CO3	Understand theoretical principles of magnetism through the experiments.	**K2**
CO4	Acquire knowledge about arc spectrum and applications of laser	**K1, K3**
CO5	Improve the analytical and observation ability in Physics Experiments	**K3, K5**
CO6	Conduct experiments on applications of FET and UJT	**K4**
CO7	Analyze various parameters related to operational amplifiers.	**K4**
CO8	Understand the concepts involved in arithmatic and logical circuits using IC's	**K2**
CO9	Acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits	**K1**
CO10	Analyze the applications of counters and registers	**K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	2	2	3	2	2	2	1	2	3
CO2	2	2	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	2	2	2	2
CO6	2	2	2	3	3	1	1	1	3	3
CO7	2	2	3	3	3	1	1	1	3	3
CO8	3	3	3	3	3	3	2	2	3	3
CO9	3	3	3	3	3	3	1	1	1	1
CO10	3	3	3	3	3	3	1	1	1	1

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	2	2	2	3	2	2	2	1	2	3
CO2	2	2	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	2	2	2	2
CO6	2	2	2	3	3	1	1	1	3	3
CO7	2	2	3	3	3	1	1	1	3	3
CO8	3	3	3	3	3	3	2	2	3	3
CO9	3	3	3	3	3	3	1	1	1	1
CO10	3	3	3	3	3	3	1	1	1	1

TITLEOFTHECOURSE	**:**	**PHYSICS OF NANOSCIENCE AND TECHNOLOGY**
CATEGORY	**:**	**DISCIPLINE SPECIFIC ELECTIVE**
COURSECODE	**:**	**P1R3PHDSE 1:1**
NATURE OF SKILL	**:**	**EMPOLYABILITY**

MARKS : CIA:25 +Ext:75 = 100 **HOURS/WEEK : 05**

CREDITS : 03 **TOTAL INST.HOURS : 75**

COURSE OBJECTIVES:

1. To understand the fundamentals, nucleation and kinetics of nanoparticles.
2. To learn the structures and properties of nanomaterials.
3. To understand the basic concept of synthesis of nano materials
4. To provide the basic knowledge about nanoscience and technology.
5. To acquire knowledge in various applications of nano materials

UNIT I: FUNDAMENTALS OF NANOSCIENCE AND TECHNOLOGY (Inst.Hrs.:15)

Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology -– Classification of Nanomaterials – Metal and Semiconductor Nanomaterials - 2D, 1D, 0D nanostructured materials - Quantum dots – Quantum wires – Quantum wells - Surface effects of nanomaterials.

UNIT II: PROPERTIES OF NANOMATERIALS (Inst.Hrs.:15)

Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant – Mechanical behavior:Elastic properties – strength - ductility - superplastic behavior - Optical properties: - Surface Plasmon Resonance – Quantum size effects - Electrical properties - Conductivity, Ferroelectrics and dielectrics - Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS).

UNIT III: SYNTHESIS AND FABRICATION (Inst.Hrs.:15)

Physical vapour deposition - Chemical vapour deposition - sol-gel – Wet deposition techniques - electrochemical deposition method – Plasma arching - Electrospinning method - ball milling technique - pulsed laser deposition - Nanolithography: photolithography – Nanomanipulator.

UNIT IV: CHARACTERIZATION TECHNIQUES (Inst.Hrs.:15)

Powder X-ray diffraction – X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy – Photoluminescence - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) - Scanning probe microscopy (SPM) - Scanning tunneling microscopy (STM) – Vibrating sample Magnetometer.

UNIT V: APPLICATIONS OF NANOMATERIALS (Inst.Hrs.:15)

Sensors: Nanosensors based on optical and physical properties - Electrochemical sensors – Nano-biosensors. Nano Electronics: Nanobots - display screens - GMR read/write heads - Carbon Nanotube Emitters – Photocatalytic application: Air purification, water purification -Medicine: Imaging of cancer cells – biological tags - drug delivery - photodynamic therapy - Energy: fuel cells - rechargeable batteries -supercapacitors– photovoltaics,

TEXT BOOKS

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. Nanostructures and Nanomaterials – HuozhongGao – Imperial College Press (2004).
6. Nanostructures and Nanomaterials – HuozhongGao – Imperial College Press (2004).

WEB SOURCES

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

COURSE OUTCOMES:

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

CO1	Understand the basic of nanoscience and explore the different types of nanomaterials and should comprehend the surface effects of the nanomaterials.	**K1, K2**
CO2	Explore various physical, mechanical, optical, electrical and magnetic properties nanomaterials.	**K1**
CO3	Understand the process and mechanism of synthesis and fabrication of nanomaterials.	**K2, K3**
CO4	Analyze the various characterization of Nano-products through diffraction, spectroscopic, microscopic and other techniques.	**K4**
CO5	Apply the concepts of nanoscience and technology in the field of sensors, robotics, purification of air and water and in the energy devices.	**K3**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)

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

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	2	1	1	3	3	3	3
CO2	3	3	3	2	1	1	3	3	3	3
CO3	3	3	2	2	1	1	3	3	3	3
CO4	3	3	3	2	1	1	3	3	3	3
CO5	3	3	2	2	1	1	3	3	3	3

TITLE OF THE COURSE : ANALYSIS OF CRYSTAL STRUCTURES

CATEGORY : DISCIPLINE SPECIFIC ELCTIVE

COURSECODE : P1R3PHDSE 1 : 2

NATURE OF SKILL : SKILL DEVELOPMENT

MARKS : CIA :25 + Ext: 75 =100 **HOURS/WEEK : 05**

CREDITS: 03 **TOTAL INST. HOURS : 75**

COURSE OBJECTIVES

C Obj -1-To teach the concept of crystal structures and symmetry, and diffraction theory

C Obj -2-To provide students with a background to X-ray generation, scattering theory and experimental diffraction from single crystals

C Obj -3-To provide instruction on the methods and basis for determining low-molecular weight crystal structures using X-ray Crystallography

C Obj -4-To give the students a background to the instrumentation used for powder diffraction and structure refinement using Rietveld method

C Obj -5-To teach the different levels of structure exhibited by proteins and nucleic acids and methods used in protein crystallography.

UNIT I:CRYSTAL LATTICE (Inst. Hrs : 15)

Unit cell and Bravais lattices - crystal planes and directions - basic symmetry elements operations - translational symmetries - point groups - space groups - equivalent positions - Bragg's law - reciprocal lattice concept -Laue conditions - Ewald and limiting spheres - diffraction symmetry - Laue groups.

UNIT II:DIFFRACTION (Inst. Hrs : 15)

X-ray generation, properties - sealed tube, rotating anode, synchrotron radiation - absorption - filters and monochromators Atomic scattering factor - Fourier transformation and structure factor - anomalous dispersion - Laue, rotation/oscillation, moving film methods- interpretation of diffraction patterns - cell parameter determination - systematic absences - space group determination.

UNIT III:STRUCTURE ANALYSIS (Inst. Hrs : 15)

Single crystal diffractometers - geometries - scan modes - scintillation and area detectors -intensity data collection - data reduction - factors affecting X-ray intensities - temperature and scale factor - electron density - phase problem - normalized structure factor -

direct method fundamentals and procedures -Patterson function and heavy atom method - structure refinement - least squares method - Fourier and difference Fourier synthesis - R factor - structure interpretation - geometric calculations - conformational studies - computer program packages.

UNIT IV:POWDER METHODS (Inst. Hrs : 15)

Fundamentals of powder diffraction - Debye Scherrer method - diffractometer geometries - use of monochromators and Soller silts - sample preparation and data collection - identification of unknowns - powder diffraction files (ICDD) - Rietveld refinement fundamentals - profile analysis - peak shapes - whole pattern fitting - structure refinement procedures – auto-indexing – structure determination from powder data - new developments. Energy dispersive X-ray analysis – texture studies - crystallite size determination - residual stress analysis - high and low temperature and high pressure crystallography (basics only).

UNIT V:PROTEIN CRYSTALLOGRAPHY (Inst. Hrs : 15)

Globular and fibrous proteins, nucleic acids - primary, secondary, tertiary and quaternary structures - helical and sheet structures - Ramachandran map and its significance – crystallization methods for proteins - factors affecting protein crystallization - heavy atom derivatives – methods used to solve protein structures - anomalous dispersion methods.

TEXT BOOKS

1. Azaroff, L.V., "Elements of X-Ray Crystallography", Techbooksl, New York, 1992.
2. Blundell, T.L. and Johnson, L., "Protein Crystallography", Academic Press, New York, 1986.
3. Cullity, B.D. and Stock,S.R. "Elements of X-ray Diffraction", Pearson, 2014.
4. H.L. Bhat, Introduction to Crystal Growth Principles and Practice CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2015.
5. B.R. Pamplin, Crystal Growth, Pergamon Press, Oxford, 1975.

REFERENCE BOOKS

1. Glusker, J.P. and Trueblood, K.N. Crystal Structure Analysis: A Primer", Oxford University, Press, New York, 1994.
2. Ladd, M.F.C. and Palmer, R.A., "Structure Determination by X-ray Crystallography", Plenum Press, New York, 3rd Edition, 1993.

3. Stout, G.H. and Jensen, L."X-ray Structure Determination, A Practical Guide", Macmillan:,New York, 1989.
4. Woolfson, M.M. "An Introduction to X-ray Crystallography" Cambridge University Press, New York, 1997.
5. Sam Zhang, Lin Ki, Ashok Kumar, Materials Characterization Techniques, CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2009

WEB SOURCES

1. https://archive.nptel.ac.in/courses/112/106/112106227/
2. https://archive.nptel.ac.in/courses/104/108/104108098/
3. https://www.digimat.in/nptel/courses/video/102107086/L11.html
4. https://onlinecourses.nptel.ac.in/noc19_cy35/previewhttps://onlinecourses.nptel.ac.in/noc19_cy35/preview
5. https://nptel.ac.in/courses/104/104/104104011/

COURSE OUTCOME:

On completion of this course the students will be able to

CO1- Understand crystal symmetry and reciprocal lattice concept for X-ray diffraction - **K2**

CO2- Gain a working knowledge of X-ray generation, X-ray photography with Laue, oscillation and moving film methods, and space group determination - **K1,K3**

CO3- Get an exposure to crystal structure determination using program packages- **K1,K4**

CO4- Understand the instrumentation used for powder diffraction, data collection, data interpretation, and structure refinement using Rietveld method - **K2, K4**

CO5- Get an insight into the structural aspects of proteins and nucleic acids, crystallization of proteins and methods to solve protein structures - **K5**

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

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

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	2	3	2	1	2	2	2
CO2	3	3	3	2	2	2	1	2	2	2
CO3	3	3	2	2	2	2	2	2	2	2
CO4	3	2	2	2	2	2	2	2	2	2
CO5	3	2	2	2	2	2	2	2	2	2

TITLE OF THE COURSE : ADVANCED OPTICS

CATEGORY : DISCIPLINE SPECIFIC ELECTIVE

COURSE CODE : P1R3PHDSE 2:1

NATURE OF SKILL : SKILL DEVELOPMENT

MARKS : CIA:25+Ext:25=100 **HOURS WEEK : 05**

CREDIT : 3 **TOTAL INST HOURS : 75**

COURSE OBJECTIVES:

1. To know the concepts behind polarization and could pursue research work on application aspects of laser
2. To impart an extensive understanding of fiber and non-linear optics
3. To study the working of different types of LASERS
4. To differentiate first and second harmonic generation
5. Learn the principles of magneto-optic and electro-optic effects and its applications

UNIT 1:POLARIZATION AND DOUBLE REFRACTION (Inst. Hrs. : 15)

Classification of polarization – Transverse character of light waves – Polarizer and analyzer – Malu's law – Production of polarized light – Wire grid polarizer and the polaroid – Polarization by reflection – Polarization by double refraction – Polarization by scattering – The phenomenon of double refraction – Normal and oblique incidence – Interference of polarized light: Quarter and half wave plates – Analysis of polarized light – Optical activity.

UNIT II:LASERS (Inst. Hrs. : 15)

Basic principles – Spontaneous and stimulated emissions – Components of the laser – Resonator and lasing action – Types of lasers and its applications – Solid state lasers – Ruby laser – Nd:YAG laser – gas lasers – He-Ne laser – CO_2 laser – Chemical lasers – HCl laser – Semiconductor laser.

UNIT III:FIBER OPTICS (Inst. Hrs. : 15)

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 – Fiber-optic sensors: precision displacement sensor – Precision vibration sensor.

UNIT IV:NON-LINEAR OPTICS **(Inst. Hrs. : 15)**

Basic principles – Harmonic generation – Second harmonic generation – Phase matching – Third harmonic generation – Optical mixing – Parametric generation of light – Self-focusing of light.

UNIT V:MAGNETO-OPTICS AND ELECTRO-OPTICS **(Inst. Hrs. : 15)**

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 – Pockels electro-optic effect.

