DEPARTMENT OF PHYSICS
H.H. THE RAJAH'S COLLEGE(AUTO)
PUDUKKOTTAI – 622 001

COURSE STRUCTURE
AND
SYLLABI
FOR PG PROGRAMME

CHOICE BASED CREDIT SYSTEM

(2021 – 2022 ONWARDS)

H.H. THE RAJAH'S COLLEGE (AUTONOMOUS), PUDUKKOTTAI

M. Sc. Physics Programme Pattern - CBCS -2021-2022 Onwards

Sl. No.	Sem	Paper	Hrs/week	Credit	Exam hrs.	Marks		
						Internal	External	Total
1	I	Mathematical Physics - I	6	6	3	25	75	100
2	I	Classical Mechanics	6	6	3	25	75	100
	I	Practical-I : General Experiments*	4					
	I	Practical - II: Electronics Experiments*	4					
3	I	Elective - I : Electronics and Communication	6	5	3	25	75	100
4	II	Practical-I : General Experiments*	4	4	4	40	60	100
5	II	Practical - II: Electronics Experiments*	4	4	4	40	60	100
6	II	Mathematical Physics - II	6	5	3	25	75	100
7	II	Quantum theory and its application	6	5	3	25	75	100
8	II	Elective - II : Crystal Growth, Thin film and Nano Physics	6	5	3	25	75	100
9	II	EDC: Numerical Methods and scientific Programming	6	5	3	25	75	100
10	III	Thermodynamics and Statistical Physics	6	5	3	25	75	100
11	III	Electromagnetic Theory	6	5	3	25	75	100
12	III	Atomic and Molecular Spectroscopy	6	5	3	25	75	100
13	III	Elective - III; Microprocessor and Microcontroller	6	5	3	25	75	100
	III	Practical -III : Python, Microprocessor and Microcontroller Practicals*	4					
14	IV	Practical -III : Python, Microprocessor and Microcontroller Practicals *	4	4	4	40	60	100
15	IV	Nonlinear Dynamics and Relativity	6	5	3	25	75	100
16	IV	Condensed Matter Physics	6	5	3	25	75	100
17	IV	Nuclear and Particle Physics	6	5	3	25	75	100
18	IV	Project Work		6		20	80	100
				90				1800

* Exams will be held at the end of even semester

M. Sc. Physics 2021-2022 onwards

Program Educational Objectives (PEOs)

The M. Sc. Physics program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Graduates will become experts in various professional zones like industry, research, academic, business, etc. at par with national and international standards.
PEO2	Acquired knowledge in physical concepts facilitate the graduates to recognize, formulate, examine, explore and implement the ideas for societal developments.
PEO3	Graduates capable enough to meet any challenge as an individual or in a part of team towards achieving prospective scope in innovative projects.
PEO4	Graduates will have cognitive base to achieve academic excellence by learning diverse phenomena of physical concepts help them to lead and execute inter- and multidisciplinary academic and research works.
PEO5	Graduates will be skilled enough to perceive novel and innovative concepts to develop cutting edge technologies as entrepreneurial pursuit.
PEO6	Graduates will have a proficiency to enhance the application prospects of physics by interfacing the philosophical concepts with suitable perceptions beyond the subject boundary.

M. Sc. Physics 2021-2022 onwards

Program Specific Outcomes (PSOs)

After the successful completion of M.Sc., Physics program, the students are expected to	
PSO1	Be a potential graduate with the stuff of vibrant subject knowledge in every subdivision of Physics especially in Classical Mechanics, Quantum Mechanics, Mathematical Physics, Nuclear Physics, Electronics and Materials Science with application tendency.
PSO2	Be a science person to extend the application of Physics discipline to different sectors of common or needy people.
PSO3	Have the competence to get clear any comprehensive examination offers superior opportunity in official, academic and research sectors
PSO4	Have the skill to manage computational tools to explore scientific activity even at subatomic particle level using theoretical concepts without empirical approach.
PO5	Be a skillful to perceive rare or exceptional scientific phenomena using the concepts of physical science and to find solution to any challengeable task.
PSO6	Be an efficient to employ research work by applying the subject knowledge acquired from diverse objectives of Physics.
PSO7	Have the ability to meet any employment challenge demands intense subject proficiency.