TEXT BOOKS

1. B. B. Laud, 2017, Lasers and Non – Linear Optics, 3rd Edition, New Age International (P) Ltd.
2. AjoyGhatak, 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 SOURCES

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.aspx

COURSE OUTCOMES:

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

CO1	Discuss the transverse character of light waves and different polarization phenomenon	**K1**
CO2	Discriminate all the fundamental processes involved in laser devices and to analyze the design and operation of the devices	**K2**
CO3	Demonstrate the basic configuration of a fiber optic – communication system and advantages	**K3, K4**
CO4	Identify the properties of nonlinear interactions of light and matter	**K4**
CO5	Interpret the group of experiments which depend for their action on an applied magnetics and electric field	**K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	3	3	3	3	3	3
C02	3	3	3	2	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	2	3	3	3	3	3	3
CO2	3	3	3	2	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

TITLE OF THE COURSE	**:**	**BIO PHYSICS**
CATEGORY	**:**	**DISCIPLINE SPECIFIC ELCTIVE COURSE**
COURSECODE	**:**	**P1R3PHDSE 2 : 2**
NATURE OF SKILL	**:**	**SKILL DEVELOPMENT**
MARKS : CIA :25 + Ext: 75 =100		**HOURS/WEEK : 05**
CREDITS: 03		**TOTAL INST. HOURS : 75**

COURSE OBJECTIVES

C Obj -1 -To understand the physical principles involved in cell function maintenance

C Obj -2 -To understand the fundamentals of macromolecular structures involved in propagation of life.

C Obj -3 -To To understand the biophysical function of membrane and neuron.

C Obj -4 -To understand various kinds of radiation and their effects on living system and to know the hazards posed by such radiations and the required precautions.

C Obj -5-To understand the physical principles behind the various techniques available for interrogating biological macromolecules.

UNIT I: CELLULAR BIOPHYSICS (Inst. Hrs : 15)

Architecture and Life Cycle of cells – Organelles of Prokaryotic and Eukaryotic cell – Cell size and shape – Fine structure of Prokaryotic and Eukaryotic cell organization – Compartment & assemblies membrane system – Extracellular matrix - Molecular mechanisms of Vesicular traffic - Electrical activities of cardiac and neuronal cells.

UNIT II: MOLECULAR BIOPHYSICS (Inst. Hrs : 15)

Macromolecular structure: Protein structure – amino acids, peptide bonds, primary, secondary, tertiary and quaternary structures of proteins

Nucleic acid structure: nucleosides and nucleotides, RNA structure, DNA structure and conformation.

Special Bio-macromolecules: Metalloproteins, nucleoproteins, ribozymes, chaperons and prions.

UNIT III: MEMBRANE AND NEURO BIOPHYISCS (Inst. Hrs : 15)

Models membranes - Biological membranes and dynamics – Membrane Capacitors – Transport across cell and organelle membranes – Ion channels.

Nervous system: Organization of the nervous system –Membrane potential – Origins of membrane potential - Electrochemical potentials – Nernst equation – Goldman equation.

UNIT IV: RADIATION BIO PHYSICS (Inst. Hrs : 15)

X-Ray: Effects on bio-macromolecules – Gamma Radiation: Molecular effects of gamma radiation, Radiation effects on nucleic acids and membranes, Effects on cell and organelles – UV radiation: Effects on bio-macromolecules and proteins – Radiation hazards and protection – use of radiations in cancer.

UNIT V: PHYSICAL METHODS IN BIOLOGY (Inst. Hrs : 15)

Spectroscopy: UV-Visible absorption spectrophotometry – Optical Rotatory Dispersion (ORD) – Structure Determination: X-ray Crystallography, Electron spin resonance (ESR) and biological applications. Chromatography: Thin layer chromatography (TLC), Gas liquid chromatography (GLC) – Centrifugation: Differential centrifugation, density gradient centrifugation. Electrophoresis: Gel electrophoresis, polyacrylamide gel electrophoresis.

TEXT BOOKS

1. The cell: A molecular approach, Geoffrey M. Cooper, ASM Press, 2013.
2. Biophysics, VasanthaPattabhi, N. Gautham, Narosa Publishing, 2009
3. Biophysics, P. S. Mishra VK Enterprises, 2010.
4. Biophysics, M. A Subramanian, MJP Publishers, 2005.
5. Bioinstrumentation, L. Veerakumari, MJP Publishers, 2006.

REFERENCE BOOKS

1. Chemical Biophysics by Daniel A Beard (Cambridge University Press, 2008).
2. Essential cell biology by Bruce Albert et al (Garland Science)
3. Biophysics, W. Hoppe, W. Lohmann, H. Markl and H. Ziegler. Springer Verlag, Berlin (1983).
4. Membrane Biophysics by Mohammad Ashrafuzzaman, Jack A. Tuszynski, (Springer science & business media).
5. Biological spectroscopyby Iain D. Campbell, Raymond A. Dwek

WEB SOURCES

1. General Bio:http://www.biology.arizona.edu/DEFAULT.html
2. Spectroscopy: http://www.cis.rit.edu/htbooks/nmr/inside.htm
3. Electrophoresis:http://learn.genetics.utah.edu/content/labs/gel/
4. Online biophysics programs:http://mw.concord.org/modeler/
5. https://blanco.biomol.uci.edu/WWWResources.html

COURSE OUTCOME:

On completion of this course the students will be able to

CO1- Understand the structural organization and function of living cells and should able to apply the cell signaling mechanism and its electrical activities.- **K2, K3**

CO2- Comprehension of the role of biomolecular conformation to function.- **K1**

CO3- Conceptual understanding of the function of biological membranes and also to understand the functioning of nervous system.- **K2, K5**

CO4- To know the effects of various radiations on living systems and how to prevent ill effects of radiations.- **K1, K5**

CO5- Analyze and interpret data from various techniques viz., spectroscopy, crystallography, chromatography etc.,- **K1, K5**

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

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

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	2	1	2	1	3	3	2
CO2	3	3	3	2	1	2	1	3	3	2
CO3	3	3	3	3	1	1	2	3	3	2
CO4	3	3	3	2	1	1	2	3	3	3
CO5	3	3	3	3	1	1	2	3	3	3

Title of the Course	**:**	**STATISTICAL MECHANICS**
Category	**:**	**Core Course**
Course Code	**:**	**P2R3PHCC4**
Nature of Skill	**:**	**Skill Development**
Marks : CIA : 25 + Ext: = 75 = 100	**:**	**Hrs / Week : 06**
		Total Inst. Hrs : 90
Credits : 05		

Course Objectives

1. To acquire the knowledge of thermodynamic potentials and to understand phase transition in thermodynamics
2. To identify the relationship between statistic and thermodynamic quantities
3. To comprehend the concept of partition function, canonical and grand canonical ensembles
4. To grasp the fundamental knowledge about the three types of Statistics.
5. To get in depth knowledge about phase transitions and fluctuation of thermodynamic properties that vary with time.

UNIT I: PHASE TRANSITIONS (Inst. Hrs: 18)

Thermodynamic potentials - 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 transformations and dimensional analysis.

UNIT II: STATISTICAL MECHANICS AND THERMODYNAMICS (Inst. Hrs: 18)

Foundations of statistical mechanics - Specification of 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.

UNIT III: CANONICAL AND GRAND CANONICAL ENSEMBLES (Inst. Hrs: 18)

Trajectories and density of states - Liouville's theorem - Canonical and grand canonical ensembles - Partition function - Calculation of statistical quantities - Energy and

density fluctuations.

UNIT IV: CLASSICAL AND QUANTUM STATISTICS (Inst. Hrs: 18)

Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Maxwell-Boltzmann statistics - Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics - Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.

UNIT V:REAL GAS,ISING MODEL AND FLUCTUATIONS (Inst. Hrs: 18)

Cluster expansion for a classical gas - Virial equation of state – Calculation of the first Virial coefficient in the cluster expansion - Ising model - 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.

TEXT BOOKS

1. S. K. Sinha, 1990, Statistical *Mechanics*, Tata McGraw Hill, New Delhi.
2. B. K. Agarwal and M. Eisner, 1998, *Statistical Mechanics*, Second Edition New Age International, New Delhi.
3. J. K. Bhattacharjee, 1996, *Statistical Mechanics*: An Introductory Text, Allied Publication, New Delhi.
4. F. Reif, 1965, *Fundamentals of Statistical and Thermal Physics*, McGraw -Hill, New York.
5. M. K. Zemansky, 1968, *Heat and Thermodynamics*, 5th edition, McGraw-Hill New York.
6.

REFERENCE BOOKS

1. R. K. Pathria, 1996, *Statistical Mechanics*, 2nd edition, Butter WorthHeinemann, 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. W. Greiner, L. Neise and H. Stoecker, *Thermodynamics and Statistical Mechanics*, Springer Verlang, New York.
5. A. B. Gupta, H. Roy, 2002, *Thermal Physics*, Books and Allied, Kolkata.

WEB SOURCES

1. https://byjus.com/chemistry/third-law-of-thermodynamics/
2. https://web.stanford.edu/~peastman/statmech/thermodynamics.html
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

COURSE OUTCOMES:

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

CO1- To examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition. **K5**

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. **K4**

CO3- Differentiate between canonical and grand canonical ensembles and to interpret the relation between thermodynamical quantities and partition function. **K1**

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. **K4, K5**

CO5- To discuss and examine the thermodynamical behaviour of gases under fluctuation and also using Ising model. **K3**

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

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

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	1	1	2	3	1	1	3
CO2	3	3	3	1	1	2	3	1	1	3
CO3	3	3	3	1	1	2	3	2	1	3
CO4	3	3	3	1	1	2	3	2	1	3
CO5	3	3	3	1	1	2	3	1	1	3

Title of the Course	**:**	**QUANTUM MECHANICS – I**
Category	**:**	**Core Course**
Course Code	**:**	**P2R3PHCC5**
Nature of Skill	**:**	**Skill Development**
Marks : CIA : 25 + Ext: = 75 = 100	**:**	**Hrs / Week : 06**
		Total Inst. Hrs : 90
Credits : 05		

Course Objectives

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

UNIT I:BASIC FORMALISM **(Inst. Hrs: 18)**

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 –General Uncertainty relation.

UNIT II: ONE DIMENSIONAL AND THREE-DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS **(Inst. Hrs: 18)**

Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier – Alpha emission – Bloch waves in a periodic potential – Kronig-penny square – well periodic potential – Linear harmonic oscillator: Operator method – System of two interacting particle–Hydrogen atom – Rigid rotator

UNIT III:GENERAL FORMALISM **(Inst. Hrs: 18)**

Dirac notation – Equations of motions – Schrodinger representation – Heisenberg representation – Interaction representation – Coordinate representation – Momentum

representation – Symmetries and conservation laws – Unitary transformation – Parity and time reversal

UNIT IV:APPROXIMATION METHODS (Inst. Hrs: 18)

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.

UNIT V:ANGULAR MOMENTUM (Inst. Hrs: 18)

Eigenvalue spectrum of general angular momentum – Ladder operators and their algebra – Matrix representation – Spin angular momentum – Addition of angular momenta – CG Coefficients – Symmetry and anti – symmetry of wave functions – Construction of wave-functions and Pauli's exclusion principle.

TEXT BOOKS

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. A. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4thEdition, Macmillan, India, 1984.

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, New Delhi, 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 SOURCES

1. http://research.chem.psu.edu/lxjgroup/download_files/chem565-c7.pdf
2. http://www.feynmanlectures.caltech.edu/III_20.html

3. http://web.mit.edu/8.05/handouts/jaffe1.pdf
4. https://hepwww.pp.rl.ac.uk/users/haywood/Group_Theory_Lectures/Lecture_ 1.pdf
5. https://theory.physics.manchester.ac.uk/~xian/qm/chapter3.pdf

COURSE OUTCOMES:

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

CO1- Demonstrates a clear understanding of the basic postulates of quantum mechanics which serve to formalize the rules of quantum Mechanics. **K1, K5**

CO2- Is able to apply and analyze the Schrodinger equation to solve one dimensional problems and three dimensional problems. **K3, K4**

CO3- Can discuss the various representations, space time symmetries and formulations of time evolution. **K1**

CO4- Can formulate and analyze the approximation methods for various quantum mechanical problems. **K4, K5**

CO5- To apply non-commutative algebra for topics such as angular and spin angular momentum and hence explain spectral line splitting. **K3, K4**

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	S	3	2	2	3
CO3	2	3	3	2	3	2	3	2	2	3
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	3	2	3	S	3	3	2	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	S	3	2	2	3
CO3	2	3	3	2	3	2	3	2	2	3
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	3	2	3	S	3	3	2	3

Title of the Course	**:**	**PRACTICAL II**
Category	**:**	**Core Course**
Course Code	**:**	**P2R3PHCC6P**
Nature of Skill	**:**	**Skill Development**
Marks : CIA : 40 + Ext: = 60 = 100	**:**	**Hrs / Week : 06**
		Total Inst. Hrs : 90
Credits : 04		

Course Objectives

1. To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations.
2. To calculate the thermodynamic quantities and physical properties of materials.
3. To analyze the optical and electrical properties of materials.
4. To observe the applications of FET and UJT.
5. To study the different applications of operational amplifier circuits.
6. To learn about Combinational Logic Circuits and Sequential Logic Circuits

(Any Twelve Experiments)

1. Determination of Young's modulus and Poisson's ratio by Elliptical fringes - Cornu's Method
2. Determination of Stefan's constant of radiation from a hot body
3. Measurement of Coefficient of linear expansion- Air wedge Method
4. Measurement of Susceptibility of liquid - Quincke's method
5. B-H curve using CRO
6. Measurement of Magnetic Susceptibility - Guoy's method
7. LG Plate
8. Arc spectrum: Copper
9. Determination of Solar constant
10. Determination of e/m - Millikan's method
11. Miscibility measurements using ultrasonic diffraction method
12. Determination of Thickness of thin film. - Michelson Interferometer
13. GM counter – Feather's analysis: Range of Beta rays
14. Iodine absorption spectra
15. Molecular spectra – CN bands
16. Determination of Refractive index of liquids using diode Laser/ He – Ne Laser

17. Determination of Numerical Apertures and Acceptance angle of optical fibers using Laser Source.
18. Measurement of Dielectricity - Microwave test bench
19. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility
20. Interpretation of vibrational spectra of a given material
21. Determination of I-V Characteristics and efficiency of solar cell.
22. IC 7490 as scalar and seven segment display using IC7447
23. Solving simultaneous equations – IC 741 / IC LM324
24. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter
25. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
26. Construction of second order butter worth multiple feedback narrow band pass filter
27. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193
28. Construction of square wave generator using IC 555 – Study of VCO
29. Construction of Schmidt trigger circuit using IC555 for a given hysteresis – Application as squarer
30. Construction of pulse generator using the IC 555 – Application as frequency divider
31. BCD to Excess- 3 and Excess 3 to BCD code conversion
32. Study of binary up / down counters - IC 7476 / IC7473
33. Shift register and Ring counter and Johnson counter- IC 7476/IC 7474
34. Study of synchronous parallel 4-bit binary up/down counter using IC 74193
35. Study of asynchronous parallel 4-bit binary up/down counter using IC 7493
36. Study of Modulus Counter
37. Construction of Multiplexer and Demultiplexer using ICs.

TEXT BOOKS

1. Practical Physics, Gupta and Kumar, Pragati Prakasan
2. Kit Developed for doing experiments in Physics- Instruction manual, R. Srinivasan K.R Priolkar, Indian Academy of Sciences

3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
4. Electronic lab manual Vol I, K ANavas, Rajath Publishing
5. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition.

REFERENCE BOOKS

1. An advanced course in Practical Physics, D. Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd
2. Advanced Practical Physics, S.P Singh, Pragati Prakasan
3. A course on experiment with He-Ne Laser, R. S. Sirohi, John Wiley & Sons (Asia) Pvt. ltd
4. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing.
5. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi

COURSE OUTCOMES:

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

CO1- Understand the strength of material using Young's modulus. **K2**

CO2- Acquire knowledge of thermal behaviour of the materials. **K1**

CO3- Understand theoretical principles of magnetism through the experiments. **K2**

CO4- Acquire knowledge about arc spectrum and applications of laser. **K1**

CO5- Improve the analytical and observation ability in Physics Experiments. **K4**

CO6- Conduct experiments on applications of FET and UJT. **K5**

CO7- Analyze various parameters related to operational amplifiers. **K4**

CO8- Understand the concepts involved in arithmetic and logical circuits using IC's. **K2**

CO9- Acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits. **K3**

CO10- Analyze the applications of counters and registers. **K4**

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	2	2	S	S	2	2	2	3	3
CO2	2	2	S	S	S	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3
CO6	2	2	2	3	3	2	2	2	3	3
CO7	2	2	3	3	3	2	2	3	3	3
CO8	3	3	3	3	3	3	3	3	3	3
CO9	3	3	3	3	3	3	3	3	3	3
CO10	3	3	3	3	3	3	3	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	2	2	2	3	3	2	2	2	3	3
CO2	2	2	3	3	3	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3
CO6	2	2	2	S	S	2	2	2	3	3
CO7	2	2	S	S	S	2	2	3	3	3
CO8	3	3	3	3	3	3	3	3	3	3
CO9	3	3	3	3	3	3	3	3	3	3
CO10	3	3	3	3	3	3	3	3	3	3

Title of the Course	**:**	**LINEAR AND DIGITAL ICs AND APPLICATIONS**
Category	**:**	**Discipline specific elective**
Course Code	**:**	**P2R3PHDSE 3:1**
Nature of Skill	**:**	**Employability**
Marks : CIA : 25 + Ext: = 75 = 100	**:**	**Hrs / Week : 04**
		Total Inst. Hrs : 60
Credits : 03		

Course Objectives

1. To introduce the basic building blocks of linear integrated circuits.
2. To teach the linear and non-linear applications of operational amplifiers.
3. To introduce the theory and applications of PLL.
4. To introduce the concepts of waveform generation and introduce one special function ICs.
5. Exposure to digital IC‘s

UNIT I: INTEGRATED CIRCUITS AND OPERATIONAL AMPLIFIER **(Inst. Hrs: 12)**

Introduction, Classification of IC‘s, basic information of Op-Amp 741 and its features, the ideal Operational amplifier – and its Application

UNIT II:APPLICATIONS OF OP-AMP **(Inst. Hrs: 12)**

LINEAR APPLICATIONS OF OP-AMP: Solution to simultaneous equations and differential equations, Instrumentation amplifiers, V to I and I to V converters.

NON-LINEAR APPLICATIONS OF OP-AMP:

Sample and Hold circuit, Log and Antilog amplifierComparators, Schmitt trigger, Multivibrators, Triangular and Square waveform generators.

UNIT III:ACTIVE FILTERS & TIMER AND PHASE LOCKED LOOPS **(Inst. Hrs: 12)**

ACTIVE FILTERS: Introduction, Butterworth filters – low pass and high pass filters, band pass, band reject filters.

TIMER AND PHASE LOCKED LOOPS: Introduction to IC 555 timer, description of functional diagram, monostable and Astable operations Schmitt trigger, PLL - introduction, basic principle, phase detector/detector voltage controlled oscillator (IC 566).

UNIT IV: VOLTAGE REGULATOR & D to A AND A to D CONVERTERS
(Inst. Hrs: 12)

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, DAC, A to D converters -parallel comparator type ADC, counter type ADC, successive approximation ADC

UNIT V: CMOS LOGIC, COMBINATIONAL CIRCUITS USING TTL 74XX ICs & SEQUENTIAL CIRCUITS USING TTL 74XX ICs **(Inst. Hrs: 12)**

CMOS LOGIC: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates,. **COMBINATIONAL CIRCUITS USING TTL 74XX ICs**: Study of logic gates using 74XX ICs, 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, 4- bit asynchronous binary counter (IC 7493).

TEXT BOOKS

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. B.L. Theraja and A.K. Theraja, 2004, A Textbook of Electrical technology, S. Chand & Co.
4. V.K. Mehta and Rohit Mehta, 2008, Principles of Electronics, S. Chand & Co, 12th Edition.
5. V. Vijayendran, 2008, Introduction to Integrated electronics (Digital & Analog), S. Viswanathan Printers & Publishers Private Ltd, Reprint. V

REFERENCE BOOKS

1. Sergio Franco (1997), Design with operational amplifiers and analog integrated circuits, McGraw Hill, New Delhi.
2. Gray, Meyer (1995), Analysis and Design of Analog Integrated Circuits, Wiley International, New Delhi.
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 SOURCES

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-effect-controlled-thyristors/
4. https://www.electrical4u.com/applications-of-op-amp/
5. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

COURSE OUTCOMES:

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

CO1- Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve problems. **K1, K5**

CO2- Develop skills to design linear and non-linear applications circuits using Op-Amp and design the active filters circuits. **K3**

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. **K1, K3**

CO4- Learn about various techniques to develop A/D and D/A converters. **K2**

CO5- Acquire the knowledge about the CMOS logic, combinational and sequential circuits. **K1, K4**

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

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

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	3	2	2	3	3	3	2
CO2	3	3	3	3	1	3	3	3	2	1
CO3	3	3	3	3	1	3	3	3	2	1
CO4	3	3	3	3	1	3	3	3	2	1
CO5	3	3	3	2	1	1	2	3	2	1

TITLE OF THE COURSE	**:**	**COMMUNICATION ELECTRONICS**
CATEGORY	**:**	**DISCIPLINE SPECIFIC ELCTIVE**
COURSECODE	**:**	**P2R3PHDSE3:2**
NATURE OF SKILL	**:**	Employability
MARKS:CIA:25+Ext:75=100		**HOURS/WEEK : 04**
CREDITS: 03		**TOTAL INST. HOURS : 60**

COURSE OBJECTIVES

C Obj -1-To comprehend the transmission of electromagnetic waves thorough different types of antenna and also to acquire knowledge about the propagation of waves through earth's atmosphere and along the surface of the earth

C Obj -2-To gain knowledge in the generation and propagation of microwaves

C Obj -3-To acquire knowledge about radar systems and its applications and also the working principle of colour television

C Obj -4-To learn the working principle of fiber optics and its use in telecommunication

C Obj -5-To understand the general theory and operation of satellite communication systems

UNIT I:ANTENNAS AND WAVE PROPAGATION (Inst. Hrs: 12)

Radiation field and radiation resistance of short dipole antenna-groundedantenna-ungrounded antenna-antenna arrays-broadside and end side arrays-antenna gain-directional high frequency antennas-sky wave-ionosphere- Ecles and Larmor theory- Magnento ionic theory-ground wave propagation.

UNIT II:MICROWAVES (Inst. Hrs: 12)

Microwave generation—multicavity Klystron-reflex klystron-magnetrontravelling wave tubes (TWT) and other microwave tubes-MASER-Gunndiode-wave guides-rectangular wave guides-standing wave indicator andstanding wave ratio(SWR)

UNIT III: RADAR AND TELEVISION (Inst. Hrs: 12)

Elements of a radar system-radar equation-radar performance Factorsradar transmitting

systems-radar antennas-duplexers-radarreceivers and indicators-pulsed systems-other radar systems-colour TVtransmission and reception-colour mixing principle-colour picture tubes-Delta gun picture tube-PIL colour picture tube-cable TV, CCTV andtheatre TV

UNIT IV: OPTICAL FIBER **(Inst. Hrs: 12)**

Propagation of light in an optical fibre-acceptance angle-numericalaperture-step and graded index fibres-optical fibres as a cylindrical waveguide-wave guide equations-wave guide equations in step index fibres -fibre losses and dispersion-applications.

UNIT V: SATELLITE COMMUNICATION **(Inst. Hrs: 12)**

Orbital satellites-geostationary satellites-orbital patterns-satellite systemlink models-satellite system parameters-satellite system link equationlinkbudget-INSAT communication satellites

TEXT BOOKS

1. Handbook of Electronics by Gupta and Kumar, 2008 edition.
2. Electronic communication systems – George Kennedy and Davis, Tata McGraw Hill, 4th edition, 1988.
3. Taub and Schilling, principles of communication systems, second edition, Tata Mc Graw Hill (1991).
4. M. Kulkarani, Microwave and radar engineering, UmeshPublications, 1998.
5. Mono Chrome and colour television, R. R. Ghulathi

REFERENCE BOOKS

1. Electronic communications – Dennis Roody and Coolen, Prentice Hall of India, IV edition, 1995.
2. Wayne Tomasi, Advanced electronics communication systems, fourth edition, Prentice Hall of India, 1998
3. Dennis Roddy and Coolen,1995,*Electronics communications,*Prentice Hall of India IV Edition.
4. Wayne Tomasi,1998 *"Advanced Electronics communication System"* 4thedition, Prentice Hall of India, 1998

5.S. Salivahanan, N. Suersh Kumar & A. Vallavaraj, 2009, Electronic Devices and Circuits, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition.