M. Sc. Physics 2021-2022 onwards

Program Outcomes (POs)

On successful completion of the M. Sc. Physics program	
PO1	Understand the concepts of advanced physics and capable to apply them in real time problems to find appropriate solutions
PO2	Develop model and analyse to derive solution using the background of theoretical physics.
PO3	Augment the application feasibility of Physics theoretical formulations in combination with relative concepts belongs to other discipline.
PO4	Apply learned experimental skill to develop newer materials with unique characteristics employing variety of synthesis techniques
PO5	Develop software tools by applying the learned concepts in combination belongs to Mathematical physics, Quantum mechanics and computational physics.
PO6	Perceive novel and contemporary research philosophies globally facilitate to work at par with international standards
PO7	Meet any challenge globally for employment in academic, research and industry by exposing the learned skill in diverse zone under Physics discipline .

<u>CC01 : MATHEMATICAL PHYSICS - I</u>

SUB.CODE: 21PPH1

Course objectives:
The main objectives of this course are

1. To understand the need of mathematics to gain knowledge in physics.
2. To acquire knowledge about linear vector spaces,tensors and their application in physics.
3. To enhance the physically relevant problem solving techniques skills using matrices.
4. To study the connection between differential equations and their contribution in the study of dynamics.
5. To distinguish between the dynamics obtained by ordinary differential equations and partial differential equations.

UNIT - I: VECTOR ANALYSIS AND VECTOR SPACES

The Scalar and Vector fields - Differential operators : Gradient, Divergence, Curl and Laplacian in terms of special curvilinear co-ordinates : Rectangular, Cylindrical and Spherical polar co-ordinates - Integration of Vector - Line integrals, Surface integrals and Volume integrals - Gauss Divergence theorem - Stokes theorem - Green’s theorem.

Linear Vector space - Definition - Linearly dependent & Independent sets of vectors - Scalar product - Orthonormal sets - Gram-Schmidt’s orthogonalization - Schwartz inequality.

UNIT - II: MATRICES

Orthogonal matrix - Unitary matrix - Hermitian and skew Hermitian matrices - Matrices in physics - Characteristics equation of a matrix - System of linear equations - Rank of a matrix - Matrix algebra - eigenvalues and eigenvectors of a square matrix - Theorems of eigenvalues and eigenvectors - Cayley-Hamilton theorem : Problems - Inverse of a square matrix - Diagonalization - Importance of eigenvalues and eigenvectors.

UNIT - III: TENSOR ANALYSIS

Definition - Co-ordinate transformation - Indicial and Summation conventions - Kronecker delta symbol - Scalar, Covariant, Contravariant and invariant tensors - Tensors of higher Ranks - Algebraic operations of tensor - Conjugate tensors - Metric tensors : Spherical and Cylindrical co-ordinates - Riemannian Spaces - Christoffell’s three index symbols - Transformation laws of Christofell’s symbols.

UNIT - IV: ORDINARY DIFFERENTIAL EQUATIONS

Linear first order differential equations - Linear second order differential equations with constant co-efficients and with variable co-efficients - Superposition principle - Power Series solution around a ordinary point and singular point - Nonlinear differential equations - Reduction to Linear form and Homogeneous form - Solution for anharmonic oscillator problem.

UNIT - V: PARTIAL DIFFERENTIAL EQUATIONS

Linear Partial differential equations - Separation of variables - Separation of Helmholtz equation in Cartesian coordinates - Solution of Laplace’s equation in Cartesian, Spherical polar and Cylindrical, Circular and Cylindrical Harmonics coordinates - Symmetry and Separability - One dimensional and Two dimensional heat flow equation - D’Alembert’s solution of vibration spring.

Course outcomes:
On the completion of this course the students will be able to

1. Understand the contribution of mathematics for gaining knowledge in physics.
2. Acquire knowledge about linear vector spaces and tensors and their application in physics.
3. Enhance the physically relevant problem solving techniques skills using matrices.
4. Establish the connection between differential equations and their contribution in the study of dynamics.
5. Classify the differential equations and choose right method to solve problems.