WEB SOURCES

1. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
2. https://www.polytechnichub.com/difference-analog-instruments-digital-instruments/
3. http://nptel.iitm.ac.in/
4. http://web.ewu.edu/
5. http://nptel.iitm.ac.in/

COURSE OUTCOMES:

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

CO1- Discuss and compare the propagation of electromagnetic waves through sky and on earth's surface Evaluate the energy and power radiated by the different types of antenna- K1, K5

CO2- Compare and differentiate the methods of generation of microwaves analyze the propagation of microwaves through wave guides- discuss and compare the different methods of generation of microwaves - **K4**

CO3- Classify and compare the working of different radar systems- apply the principle of radar in detecting locating, tracking, and recognizing objects of various kinds at considerable distances – discuss the importance of radar in military- elaborate and compare the working of different picture tube- **K3**

CO4- Classify, discuss and compare the different types of optical fiber and also to justify the need of it-discover the use of optical fiber as wave guide- **K1, K3**

CO5- Explain the importance of satellite communication in our daily life-distinguish between orbital and geostationary satellites elaborate the linking of satellites with ground station on the earth- **K4**

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

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

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	1	2	2	3	2	1	3
CO2	3	3	3	1	2	2	3	2	1	3
CO3	3	3	3	1	2	2	3	2	1	3
CO4	3	3	3	1	2	2	3	2	1	3
CO5	3	3	3	1	2	2	3	2	1	3

Title of the Course	**:**	**MICROPROCESSOR 8085 AND MICROCONTROLLER 8051**
Category	**:**	**Discipline specific elective**
Course Code	**:**	**P2R3PHDSE 4:1**
Nature of Skill	**:**	**Employability**
Marks : CIA : 25 + Ext: = 75 = 100	**:**	**Hrs / Week : 04**
		Total Inst. Hrs : 60
Credits : 03		

Course Objectives

1. To Understand the Microprocessor architecture and functioning of microprocessor 8085
2. To understand the methods of interfacing I/O devices and memory to microprocessor.
3. To introduce 8085A programming and applications
4. To understand the architecture and instruction sets of microcontroller 8051
5. To understand the assembly language program of the microcontroller

UNIT I: 8085 PROGRAMMING, PERIPHERAL DEVICES AND THEIR INTERFACING (Inst. Hrs: 12)

Instruction set - Addressing modes - Programming techniques - Memory mapped I/O scheme- I/O mapped I/O scheme - Memory and I/O interfacing- Data transfer schemes - Interrupts of 8085 - Programmable peripheral interface (PPI) - Control group and control word- Programmable DMA controller - Programmable interrupt controller – Programmable communication interface - Programmable counter /interval timer.

UNIT II:8085 INTERFACING APPLICATIONS (Inst. Hrs: 12)

Seven segment display interface - Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities –Voltage and current) Measurement of physical quantities (Temperature an strain).

UNIT III:8051 MICROCONTROLLER HARDWARE (Inst. Hrs: 12)

Introduction – Features of 8051 – 8051 Microcontroller Hardware: Pin-out 8051, Central Processing Unit (CPU), internal RAM, Internal ROM, Register set of 8051 – Memory organization of 8051 – Input/ Output pins, Ports and Circuits – External data memory and program memory: External program memory, External data memory.

UNIT IV: 8051 INSTRUCTION SET AND ASSEMBLY LANGUAGE

PROGRAMMING

(Inst. Hrs: 12)

Addressing modes – Data moving (Data transfer) instructions: Instructions to Access external data memory, external ROM / program memory, PUSH and POP instructions, Data exchange instructions – Logical instructions: byte and bit level logical operations, Rotate and swap operations – Arithmetic instructions: Flags, Incrementing and decrementing, Addition, Subtraction, Multiplication and division, Decimal arithmetic – Jump and CALL instructions: Jump and Call program range, Jump, Call and subroutines – Programming.

UNIT V:INTERRUPT PROGRAMMING AND INTERFACING TO EXTERNAL WORLD **(Inst. Hrs: 12)**

8051 Interrupts – Interrupt vector table – Enabling and disabling an interrupt – Timer interrupts and programming – Programming external hardware interrupts – Serial communication interrupts and programming – Interrupt priority in the 8051 : Nested interrupts , Software triggering of interrupt. LED Interface Seven segment display interface- Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities – Voltage and current) Measurement of physical quantities(Temperature an strain).

TEXT BOOKS

1. A. NagoorKani, Microprocessors & Microcontrollers, RBA Publications (2009).
2. A. P. Godse and D. A. Godse, Microprocessors, Technical Publications, Pune (2009).
3. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, Penram International Publishing (2013).
4. B. Ram, Fundamentals of Microprocessors & Microcontrollers, DhanpatRai publications New Delhi (2016).
5. V. Vijayendran, 2005, Fundamentals of Microprocessor-8085", 3rd Edition S.Visvanathan Pvt, Ltd.

REFERENCE BOOKS

1. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008)
2. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education (2008).
3. Barry B. Brey, 1995, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi.
4. J. Uffrenbeck, "The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.
5. W. A. Tribel, Avtar Singh, "The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.

WEB SOURCES

1. https://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.html
2. http://www.electronicsengineering.nbcafe.in/peripheral-mapped-io-interfacing/
3. https://www.geeksforgeeks.org/programmable-peripheral-interface-8255/
4. http://www.circuitstoday.com/8051-microcontroller
5. https://www.elprocus.com/8051-assembly-language-programming/

COURSE OUTCOMES:

At the end of the course, the student will be able to:
CO1- Gain knowledge of architecture and working of 8085 microprocessor. **K1**
CO2- Get knowledge of architecture and working of 8051 Microcontroller. **K1**
CO3- Be able to write simple assembly language programs for 8085A microprocessor. **K2, K3**
CO4- Able to write simple assembly language programs for 8051 Microcontroller. **K3, K4**
CO5- Understand the different applications of microprocessor and microcontroller. **K3,K 5**

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) **and** LOW (1)**.**

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

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	2	3	3	3	3	1	1	1	1	1
CO2	2	1	1	1	1	1	1	1	1	1
CO3	3	3	3	3	3	1	1	1	1	1
CO4	3	3	3	3	3	1	1	1	1	1
CO5	3	3	3	3	3	1	1	1	1	1

TITLE OF THE COURSE	**:**	**CHARACTERIZATON OF MATERIALS**
CATEGORY	**:**	**DISCIPLINE SPECIFIC ELCTIVE COURSE**
COURSECODE	**:**	**P2R3PHDSE4:2**
NATURE OF SKILL	**:**	**SKILLDEVELOPMENT**
MARKS:CIA:25+Ext:75=100		**HOURS/WEEK : 04**
CREDITS: 03		**TOTAL INST. HOURS : 60**

COURSE OBJECTIVES

C Obj -1-To make the students learn some important thermal analysis techniques namely TGA, DTA, DSC and TMA.

C Obj -2-To make the students understand the theory of image formation in an optical microscope and to introduce other specialized microscopic techniques.

C Obj -3-To make the students learn and understand the principle of working of electron microscopes and scanning probe microscopes.

C Obj -4-To make the students understand some important electrical and optical characterization techniques for semiconducting materials.

C Obj -5-To introduce the students the basics of x-ray diffraction techniques and some important spectroscopic techniques.

UNIT I THERMAL ANALYSIS **(Inst. Hrs: 12)**

Introduction – thermogravimetric analysis (TGA) – instrumentation – determination of weight loss and decomposition products – differential thermal analysis (DTA)- cooling curves – differential scanning calorimetry (DSC) – instrumentation – specific heat capacity measurements – determination of thermomechanical parameters.

UNIT II MICROSCOPIC METHODS **(Inst. Hrs: 12)**

Optical Microscopy: optical microscopy techniques – Bright field optical microscopy – Dark field optical microscopy – Dispersion staining microscopy - phase contrast microscopy – differential interference contrast microscopy - fluorescence microscopy - confocal microscopy - - digital holographic microscopy - oil immersion objectives - quantitative metallography - image analyzer.

UNIT III ELECTRON MICROSCOPY AND SCANNING PROBE MICROSCOPY

(Inst. Hrs: 12)

SEM, EDAX, EPMA, TEM: working principle and Instrumentation – sample preparation – Data collection, processing and analysis- Scanning tunnelingmicroscopy (STEM) - Atomic force microscopy (AFM) - Scanning new field optical microscopy.

UNIT IV ELECTRICAL METHODS AND OPTICAL CHARACTERISATION

(Inst. Hrs: 12)

Two probe and four probe methods- van der Pauw method – Hall probe and measurement – scattering mechanism – C-V characteristics – Schottky barrier capacitance – impurity concentration – electrochemical C-V profiling – limitations. Photoluminescence – light – matter interaction – instrumentation – electroluminescence – instrumentation – Applications.

UNIT V X-RAY AND SPECTROSCOPIC METHODS (Inst. Hrs: 12)

Principles and instrumentation for UV-Vis-IR, FTIR spectroscopy, Raman spectroscopy, ESR, NMR, NQR, XPS, AES and SIMS-proton induced X-ray Emission spectroscopy (PIXE) –Rutherford Back Scattering (RBS) analysis-application - Powder diffraction - Powder diffractometer -interpretation of diffraction patterns - indexing - phase identification - residual stress analysis - Particle size, texture studies - X-ray fluorescence spectroscopy - uses.

TEXT BOOKS

1. R. A. Stradling and P. C. Klipstain. Growth and Characterization of semiconductors. Adam Hilger, Bristol, 1990.
2. J. A. Belk. Electron microscopy and microanalysis of crystalline materials. Applied Science Publishers, London, 1979.
3. Lawrence E. Murr. Electron and Ion microscopy and Microanalysis principles and Applications. Marcel Dekker Inc., New York, 1991
4. D. Kealey and P. J. Haines. Analytical Chemistry. Viva Books Private Limited, New Delhi, 2002.
5. Li, Lin, Ashok Kumar Materials Characterization Techniques Sam Zhang; CRC Press,(2008).

REFERENCE BOOKS

1. Cullity, B.D., and Stock, R.S., "Elements of X-Ray Diffraction", Prentice-Hall, (2001).
2. Murphy, Douglas B, Fundamentals of Light Microscopy and Electronic Imaging,Wiley-Liss, Inc. USA, (2001).
3. Tyagi, A.K., Roy, Mainak, Kulshreshtha, S.K., and Banerjee, S., Advanced Techniques for Materials Characterization, Materials Science Foundations (monograph series), Volumes 49 – 51, (2009).Volumes 49 – 51, (2009).

4. Wendlandt, W.W., Thermal Analysis, John Wiley & Sons, (1986).
5. Wachtman, J.B., Kalman, Z.H., Characterization of Materials, ButterworthHeinemann, (1993)

WEB SOURCES

1. https://cac.annauniv.edu/uddetails/udpg_2015/77.%20Mat%20Sci(AC).pdf
2. http://www.digimat.in/nptel/courses/video/113106034/L11.html
3. https://nptel.ac.in/courses/104106122
4. https://nptel.ac.in/courses/118104008
5. https://www.sciencedirect.com/journal/materials-characterization

COURSE OUTCOMES:

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

CO1- Describe the TGA, DTA, DSC and TMA thermal analysis techniques and make interpretation of the results.- K1, K3

CO2- The concept of image formation in Optical microscope, developments in other specialized microscopes and their applications.- **K2**

CO3- The working principle and operation of SEM, TEM, STM and AFM.- **K2, K3**

CO4- Understood Hall measurement, four –probe resistivity measurement, C-V, I-V, Electrochemical, Photoluminescence and electroluminescence experimental techniques with necessary theory.- **K3, K4**

CO5- The theory and experimental procedure for x- ray diffraction and some important spectroscopic techniques and their applications.- **K4,K5**

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	2	2	2	2	3
CO2	3	3	3	2	2	2	2	2	2	2
CO3	3	3	2	2	2	3	2	2	2	2
CO4	2	2	2	3	2	3	2	2	2	2
CO5	2	2	2	2	2	2	3	2	2	2

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	2	2	2	2	2	2	3
CO2	3	3	3	2	2	2	2	2	2	2
CO3	3	3	2	2	2	3	2	2	2	2
CO4	2	2	2	3	2	3	2	2	2	2
CO5	2	2	2	2	2	2	3	2	2	2

Title of the Course	**:**	**SOLID WASTE MANAGEMENT**
Category	**:**	**Skill Enhancement Course**
Course Code	**:**	**P2R3PHSEC 1:1**
Nature of Skill	**:**	**Entrepreneurship**
Marks : CIA : 25 + Ext: = 75 = 100	**:**	**Hrs / Week : 04**
		Total Inst. Hrs : 60
Credits : 02		

Course Objectives

1. To gain basic knowledge in solid waste management procedures
2. To gain industry exposure and be equipped to take up a job.
3. To harness entrepreneurial skills.
4. To analyze the status of solid waste management in the nearby areas.
5. To sensitize the importance of healthy practices in waste managements

UNIT I:SOLID WASTE MANAGEMENT (Inst.Hrs:12)

Introduction - Definition of solid waste - Types – Hazardous Waste: Resource conservation and Renewal act – Hazardous Waste: Municipal Solid waste and non-municipal solid waste.

UNIT II:SOLID WASTE CHARACTERISTICS (Inst.Hrs: 12)

Solid Waste Characteristics: Physical and chemical characteristics - SWM hierarchy - factors affecting SW generation

UNIT III:TOOLS AND EQUIPMENT (Inst.Hrs: 12)

Tools and equipment - Transportation - Disposal techniques - Composting and land filling technique

UNIT IV:ECONOMIC DEVELOPMENT (Inst.Hrs: 12)

SWM for economic development and environmental protection Linking SWM and climate change and marine litter.

UNIT V:INDUSTRIAL VISIT (Inst.Hrs: 12)

SWM Industrial visit – data collection and analysis - presentation

TEXT BOOKS

1. Handbook of Solid Waste Management /Second Edition, George Tchobanoglous, McGraw Hill (2002).

2. Prospects and Perspectives of Solid Waste Management, Prof. B BHosett, New Age International (P) Ltd (2006).
3. Solid and Hazardous Waste Management, Second Edition, M.N Rao, BS Publications BSP /Books (.(2020
4. Integrated Solid Waste Management Engineering Principles and Management, Tchobanoglous, McGraw Hill (2014).
5. Solid Waste Management (SWM), Vasudevan Rajaram, PHI learning private limited, 2016

REFERENCE BOOKS

1. Municipal Solid Waste Management, Christian Ludwig, Samuel Stucki, Stefanie Hellweg, Springer Berlin Heisenberg, 2012
2. Solid Waste Management Bhide A. D Indian National Scientific Documentation Centre, New Delhi Edition 1983 ASIN: B0018MZ0C2
3. Solid Waste Techobanoglous George; Kreith, Frank McGraw Hill Publication, New Delhi 2002, ISBN 9780071356237
4. Environmental Studies Manjunath D. L. Pearson Education Publication, New Delhi, 20061SBN-I3: 978-8131709122
5. Solid Waste Management Sasikumar K. PHI learning, New Delhi, 2009 ISBN 8120338693

WEB SOURCES

1. https://www.meripustak.com/Integrated-Solid-Waste-Management-Engineering-Principles-And-Management-Issues-125648
2. https://testbook.com/learn/environmental-engineering-solid-waste-management/
3. https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsA-gM0iVpismAJN93CHA1sX6NuNeOKLXfQJ_jxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB
4. https://images.app.goo.gl/tYiW2gUPfS2cxdD28
5. https://amzn.eu/d/5VUSTDI

COURSE OUTCOMES:

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

CO1- Gained knowledge in solid waste management. **K1**

CO2- Equipped to take up related job by gaining industry exposure. **K5**

CO3- Develop entrepreneurial skills. **K3**

CO4- Will be able to analyze and manage the status of the solid wastes in the nearby areas. **K4**

CO5- Adequately sensitized in managing solid wastes in and around his/her locality. **K5**

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	3	3	3	2	2	2	2	2	3
CO2	2	3	3	2	2	2	3	3	3	2
CO3	2	3	2	2	2	2	3	3	3	2
CO4	3	2	2	2	2	3	3	3	3	2
CO5	2	3	3	2	2	2	3	3	2	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	2	3	3	3	2	2	2	2	2	3
CO2	2	3	3	2	2	2	3	3	3	2
CO3	2	3	2	2	2	2	3	3	3	2
CO4	3	2	2	2	2	3	3	3	3	2
CO5	2	3	3	2	2	2	3	3	2	3

TITLE OF THE COURSE	**:**	**SEWAGE AND WASTE WATER TREATMENT AND REUSE**
CATEGORY	**:**	**SKILL ENHANCEMENT COURSE**
COURSECODE	**:**	**P3R3PHSEC1:2**
NATURE OF SKILL	**:**	**Entrepreneurship**
MARKS:CIA:25+Ext:75=100		**HOURS/WEEK : 04**
CREDITS: 02		**TOTAL INST. HOURS : 60**

COURSE OBJECTIVES

C Obj -1-To gain basic knowledge in sewage and waste water Treatment procedures

C Obj -2-To gain industry exposure and be equipped to take up job.

C Obj -3-To harness entrepreneurial skills.

C Obj -4-To analyze the status of sewage and waste water management in the nearby areas.

C Obj -5-To sensitize the importance of healthy practices in waste water management.

UNIT I: RECOVERY & REUSE OF WATER (Inst. Hrs: 12)

Recovery & Reuse of water from Sewage and Waste water: Methods of recovery: Flocculation - Sedimentation - sedimentation with coagulation - Filtration - sand filters - pressure filters - horizontal filters - vector control measures in industries - chemical and biological methods of vector eradication.

UNIT II: DISINFECTION (Inst. Hrs: 12)

Disinfection: Introduction to disinfection and sterilization: Disinfectant - UV radiation - Chlorination - Antisepsis - Sterilant - Aseptic and sterile -Bacteriostatic and Bactericidal - factors affecting disinfection.

UNIT III: CHEMICAL DISINFECTION (Inst. Hrs: 12)

Chemical Disinfection: Introduction - Theory of Chemical Disinfection - Chlorination Other Chemical Methods - Chemical Disinfection Treatments Requiring - Electricity - Coagulation/Flocculation Agents as Pretreatment - Disinfection By-Products(DBPs)

UNIT IV: PHYSICAL DISINFECTION (Inst. Hrs: 12)

Physical Disinfection: Introduction - Ultraviolet Radiation - Solar Disinfection - Heat Treatment - Filtration Methods - Distillation - Electrochemical Oxidation Water Disinfection by Microwave Heating.

UNIT V: INDUSTRIAL VISIT (Inst. Hrs: 12)

Industrial visit – data collection and analysis - presentation

TEXT BOOKS

1. Drinking water and disinfection technique, Anirudhha Balachandra. CRC press (2013)
2. Design of Water and Wastewater Treatment Systems (CV-424/434), ShashiBushan,Jain Bros)2015(
3. Integrated Water Resources Management, Sarbhukan M M, CBS PUBLICATION (2013)
4. C.S. Rao, Environmental Pollution Control Engineering, New Age International, 2007
5. S.P. Mahajan, Pollution control in process industries, 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.

REFERENCE BOOKS

1. Handbook of Water and Wastewater Treatment Plant Operations, Frank. R Spellman, CRC Press, 2020
2. Wastewater Treatment Technologies, MritunjayChaubey, Wiley, 2021.
3. Metcalf and Eddy, Wastewater Engineering, 4th ed., McGraw Hill Higher Edu., 2002.
4. W. Wesley Eckenfelder, Jr., Industrial Water Pollution Control, 2nd Edn., McGraw Hill Inc., 1989
5. Lancaster, Green Chemistry: An Introductory Text, 2nd edition, RSC publishing, 2010.

WEB SOURCES

1. https://www.google.co.in/books/edition/Drinking_Water_DisinfectionTechniques/HVbNBQAAQBAJ?hl=en

2.https://www.meripustak.com/Integrated-Solid-Waste-Management-Engineering-Principles-And-Management-Issues-125648?

3.https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsAC-gM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB

4. https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsAC-gM0iVpismAJN93CHA1sX6NuNeOKLXfQJ jxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB
5. https://www.amazon.in/Design-Wastewater-Treatment-Systems-CV-424/dp/B00IG2PI6K/ref=asc_df_B00IG2PI6K/?tag=googleshopmob-21&linkCode=df0&hvadid=397013004690&hvpos=&hvnetw=g&hvrand=4351305881865063672&hvpone=&hvptwo=&hvqmt=

&hvdev=m&hvdvcmdl=&hvlocint=&hvlocphy=9061971&hvtargid=pla-890646066127&psc=1&ext_vrnc=hi

COURSE OUTCOMES:

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

CO1- Gained knowledge in solid waste management- **K1**

CO2- Equipped to take up related job by gaining industry exposure- **K5**

CO3- Develop entrepreneurial skills- **K3**

CO4- Will be able to analyze and manage the status of the solid wastes in the nearby areas- **K4**

CO5- Adequately sensitized in managing solid wastes in and around his/her locality- **K5**

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	3	3	2	3	2	3	2
CO2	2	3	2	2	3	3	2	3	2	2
CO3	2	2	2	2	2	3	3	3	3	2
CO4	3	2	3	3	2	3	3	3	3	2
CO5	2	2	2	2	3	3	2	2	2	2

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	3	3	3	2	3	2	3	2
CO2	2	3	2	2	3	3	2	3	2	2
CO3	2	2	2	2	2	3	3	3	3	2
CO4	3	2	3	3	2	3	3	3	3	2
CO5	2	2	2	2	3	3	2	2	2	2

TITLE OF THE COURSE	**:**	**ELECTROMAGNETIC THEORY**
CATEGORY	**:**	**CORE COURSE**
COURSECODE	**:**	**P3R3PHCC7**
NATURE OF SKILL	**:**	**SKILLDEVELOPMENT**
MARKS:CIA:25+Ext:75=100		**HOURS/WEEK : 06**
CREDITS: 05		**TOTAL INST. HOURS : 90**

COURSE OBJECTIVES

C. obj – 1. To develop theoretical knowledge in electromagnetism.

C. obj – 2. To develop skills on solving analytical problems in electromagnetism.

C. obj – 3. To give basics of defining the complete electromagnetic response of complex systems.

C. obj – 4.To understand the Gauss's law of electrostatics

C. obj – 5.To acquire the knowledge of EM waves in conductor and dielectric

UNIT -I: ELECTROSTATICS (Inst. Hrs : 18)

Coulomb's law- The electric field –Gauss's law - application of Gauss's law – curl of E - Poisson's equation and Laplace's equation – work and energy in electrostatics – energy of a point charge distribution – energy of continuous charge distribution – induced charges – capacitors.

Potentials: Laplace equation in one dimension and two dimensions – Dielectrics – induced dipoles – Gauss's Law in the presence of dielectrics

UNIT- II: MAGNETOSTATICS (Inst. Hrs : 18)

Lorentz force – magnetic fields – magnetic forces – currents – Biot-Savart Law – divergence and curl of B – Ampere's Law – Electromagnetic induction - comparison of magnetostatics and electrostatics – Magnetic vector potential (Assignment).

Magnetization: effect of magnetic field on atomic orbit – Ampere's Law in magnetized materials – ferromagnetism.

UNIT-III: ELECTROMOTIVE FORCE (Inst. Hrs : 18)

Ohm's Law – electromotive force – motional emf – Faraday's Law – induced electric field – inductance – energy in magnetic field – Maxwell's equation in free space and linear isotrophic media – continuity equation – Poynting theorem

Electromagnetic waves in vacuum: Waves in one dimension – wave equation – sinusoidal waves – reflection and transmission – Polarization.

UNIT-IV: ELECTROMAGNETIC WAVES (Inst. Hrs : 18)

The wave equation for E and B – Monochromatic Plan waves – energy and momentum in electromagnetic waves – electromagnetic waves in matters –TE waves in rectangular wave guides – the co-axial transmission line.

Potentials: potentials and fields – scalar and vector potentials – Gauge transformation – Coulomb Gauge and Lorentz Gauge – Lorentz force law in potential form .

UNIT-V: APPLICATION OF ELECTROMAGNETIC WAVES (Inst. Hrs : 18)

Boundary conditions at the surface of discontinuity – Reflection and refraction of E.M waves at the interface of non – Conducting media – Kinematic and dynamic properties – Fresnel's equation – Electric field vector 'E' parallel to the plane of incidence and perpendicular to the plane of incidence – Brewster's law and degree of polarization. – Total internal reflection.

BOOK FOR STUDY:

1. Introduction to Electrodynamics – David J. Griffiths, 4th Edition, Pearson.

2. Electromagnetic Theory and Electrodynamics, SathyaPrakash, KedarNath Ram Nath and Co, 2017.

3. Electromagnetics, B.B Laud, Wiley Eastern Company, 2000.

4. Fundamentals of Electromagnetic, WazedMiah, Tata Mc Graw Hill, 1980.

5. Basic Electromagnetics with Application, Narayanarao, (EEE) Prentice Hall, 1997.

BOOKS FOR REFERENCE:

1. Fundamentals of Electromagnetic Theory, Third edition, Narosa Publishing House, New Delhi – John R.Reitz, Frederick J Milford and Robert W.Christy, 1998.

2. Classical Electrodynamics – J.D. Jackson, II Edition, Wiley Eastern Limited, 1993.

3. Electromagnetic Fields and Waves – P.Lorrain and D.Corson.

4. Electromagnetics , B.B Laud, Wiley Eastern Company, 2000.

On line Resource Link:

1. https://drive.google.com/file/d/1-QQLBEpQz3jB7U_soJrtwKVXCS2rXAHD/view?usp=sharing

COURSE OUTCOME:

On completion of this course the students will be able to

CO .1.understand the basics of Electrostatics - K2

CO. 2. understand the basics of Magnetostatics - K2

CO. 3. acquire knowledge on field equations and electromotive force - K1

CO. 4.acquire the knowledge of the various modes of propagation of EM waves in waveguides - K1

CO. 5. analyze the behavior of EM waves in conducting surface through absorption, dispersion and reflection - K4

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

Title of the Course: ELECTROMAGNETIC THEORY						**Course Code:P3R3PHCC7**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	3	2	2	3	2	3	2	2.5
CO2	3	2	3	2	2	2	3	2	2	2	2.3
CO3	2	3	2	2	3	3	2	2	3	2	2.4
CO4	2	3	2	3	3	3	2	2	3	2	2.5
CO5	2	3	2	2	3	3	2	2	2	3	2.4
									Mean Overall Score		**2.42**
									Result		**High**

TITLE OF THE COURSE : QUANTUM MECHANICS – II

CATEGORY : CORE COURSE

COURSECODE : P3R3PHCC8

NATURE OF SKILL : SKILLDEVELOPMENT

MARKS:CIA:25+Ext:75=100 HOURS/WEEK : 06

CREDITS: 05 TOTAL INST. HOURS : 90

COURSE OBJECTIVES

C. obj – 1.Formal development of the theory and the properties of angular moment, both orbital and spin

C. obj – 2.To familiarize the students to the crucial concepts of scattering theory such as partial wave analysis and Barn approximation.