Books for study and reference:

1. B.D.Gupta, Mathematical Physics, Vikas publishing ltd, India(2010).
2. Sathyaprakash, Mathematical Physics, Sultan Chand & Sons, New Delhi. 6th edition, 2012.
3. Mathematical Physics,P.K.Chattopadhyay,New Age International Publishers, 2nd Edition, 2013
4. H.K Dass & Dr.Ramavarma, Mathematical Physics, Sultan Chand & Sons, New Delhi.(2010)
5. M. T. Vaughn, Introduction to Mathematical Physics (Wiley India, 1st edition, 2013).
6. E. Kreyszig, Advanced Engineering Mathematics (Wiley Itel. Student Version, 10th edition, 2015).
7. D. G. Zill, Advanced Engineering Mathematics (Jones & Bartlett, 6th edition, 2017).
8. V. Balakrishnan, Mathematical Physics with Applications, Problems and Solutions
   (Ane Books Pvt. Ltd. 1st edition, 2018).

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1. https://nptel.ac.in/course.html/Physics/Integrals and vector calculus
2. https://nptel.ac.in/courses/115/106/16086/
3. https://nptel.ac.in/course.html/Physics/Matrix analysis and with applications

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Mapping with programme outcomes 21PPH1							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	9	9	9	9
CO2	9	9	9	9	9	9	9
CO3	9	9	3	9	9	3	9
CO4	9	9	9	9	1	9	9
CO5	9	9	9	3	9	9	1
Total	45	45	39	39	37	39	37
Weightage	**5.56**	**5.56**	**6.21**	**6.23**	**6.73**	**5.79**	**6.75**

***S-Strong(9); M-Medium(3); L-Low(1).**

CC02 : CLASSICAL MECHANICS

SUB.CODE: 21PPH2

Course objectives:
The main objectives of this course are

1. To understand the Lagrangian formulation of mechanics.
2. To acquire knowledge about the dynamics many body problems.
3. To analysis of the classical scattering theory.
4. To study the dynamics associated with the rigid bodies including symmetric top.
5. To understand the Hamilton Jacobi theory and Poisson bracket formalism.

UNIT - I: LAGRANGIAN MECHANICS

Mechanics of a system of particles - Constraints - Principle of virtual work - D'Alembert's principle - Derivation of Lagrange's equation for conservative and Dissipative system - Principle of least action - Derivation of Lagrange's equation from it - Simple applications of Lagrange's equation of equation- Motion of single particle in Cartesian and polar coordinates - Atwoods machine - Cyclic coordinates.

UNIT - II: PROBLEM OF CENTRAL FORCES

Reduction of two body problem to the equivalent one body problem- Reduced mass - Equations of motions and first integrals - Classification of orbits - Virial theorem - Differential equation for the orbit - Bertrand's theorem - Kepler problem - Motion in time in Kepler problem - The Laplace - Runge Lenz vector - Scattering in a central force field - Scattering cross section - Scattering problem in laboratory coordinates - Centre of mass frames.

UNIT - III: RIGID BODY DYNAMICS

Orthogonal transformations - Transformation matrix - Euler angles and Euler theorem - stability analysis - Cayley Klein parameters - Finite and infinitesimal rotations - Corolis effect - Non inertial frame - Inertial tensor and moment of inertia - Principle axis transformation - Euler equations of motion - periodic motion - Normal modes - Motion of heavy symmetric top with one point fixed.

UNIT - IV: SMALL OSCILLATIONS

Formulation of the problem - Eigen value equation and the principal axis transformation - Frequencies of free vibrations and normal coordinates - Free vibrations of a linear tri-atomic molecule - Forced vibrations and the effect of dissipative forces - Damped driven pendulum and the Josephson junction.

UNIT - V: CANONICAL TRANSFORMATIONS AND HAMILTON JACOBI THEORY

Equations of canonical transformation - Examples of canonical transformations - The harmonic oscillator - Poisson brackets and other canonical invariants - Equation of motion in Poisson bracket Subsystem of the Hamilton Jacobi method of one degree of freedom - Hamilton Jacobi equation for Hamilton's Principal function - The angular momentum an Poisson bracket relation - Harmonic oscillator problem as an example - Hamilton equation for Hamilton's characteristic function - Action angle variables.

Course outcomes:
On successful completion the student will able to

1. Understand the Lagrangian formulation of mechanics.
2. Acquire knowledge about the dynamics many body problems.
3. Analyze the classical scattering theory of many body systems in different coordinate systems.
4. Know the dynamics associated with the rigid bodies including symmetric top.
5. Reckon the Hamilton Jacobi theory and Poisson bracket formalism.