C. obj – 3.Time-dependent Perturbation theory and its application to study of interaction of an atom with the electromagnetic field

C. obj – 4.To give the students a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts

C. obj – 5.To introduce the concept of covariance and the use of Feynman graphs for depicting differen

UNIT 1: SCATTERING THEORY (Inst. Hr 18)

Scattering amplitude – Cross sections – Born approximation and its validity – Scattering by a screened coulomb potential – Yukawa potential – Partial wave analysis – Scattering length and Effective range theory for s wave – Optical theorem – Transformation from centre of mass to laboratory frame.

UNIT II: PERTURBATION THEORY (Inst. Hr 18)

Time dependent perturbation theory – Constant and harmonic perturbations – Fermi Golden rule – Transition probability Einstein's A and B Coefficients – Adiabatic approximation – Sudden approximation – Semi – classical treatment of an atom with electromagnetic radiation – Selection rules for dipole radiation

UNIT III:RELATIVISTIC QUANTUM MECHANICS (Inst. Hr 18)

Klein – Gordon Equation – Charge And Current Densities – Dirac Matrices – Dirac Equation – Plane Wave Solutions – Interpretation Of Negative Energy States – Antiparticles – Spin of Electron – Magnetic Moment Of An Electron Due To Spin

UNIT IV: DIRAC EQUATION (Inst. Hr 18)

Covariant form of Dirac Equation – Properties of the gamma matrices – Traces – Relativistic invariance of Dirac equation – Probability Density – Current four vector – Bilinear covariant

– Feynman's theory of positron (Elementary ideas only without propagation formalism)

UNIT V: CLASSICAL FIELDS AND SECOND QUANTIZATION

Classical fields – Euler Lagrange equation – Hamiltonian formulation – Noether's theorem – Quantization of real and complex scalar fields – Creation, Annihilation and Number operators – Fock states – Second Quantization of K-G field.

TEXT BOOKS

1. P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics,2nd Edition,Tata McGraw-Hill, New Delhi, 2010.
2. G. Aruldhas, Quantum Mechanics, 2nd Edition, Prentice-Hall of India, NewDelhi,2009
3. L. I. Schiff, Quantum Mechanics, 3rd Edition, International Student Edition, McGraw-Hill Kogakusha, Tokyo, 1968
4. V. Devanathan, Quantum Mechanics, 1st Edition, Narosa Publishing House, New Delhi, 2005.
5. NouredineZettili, Quantum mechanics concepts and applications, 2nd Edition, Wiley, 2017

REFERENCE BOOKS

1. P. A. M. Dirac, The Principles of Quantum Mechanics, 4th Edition,Oxford University Press, London, 1973.
2. B.K.Agarwal & HariPrakash, Quantum Mechanics, 7th reprint, PHI Learning Pvt. Ltd., New Delhi, 2009.
3. Deep Chandra Joshi, Quantum Electrodynamics and Particle Physics,1st edition,I.K.International Publishing house Pvt.Ltd., 2006
4. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4th Edition, Macmillan India, New Delhi
5. E. Merzbacher, Quantum Mechanics, 2nd edition, John Wiley and Sons, New York, 1970

WEB SOURCES

1. https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture notes/MIT8_05F13_Chap_09.pdf
2. http://www.thphys.nuim.ie/Notes/MP463/MP463_Ch1.pdf
3. http://hep.itp.tuwien.ac.at/~kreuzer/qt08.pdf
4. https://www.cmi.ac.in/~govind/teaching/rel-qm-rc13/rel-qm-notes-gk.pdf
5. https://web.mit.edu/dikaiser/www/FdsAmSci.pdf

COURSE OUTCOMES:

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

CO 1. familiarize the concept of scattering theory such as partial wave analysis and Born approximation **K1**

CO 2.give a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts **K2**

CO. 3 discuss the relativistic quantum mechanical equations namely, Klein-Gordon and Dirac equations and the phenomena accounted by them like electron spin and magnetic moment **K1,K4**

CO. 4 introduce the concept of covariance and the use of Feynman graphs for depicting different interactions **K1**

CO. 5 demonstrate an understanding of field quantization and the explanation of the scattering matrix. K5

Relationship Matrix forCourse Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

Title of the Course: QUNANTUM MECHANICS-II						**Course Code:P3R3PHCC8**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	2	3	2	3	2	2.6
CO2	3	2	3	3	2	2	3	2	3	2	2.4
CO3	2	3	3	2	3	3	2	2	3	2	2.5
CO4	2	3	2	3	2	3	2	2	3	2	2.3
CO5	2	3	3	2	3	3	2	2	2	3	2.5
	Mean Overall Score										**2.42**
	Result										**High**

TITLE OF THE COURSE : CONDENSED MATTER OF PHYSICS

CATEGORY : CORE COURSE

COURSECODE : P3R3PHCC9

NATUREOFSKILL : SKILLDEVELOPMENT

MARKS:CIA:25+Ext:75=100 **HOURS/WEEK : 06**

CREDITS: 05 **TOTAL INST. HOURS : 90**

COURSE OBJECTIVES

The main objectives of this course are:

C Obj -1 To study the different structure of crystalline solids.

C Obj -2 To gain knowledge about carrier movement, lattice vibration and thermal property in solids.

C Obj -3 To understand the concepts of Free Electron and Band Theory of Solids.

C Obj -4 To study the different types of magnetism in solids.

C Obj -5 To study super conductivity and its applications.

UNIT – I: CRYSTAL PHYSICS (Inst. Hrs: 18)

Crystals - Crystal lattice and translation vectors - Types of lattices (2D & 3D) - Point group – Space groups - Lattice direction and planes - Simple crystal structures - Close packed and loose packed structures - Structure of Diamond, Zinc Blend and Sodium chloride- X-ray diffraction - X-ray diffraction methods (Laue's method, Power crystal method) - Reciprocal lattice and its Properties - Imperfections in crystals - Point defects - line defects.

UNIT–II: SEMICONDUCTORS, LATTICE VIBRATIONS AND THERMAL PROPERTY (Inst. Hrs: 18)

Intrinsic and Extrinsic semiconductors - General study of carrier movement - Fermi level and conductivity – Lattice vibrations - One dimensional Monatomic lattice and diatomic lattice - Phonons - Phonon momentum - Lattice heat capacity - Classical theory (Dulong and Petit Law) - Einstein theory - Debye's model - Density modes.

UNIT – III:FREE ELECTRON THEORY AND BAND THEORY OF SOLIDS

(Inst. Hrs: 18)

Drude - Lorentz's classical theory of free electron gas – Relation between thermal and electrical conductivity (Wiedemann-Franz Law) – Free electron Gas in a 1-D - Free electron Gas in a 3-D- Application of free electron gas model – Bloch theorem – Kronig-Penny model . – effective mass of electron.

UNIT – IV: DIELECTRICS AND MAGNETISM IN SOLIDS (Inst. Hrs: 18)

Polarization and Susceptibility – Local field - Dielectric constant and Polarizability (Clausius-Mosotti Equation) - Sources of Polarizability - Ferro electricity - Classical and Quantum theory of Dia and Para magnetism - Weiss theory of ferromagnetism . – Hund's rules- Concepts of Domains – Anti ferromagnetism – Ferrimagnetism- Piezo electricity – Phenomenological approach to Piezoelectric effects – Piezoelectric parameters and their measurements – Piezoelectric materials.

UNIT – V: SUPERCONDUCTIVITY (Inst. Hrs: 18)

Introduction – The Meissner effect (Assignment) – Soft and hard superconductors – Thermo dynamical and optical properties – Type -I and Type-II superconductors - London equations – BCS theory- Quantum tunneling-Josephson tunneling- Theory of DC Josephson effect – Theory of AC Josephson effect- High Tc super conductors – SQUIDS – Applications of super conductors.

BOOKS FOR STUDY

1. Introduction to Solid State Physic, C. Kittel, Wiley Eastern, New Delhi, 2008.
2. Solid State Physics, A. J. Dekker, McMillan, Madras, 1971.
3. Solid State Physics, S. O. Pillai, New Age International (P) Ltd, Revised 6th Edition, 2008.
4. Solid State Physics, Gupta and Kumar, K.Nath& Co, Meerut, 2011.

BOOKS FOR REFERENCE

1. An Introduction to X-ray Crystallography, M. M. Woolfson, Cambridge University Press, Cambridge, 1991.
2. Solid State Physics N. W. Ashcrof and N. D. Mermin, Holt, Rinehart and Winston, Philadelphia.

3. Solid State Physics J. S. Blakemore, Cambridge University Press, Cambridge, 1985.

ONLINE RESOURCES

http://www4.hcmut.edu.vn/~huynhqlinh/project/Minhhoa3/Nhieuxa/Nx2/www.matter.org.uk/diffraction/x-ray/laue_method.htm

https://winnerscience.com/london-equations-in-superconductors-derivation-and-

COURSE OUTCOMES

On the successful completion of the course the students will be able to:

CO-1 classify crystal structures and their defects **-K2**

CO-2 compare classical and quantum theories of lattice heat capacity **-K4**

C0-3 apply free electron gas model **-K3**

CO-4 distinguish different types of magnetism in solids **-K4**

CO-5 elaborate the applications of superconductors **- K6**

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

Title of the Course: Condensed Matter of Physics						**Course Code: P3R3PHCC9**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	3	3	3	2	2	3	2.6
CO2	3	3	3	2	2	3	3	1	2	2	2.4
CO3	2	3	3	2	2	3	3	3	2	2	2.5
CO4	3	3	2	1	3	3	3	3	2	2	2.4
CO5	3	2	2	3	3	3	3	2	3	2	2.6
	Mean Overall Score										**2.5**
	Result										**High**

TITLE OF THE COURSE : PRACTICAL-III

CATEGORY : CORE COURSE

COURSE CODE : P3R3PHCC10P

NATURE OF SKILL : SKILL DEVELOPMENT

MARKS:CIA:40+Ext:60=100 HOURS/WEEK: 06

CREDITS: 05 TOTAL INST. HOURS : 90

COURSE OBJECTIVES:

The main objectives of this course are **:**

C. obj - 1. To understand the concepts of charge of an electron by spectrometer..

C. obj - 2. To Acquire Knowledge about polarizability of liquids.

C. obj – 3. To understand the concept of Ultrasonic Interferometer

C. obj – 4. To understand the concept of microprocessor

C. obj – 5. To develop programming skill in interfacing using microprocessor

(Minimum of Twelve Experiments from the list)

1. Charge of an electron by spectrometer.
2. Polarizability of liquids by finding the refractive indices at different wavelengths.
3. Determination of wavelength of monochromatic source using Biprism.
4. Determination of specific rotatory power of a liquid using Polari meter.
5. Determination of Thickness of air film. - Solar spectrum – Hartmann's formula. Edser and Butler fringes.
6. Determination of velocity and compressibility of a liquid using Ultrasonic Interferometer
7. Determination of Diffraction pattern of light with circular aperture using Diode/He-Ne laser.
8. Construction of square wave generator using IC 555 – Study of VCO
9. Study of Binary to Gray and Gray to Binary code conversion.
10. Construction of Encoder and Decoder circuits using ICs.
11. Study of Modulus Counter
12. 8-bit addition and subtraction, multiplication and division using microprocessor 8085
13. Sum of a set of N data (8-bit number), picking up the smallest and largest number in an array. Sorting in ascending and descending orderusing microprocessor 8085
14. Code conversion (8-bit number): a) Binary to BCD b) BCD to Binary using microprocessor 8085
15. Interfacing of seven segment display using microprocessor 8085
16. Interfacing of DC stepper motor – Clockwise, Anti-clockwise, Angular movement and Wiper action using microprocessor 8085
17. Interfacing of Traffic light controller using microprocessor 8085

BOOKS FOR REFERENCE:

1. A text book of practical Physics–M.N.Srinivasan and others–Sultan Chand &Sons, New Delhi.
2. Practical Physics, S. Somasundaram, V. Balachandran, S. Padmanathan, Apsara Publications, Tiruchirapalli

ON LINE RESOURCE:

1.https://www.pdfdrive.com/microprocessor-8086-lab-manual-e33574949.htm

2.https://www.jnec.org/labmanuals/eep/se/sem2/SY%20P2%20NMP%20Lab%20manual.pdf

COURSE OUTCOME:

On the successful completion of the course the students will be able to:

CO-1. retrieve the knowledge about the charge of electron by spectrometer-**K1.**

CO-2.become expertise about Polarizability of liquids by finding the refractive indices at different wavelengths **-K2**

CO-3.acquire Knowledge about ultrasonic interferometer-**K1,K4**

CO-4.apply Interfacing device to microprocessor **- K3**

CO-5. write Assembly Language programme for the 8086 **-K1**

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

Title of the Course: Practical-III						**Course Code:P3R3PHCC10P**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	3	3	3	2	2	3	2.6
CO2	3	3	3	2	2	3	3	1	2	2	2.4
CO3	2	3	3	2	2	3	3	3	2	2	2.5
CO4	3	3	2	1	3	3	3	3	2	2	2.4
CO5	3	2	2	3	3	3	3	2	3	2	2.6
	Mean Overall Score										**2.5**
	Result										**High**

TITLEOFTHECOURSE : CRYSTAL GROWTH AND THIN FILMS

CATEGORY : DISCIPLINE SPECIFIC ELECTIVE

COURSECODE : P3R3PHDSE 5: 1

NATUREOFSKILL : EMPOLYABILITY

MARKS : CIA:25+Ext:75=100 **HOURS/WEEK :04**

CREDITS :03 **TOTALINST.HOURS:60**

COURSE OBJECTIVES:

The main objectives of this course are:

C obj-1. The students will learn the crystal growth mechanisms and techniques.

C obj-2.To study the various thin film deposition techniques and its analysis.

C obj-3.Acquire knowledge about applications of thin films.

Understand the various methods of thin films preparations

Understand the various technique of characterizations

UNIT-I: NUCLEATION AND CRYSTAL GROWTH (Inst.Hrs:12)

Nucleation - Different kinds of nucleation - Concept of formation of critical nucleus- Classical theory of nucleation - Spherical and cylindrical nucleus - Low temperature solution growth: Solution - Solubility and super solubility - Expression of super saturation -Mier's T-C diagram - Growth Kinetics of Thin Films - Thin Film Structure- Crystal System and Symmetry.

UNIT-II: GEL AND SOLUTION GROWTH TECHNIQUES (Inst.Hrs:12)

Constant temperature bath and crystallizer -Seed preparation and mounting - Slow cooling and solvent evaporation methods.

Principle - Various types - Structure of gel - Importance of gel - Experimental procedure - Chemical reaction method - Single and double diffusion method - Chemical reduction method -Complex and decomplexion method. - Advantages of gel method.

UNIT-III: MELT AND VAPOUR GROWTH TECHNIQUES (Inst.Hrs:12)

Melt technique: Bridgman technique - Basic process - Various crucibles design - Thermal consideration - Vertical Bridgman technique - Czochralskitechnique - Experimental arrangement - Growthprocess.

Vapour technique: Physical vapour deposition - Chemical vapour deposition (CVD) - Chemical Vapour Transport.

UNIT-IV: THIN FILM DEPOSITION TECHNIQUES (InstHrs:12)

Thin Films - Introduction to Vacuum Technology - Deposition Techniques - Physical Methods - Resistive Heating, Electron Beam Gun, Laser Gun Evaporation and Flash Evaporations, Sputtering - Reactive Sputtering, Radio-Frequency Sputtering - Chemical Methods - Spray Pyrolysis -Electro deposition - Sol-gel technique.

UNIT-V: CHARACTERIZATION TECHNIQUE (InstHrs:12)

X-ray Diffraction (XRD) - Powder and single crystal - Fourier transform Infrared analysis (FT-IR) - Elemental dispersive X-ray analysis (EDAX) - Transmission electron microscopy (TEM) and Scanning Electron Microscopy (SEM) - UV-VIS-NIR Spectrometer - Chemical Etching - Vickers Micro hardness - Photoluminescence spectroscopy (PL).

BOOKS FOR STUDY:

1. I.V. Markov, Crystal Growth for Beginners: Fundamentals of Nucleation, Crystal Growth and Epitaxy, (2004) 2nd edition.
2. P. Santhanaragavan and P. Ramasamy, Crystal Growth Process and Methods (KRU Publications, Kumbakonam, 2001).
3. A. Goswami, Thin Film Fundamentals (New Age International (P) Limited, New Delhi, 2008).
4. H.H. Willard, L.L. Meritt, J.A. Dean, F.A. Sette, Instrumental Methods of Analysis (CBS Publishers, New Delhi, 1986).
5. S. Zhang, L. Li and A. Kumar, Materials Characterization Techniques (CRC Press, Bota Racon, 2009).

BOOKS FOR REFERENCE:

1. J. C. Brice, Crystal Growth Process (John Wiley and Sons, New York, 1986).
2. M. Ohring, Materials Science of Thin Films (Academic Press, Boston, 2002) 2nd edition.
3. E. N. Kaufmann, Characterization of Materials, Volume-I (John Wiley, New Jersey,2012).
4. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, CBS, Publishers and Distributors, NewDelhi.

ON LINERE SOURCE:

1. https://www.msm.cam.ac.uk/research/research-disciplines/crystal-growth-and-thin-films

COURSE OUTCOMES:

On the successful completion of the course the students will be able to:

CO-1.understand the nucleation and kinetics of crystal growth and technique. -

K1

CO-2.knowledge about modern crystal growth technique. -

K3

CO-3.acquire knowledge about physical properties of crystals. -

K5

CO-4.understand the thin film deposition techniques, film growth and structure. -

K4

CO-5.knowledge about thin film analysis, electrical, optical and magnetic properties. -

K2

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

Title of the Course: Crystal Growth and Thin films						**Course Code:P3R3PHDSE 5:1**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	2	3	3	2	2	3	2.5
CO2	3	3	3	2	2	3	3	1	2	2	2.4
CO3	2	2	3	2	2	3	3	3	2	2	2.4
CO4	3	3	2	1	3	3	3	3	2	2	2.4
CO5	3	2	2	3	3	3	3	2	2	2	2.5
										Mean Overall Score	**2.44**
										Result	**High**

TITLE OF THE COURSE : MEDICAL PHYSICS

CATEGORY : DISCIPLINE SPECIFIC ELECTIVE

COURSE CODE : P3R3PHDSE 5:2

NATURE OF SKILL : EMPLOYABILITY

MARKS : CIA:25+Ext:75=100 **HOURS WEEK : 04**

CREDIT :03 **TOTAL INST HOURS: 60**

COURSE OBJECTIVES

The main objectives of this course are

C obj-1. To understand the general concepts in radiation and its interaction and dose measurement.

C obj-2 To Understand physics principle involved Medical physics

C obj-3. To apply the physics concepts in clinical trials.

C obj-4 To educate scientifically the principles of radiation and its effect in the medical field

C obj-5 To emphasize the significance of various medical techniques and therapy

UNIT – I **(Inst Hrs:12)**

Basic concepts in Radiation Dosimetry: Definitions of Dosimetric Quantities-units and relationship between DQ- linear energy transfer- tissue weighting factor-charged particle equilibrium-biological effects of radiation.

UNIT –II **(Inst Hrs:12)**

Interaction of gamma rays and X-rays with matter: Introduction- typesof interaction with matter – over all interaction of photons with matter.

UNIT – III **(Inst Hrs:12)**

Treatment planning in radiation therapy- photon beam treatment planning-electron beam treatment planning.

UNIT – IV **(Inst Hrs:12)**

Image-Guided radiation therapy: Introduction – Rationale of IGRT- current available IG techniques– traditional IGRT technologies –real time tracking systems – image registration and correction strategies – image guided Adaptive treatment (IG-ART) -

management of respiratory motion.

UNIT –V **(Inst Hrs:12)**

Magnetic Resonance Imaging (MRI): MRI – contrasts in MRI – Physiological and functional MRI – MRI safety – future MRI applications. CT and MRI Radiotherapy: CT based treatment simulation and planning – MRI in Radiotherapy.

BOOKS FOR STUDY:

1. Introduction to Medical Physics – Muhammad Maqbool – Springer International Publishing (2017).

2.Medical Physics-John R Cameron and jamesG,Skofronick, John Wiley and Sons-Interscience Oublications,1978.

BOOKS FOR REFERENCE:

1. Attix FH (1986) An introduction to radiological physics and radiation dosimetry, Wiley.

2. Hendee WR, Ritenour ER (2002) Medical imaging physics, 4th edn. Wiley-Liss. xix,

New York

ONLNE RESOURCE

https://www.routledge.com/Introduction-to-Medical-Physics/Keevil-Padovani-Tabakov-Greener-Lewis/p/book/9781498744799

COURSE OUT COME

On the successful completion of the course the students will be able to:

CO-1 understand basic concepts of Radiation. **–K2**

CO-2.explain the types of Interaction. **-K2**

CO-3.analyze the different radiation therapy **-K4**

CO-4.explain the radiation therapy **-K2**

CO-5.apply the various technique in MRI **-K3**

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

Title of the Course :Medical Physics						**Course Code:P3R3PHDSE 5:2**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	3	3	3	2	2	3	2.6
CO2	3	3	3	2	2	3	3	2	2	2	2.5
CO3	2	3	3	2	2	3	3	3	2	2	2.5
CO4	3	3	2	1	3	3	3	3	2	2	2.4
CO5	3	2	2	3	3	3	3	2	3	2	2.6
	Mean Overall Score										**2.52**
	Result										**High**

TITLE OF THE COURSE : SOLAR ENERGY UTILIZATION

CATEGORY : SKILL ENHANCEMENT COURSE

OURSE CODE : P3R3PHSEC 2:1

NATURE OF SKILL : EMPLOYABILITY

MARKS:CIA:25+Ext:75=100 HOURS WEEK : 02

CREDIT : 02 TOTAL INST HOURS : 30

COURSE OBJECTIVES

The main objectives of this course are

C obj-1. To understand the general concepts in Heat transfer and radiation.

C obj-2 . To Understand the basic principle of solar collecter.

C obj-3. To Know the various types of Solar Heater.

C obj-4. To educate scientifically the principles of Solar energy conversion.

C obj-5 . To emphasize the significance of Nano materials

UNIT I: HEAT TRANSFER & RADIATION ANALYSIS (Inst Hrs:06)

Conduction, Convection and Radiation – Solar Radiation at the earth's surface - Determination of solar time – Solar energy measuring instruments.

UNIT II: SOLAR COLLECTORS (Inst Hrs:06)

Physical principles of conversion of solar radiation into heat flat plate collectors - General characteristics – Focusing collector systems – Thermal performance evaluation of optical loss.

UNIT III: SOLAR HEATERS (Inst Hrs:06)

Types of solar water heater - Solar heating system – Collectors and storage tanks – Solar ponds – Solar cooling systems.

UNIT IV: SOLAR ENERGY CONVERSION (Inst Hrs:06)

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, Anti reflective coatings, metallization.

UNIT V: NANOMATERIALS IN FUEL CELL APPLICATIONS (Inst Hrs:06)

Use of nanostructures and nano materials 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- College Solar power Plant Visit - data collection – analysis - Presentation.

BOOKS FOR STUDY:

1. Solar energy utilization -G.D. Rai –Khanna publishers – Delhi 1987.
2. Solar energy – principles of thermal collection & storage – S.P. Sukhatme, TMH Delhi 1984.
3. Maheshwar Sharon, MadhuriSharon, Carbon "Nano forms and Applications", McGraw-Hill,2010.

BOOKS FOR REFERENCE:

1. Solar Energy – An Introduction to Physic s – R.H. Romer, W.H .Freeman.(1976)

ONLINE RESOURCE

https://solareis.anl.gov/guide/solar/index.cfm

COURSE OUT COMES

On the successful completion of the course the students will be able to:

CO-1.understand basic concepts of Radiation. **–K2**

CO-2 apply the Physics Principle of conversion solar radiation **-K3**

CO-3.explain the types of Solar Heater. **-K2**

CO-4.demonstrate the Solar Energy conversion **-K2**

CO-5.apply the Nanomaterials in Fuel cell Applications. **-K3**

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

Title of the Course : Solar Energy Utilization						**Course Code:P3R3PHSEC 2:1**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	3	3	3	2	2	3	2.6
CO2	3	3	3	2	2	3	3	1	2	2	2.4
CO3	2	3	3	2	2	3	3	3	2	2	2.5
CO4	3	3	2	1	3	3	3	3	2	2	2.4
CO5	3	2	2	3	3	3	3	2	3	2	2.6
	Mean Overall Score										**2.5**
	Result										**High**

TITLE OF THE COURSE : THIN FILM PHYSICS

CATEGORY : SKILL ENHANCEMENT COURSE

COURSE CODE : P3R3PHSEC 2:2

NATURE OF SKILL : EMPOLYABILITY

MARKS:CIA:25+Ext:75=100 HOURS/WEEK: 02

CREDITS: 02 TOTAL INST.HOURS: 30

COURSE OBJECTIVES:

The main objectives of this course are:

C obj-1. To understand the basic concepts of thin films technology.

C obj-2. To acquire the knowledge about thin film coating methods, its characterization methods

and its applications.

C obj-3.To gain knowledge in determining the thickness of films

C obj-4. To explain the electric, electronic, magnetic, and structural behaviour of functional materials, the experimental methods used to investigate their functionality,

C obj-5.the mathematical and computational techniques used to model their properties.

UNIT-I: PREPARATION OF THIN FILM (Inst.Hrs:06)

Nature of Thin Film-Deposition Technology-Distribution of Deposit-Resistance Heating-Thermal Evaporation -Flash Evaporation.

UNIT-II: DEPOSITION TECHNIQUES (Inst.Hrs:06)

Electron Beam Method- Cathodic Sputtering-Glow Discharge Sputtering- Low Pressure Sputtering-Reactive Sputtering-RF Sputtering-Chemical Vapour Deposition-Chemical Deposition.

UNIT-III: FILM THICKNESS AND ITS CONTROL (Inst.Hrs:06)

Mass Methods-Optical Method-Photometry-Ellipsometry-Interferometry- Other Methods-Substrate Cleaning-Microscopic Defect and Dislocation- Edge Dislocation-Screw Dislocation-Boundary Defect-Stress Effect-Removal of Defect-Defect and Energy State.

UNIT-IV: THIN FILM ANALYSIS (InstHrs:06)

Electron Diffraction Technique- High Energy Electron Diffraction-Low Energy Electron Diffraction-Electron Microscopy-Scanning Electron Microscopy-X Ray Photoelectron Spectroscopy –Mass Spectroscopy- Thermodynamics of Nucleation-Nucleation Theories- Film Growth-Incorporation of Defects, Impurities etc. in Film-Deposition Parameters and Grain Size.

UNIT-V: THIN FILM GROWTH PROCESS (InstHrs:06)

Epitaxy-Thin Film Structure-Substrate Effect-Epitaxial Deposit-Twinning and Multi twinning-Phase Transition-Dissociations-Film Thickness Effect- Crystal Growth Process

BOOKS FOR STUDY:

1. Thin Film Fundamentals, A. Goswami-New Age International-New Delhi.

BOOKS FOR REFERENCE:

1. Thin Film Phenomena-K.L. Chopra.
2. Handbook of Thin Film Technology-L.T. Meissel& R. Glang-McGraw Hill.

ONLINERESOURCE:

1. https://static.ifp.tuwien.ac.at/homepages/Personen/duenne_schichten_alt/pdf/t_p_ds_contents_cover.pdf

COURSE OUTCOMES:

On the successful completion of the course the students will be able to:

CO-1.apply the knowledge of basic principles of materials science in thin film technology.- **K1**

CO-2.use various techniques to synthesis thin films of desired characteristics. - **K3**

CO-3.understand the formation of thin filmmechanism. - **K2**

CO-4.make application of thin films for devices fabrication. - **K4**

CO-5.acquire skills required for entrepreneurship or jobs in the field of thin films. - **K1**

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

Title of the Course: Thin Film Physics						**Course Code:P3R3PHSEC2:2**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	3	3	3	2	2	3	2.6
CO2	3	3	3	2	2	3	3	1	2	2	2.4
CO3	2	3	3	2	2	3	3	3	2	2	2.5
CO4	3	3	2	2	3	3	3	3	2	2	2.5
CO5	3	2	2	3	3	3	3	2	3	2	2.6
	Mean Overall Score										**2.52**
	Result										**High**

TITLE OF THECOURSE	**:**	**INTERNSHIP**
CATEGORY	**:**	**INTERNSHIP**
COURSE CODE	**:**	**P3R3PHINT**
NATURE OF SKILL	**:**	**EMPLOYABILITY**

MARKS : 100 **HOURS/WEEK :**

CREDITS : 03 **TOTAL INST.HOURS : 30**

TITLE OF THE COURSE : SPECTROSCOPY

CATEGORY : CORE COURSE

COURSECODE : P4R3PHCC11

NATUREOFSKILL : SKILLDEVELOPMENT

MARKS:CIA:25+Ext:75=100 **HOURS/WEEK : 06**

CREDITS: 05 **TOTAL INST. HOURS : 90**

COURSE OBJECTIVES:

The main objectives of this course are:

C. obj - 1. Learn and understand the concept of Molecular spectroscopy

C. obj - 2. The concept of FT-IR is well understood

C. obj - 3. The concepts of Raman Spectroscopy is well understood

C. obj - 4. learn and understand the concepts of NMR and ESR spectroscopy

C. obj - 5. The concepts of Mossbauer spectroscopy is understood

UNIT-I: MICROWAVE SPECTROSCOPY (Inst. Hr : 18)

Rotation of Molecules – Rigid Rotor (Diatomic Molecules) – Expression for the Rotational Constant - Intensity of Spectral Lines – Effect of Isotopic Substitution - Molecular Parameters (Bond Length, Bond Angle, Dipole Moment) from Rotation Spectra – Techniques and Instrumentation.

UNIT II: INFRARED SPECTROSCOPY (Inst. Hr : 18)

Vibrational energy of a diatomic molecule- Infrared selection rules-Vibrating diatomic molecule-Diatomic vibrating rotator- Vibrations of polyatomic molecules-Fermi resonance-Rotation vibration spectra of polyatomic molecules-Normal modes of vibration in crystal-Interpretation of vibrational spectra-Group frequencies-IR spectrophotometer-Instrumentation-Sample handling techniques-Fourier Transform Infrared spectroscopy-Applications

UNIT III: RAMAN SPECTROSCOPY (Inst. Hr : 18)

Introduction-Theory of Raman scattering-Rotational Raman spectra-Vibrational Raman spectra-Mutual Exclusion principle-Raman spectrometer-Sample handling techniques-Polarization of Raman scattered light-Structure determination using IR and Raman spectroscopy-Raman investigation of phase transitions-Resonance Raman scattering-Nonlinear Raman phenomena-Preliminaries-Hyper Raman effect-Stimulated Raman scattering-Inverse Raman effect-Coherent Anti-Stokes Raman scattering .

UNIT IV: NUCLEAR MAGNETIC AND ELECTRON SPIN RESONANCE SPECTROSCOPY (Inst. Hr : 18)

Basic principles – Quantum theory of NMR - magnetic resonance – relaxation processes – chemical shifts – spin-spin coupling - Spectra and molecular structure – Fourier Transform NMR –Instrumentation – Applications.

Basic principles – Quantum theory - g-factor – Nuclear Interaction and Hyperfine structure – Relaxation effects - Hyperfine interaction – line widths – ESR spectrometer – Instrumentation – applications.

UNIT V: MOSSBAUER SPECTROSCOPY (Inst. Hr : 18)

Mossbauer effect: Principle of Mossbauer spectroscopy – recoilless emission and absorption - hyperfine interaction - chemical isomer shift - magnetic hyperfine and electric quadruple interactions – ` Instrumentation – applications.

BOOKS FOR REFERENCE:

1. Colin N. Banwell, Elaine M. McCash, Fundamentals of Molecular Spectroscopy (Fourth Edition), Tata McGraw-Hill Publishing Company Ltd, 1995.

2. J.D. Graybeal, Molecular Spectroscopy, McGraw-Hill, New York, 1988.

3. Hollas, Michael, Modern Spectroscopy (Fourth Edition) John Wiley, New York, 2004.

4. R.P Straughen, S.Walker, Spectroscopy Vols.I,II and III, Chapman & Hall, London, 1976.

On Line Resource Link:

1.https://drive.google.com/file/d/1mUhjPY47kNp6CaGO0LeVrbS2magVwlZN/view?usp=sharing

Course Outcomes:

Oncompletionofthecoursethestudentswillhave:

CO. 1.understand the aspects of rotational spectroscopy and its techniques **– K2**

CO. 2.understand the theory and principles of vibrational spectroscopy and. **– K2**
its techniques.

CO. 3.comprehend the basics of Raman and their instrumentation techniques **– K4**

CO. 4.understand the physics behind NMR and ESR spectroscopy and its **– K2**
instrumentation.

CO. 5.understand Mossbauer spectroscopic techniques and hyperfine spectral lines –K2

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

Title of the Course: SPECTROSCOPY						**Course Code:P4R3PHCC11**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	3	2	2	2	2	3	2.4
CO2	3	2	3	2	3	3	2	2	2	2	2.4
CO3	2	2	2	2	2	2	2	3	2	3	2.2
CO4	3	2	2	3	3	2	3	2	2	2	2.4
CO5	3	3	2	3	2	3	2	2	2	2	2.4
	Mean Overall Score										**2.36**
	Result										**High**

TITLE OF THE COURSE : NUCLEAR AND PARTICLE PHYSICS

CATEGORY : CORE COURSE

COURSECODE : P4R3PHCC12

NATUREOFSKILL : SKILLDEVELOPMENT

MARKS: CIA:25+Ext:75=100 HOURS/WEEK : 06

CREDITS: 05 TOTAL INST. HOURS : 90

COURSE OBJECTIVES:

The main objectives of this course are:

C obj-1.To understand the characteristics of nucleus forces

C obj-2. Gain knowledge in different types of nuclear models

C-obj-3.Acquire skill for deducing expression for Q-value

C-obj-4.Develop skill in Fermi& G.T Selection rules

C-obj-5.Analyze the interaction between elementary particles

UNIT I:NUCLEARFORCES (Inst Hrs.18)

Characteristics of Nucleus Forces – Exchange forces and tensor forces – charge independence-Spin dependence of Nucleus Forces - Meson theory of nuclear forces- Ground state of deuteron-Nucleon-nucleon scattering singlet and triplet parameters – Nucleon-Nucleon scattering: Cross-section, Differential Cross-section, Scattering Cross-sections – magnetic moment- Quadruple moment–Sand Stated mixtures-Effective range theory of

n-p scattering at low energies.

UNIT II: NUCLEARMODELS (InstHrs: 18)

Binding energy & mass defect – Weizacker's formula – mass parabola - Liquid drop model– Bohr -Wheeler theory of fission- Activation energy for fission- Shell model- Spin – Orbit coupling-Spins of nuclei- Magnetic moments – Schmidt lines- Electric quadrupole moments - Collective model of Bohr and Mottelson: Nuclear vibration – Nuclear rotation – Nelson model.

UNIT III:NUCLEARREACTIONS (Inst. Hrs:

18)

Nuclear reaction - Q- value– Nuclear reaction cross section – Direct Nuclear Reactions: Knockout reaction, Pick-up reaction, Stripping reaction – Compound nucleus theory – Formation –Disintegrationenergylevels– PartialwaveanalysisofNuclearreactioncross-section-Resonance Scattering and Reaction cross-section (Breit-Wigner dispersion formula) –Scattering matrix-Reciprocity theorem– –Breit-Wigner one level formula–Resonance scattering–Absorption cross section at high energy.

UNIT IV:RADIOACTIVE DECAYS (Inst. Hrs: 18)

Alpha decay - Beta decay –Energy release in beta decay – Fermi theory of beta decay – Shape of the beta spectrum – decay rate Fermi-Curie plot – Fermi & G.T Selection rules – Comparatives half - lives and forbidden decays- Gama decay – Multiple radiation – Angular momentum and parity selection rules –Internal conversion– Nuclear isomerism.

UNITI V:ELEMENTRYPARTICLEPHYSICS (Inst. Hrs: 18)

Classification of elementary particles- Types of interaction between elementary particles–Hadronsandleptons–Symmetryandconservationlaws– Strangenessandassociateproduction - CPT theorem – classification of hadrons– Quark model – Iso spin multiples - SU(2)- SU(3)multiplets- Gell-Mann - Okubo mass formula for octet and decupled hadrons– Phenomenology of weak interaction hadrons and leptons - Universal Fermi interaction – Elementary concepts of weak interactions.

TEXT BOOKS:

1. IntroductoryNuclearPhysics,K.Krane,Wiley,NewYork,1987.
2. Nuclear Physics, V.Devanathan,Narosa Publishing house.
3. Nuclear Physics, D.C.Tayal, Himalaya Publishing House Pvt., Ltd.,Vedition,2018.

REFERENCE:

1. IntroductiontoElementaryParticles,D.Griffiths,IntroductiontoElementaryParticles (WileyInternational,NewYork,1987).

ONLINE RESOURCE:

https://www.nuclear-power.com/nuclear-power/fission/liquid-drop-model/

COURSE OUTCOMES:

On the successful completion of the course the students will be able to:

CO-1.gain knowledge in Nucleon scattering -K2

CO-2.obtain art of using Weizacker's formula -K3

CO-3. attain familiarity in Nuclear Reactions -K4

CO-4.catch on the Fermi theory of beta decay -K5

CO-5. figure out the Quark model **-K4**

Relationship Matrix for Course Outcome, Programme Outcomes and Programme Specific Outcomes

M.Sc. Physics – PSPH

Title of the Course: NUCLEAR AND PARTICLE PHYSICS						**Course Code: P4R3PHCC12**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	1	3	2	2	3	3	2.4
CO2	3	1	3	2	3	3	3	2	2	2	2.4
CO3	3	3	2	1	3	3	3	1	2	2	2.3
CO4	3	3	2	2	1	3	2	2	2	3	2.3
CO5	3	2	3	3	1	2	3	2	3	2	2.5
	Mean Overall Score										**2.38**
	Result										**High**

TITLEOFTHECOURSE	**:**	**PROJECT WORK**
CATEGORY	**:**	**CORE COURSE**
COURSECODE	**:**	**P4R3PHCC13PW**
NATUREOFSKILL	**:**	**SKILL DEVELOPMENT**

MARKS : 100 **HOURS/WEEK : 18**

CREDITS : 18 **TOTALINST.HOURS : 96**