Books for study and reference:

1. H. Goldstein, C. Poole and J. Sofko, Classical Mechanics (Pearson Education, New Delhi,2013).
2. N.C.Rana and P.S.Joag, Classical Mechanics, (Tata Mc-Graw Hill, New Delhi, 2001).
3. G. K. Sharma, Classical Mechanics, (Pragati Prakashan, New Delhi, 2012)
4. S. T.Thornton and J. B. Marion, Classical Dynamics of Particles and Systems.(Cengage Learning, 2003).
5. T. L. Chow, Classical Mechanics (John Wiley, New York, 1995).
6. Classical Mechanics – J. C. Upadhyaya, Himalaya Publishing House, 2012.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1. https://nptel.ac.in/course.html/Physics/ Introduction to classical mechanics
2. https://nptel.ac.in/courses/122/106/122106027/

Mapping with programme outcomes 21PPH2							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	9	3	9	9
CO2	9	9	9	9	9	9	1
CO3	9	9	3	9	9	9	9
CO4	9	9	9	9	9	3	9
CO5	9	9	9	3	1	9	3
Total	45	45	39	39	31	39	31
Weightage	**5.56**	**5.56**	**6.21**	**6.23**	**5.64**	**5.79**	**5.66**

***S-Strong(9); M-Medium(3); L-Low(1).**

CC03 : GENERAL PHYSICS PRACTICAL

SUB.CODE: 21PPHM3P

Course objectives:
The main objectives of this course are

1. To give hands on training to do advanced physics experiment.
2. To make the students understand the concepts behind various physical experiments such as polarizablity of liquids, dispersive power of prism,refractive index of glass.
3. To motivate the students to apply the experimental techniques in youngs modulus of material.
4. To give exposure to measure some of the physical parameters with maximum accuracy.
5. To motivate the students to apply the experimental techniques in Transmission of heat.

LIST OF EXPERIMENTS
(ANY 15 EXPERIMENTS)

1. Determination of q,n,σ by forming elliptic fringes.
2. Determination of q,n,σ by forming hyperbolic fringes.
3. Determination of Stefan's constant.
4. Identification of Prominent lines by spectrum photograph- Iron Spectrum.
5. Identification of Prominent lines by spectrum photograph- Copper Spectrum.
6. Determination of electronic Specific charge e/m by Thomson's method.
7. Determination of Planck constant by Photo electric effect.
8. Determination of Carrier Concentration and Hall coefficient in semiconductors.
9. Determination of Magnetic susceptibility of a liquid by Guoy method.
10. Determination of Magnetic susceptibility of a powder Guoy method.
11. Determination of Magnetic susceptibility of a thin rod by Guoy method.
12. Determination of magnetic susceptibility of liquids by Quincke's method.
13. Determination of Charge of an electron by spectrometer.
14. Determination of Specific rotatory power of a liquid using polarimeter.
15. Determination of thermal conductivity by Forbe's method.
16. Determination of wavelength of monochromatic source using biprism.
17. Determination of wavelength and thickness of a film using Michelson interferometer.
18. Determination of polarization of liquid (benzene) using spectrometer.
19. Determination of Rydberg constant using spectrometer.
20. Determination of resistivity by Four Probe method.
21. He-Ne Laser experiments (particle size, diameter of thin wire determination).
22. Conductance of photo conductor,photo voltaic cell (solar cell) photo diode.
23. Compressibility of a Liquid using Ultrasonic interferometer.

Expected course outcomes:
After passing the course the students should be able to

1. Understand the concepts behind various physics experiments.
2. Measure different physical parameters with maximum accuracy.
3. Determine various physical constants through different physical experiments.
4. Understand the practical knowledge of usage of various optical components in modern and devices and instruments.
5. Establish practical knowledge and an extensive understanding of laser and non-linear optics.

Reference books:

1. General Physics Laboratory Manual,Department of Physics,ST.Joesph College,Trichy.(2000)
2. Practical Physics and Electronics,C.C.Ouseph,U.J.Rao,V.Vijayendran,S.Viswanathan Publishers(2007).
3. A text book of Practical Physics,M.N.Srinivasan,S.Balasubramanian,R.Ranganathan,sultan Chand&Sons(2017).
4. D.Malacara(ed.),Methods of Experimental Physics,Series of volume,Acadamic Press Inc.(1988)

Mapping with programme outcomes 21PPHM3P							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	9	3	9	9
CO2	9	9	3	9	9	9	1
CO3	9	9	9	1	9	9	9
CO4	9	9	9	9	9	3	9
CO5	9	9	9	3	9	9	3
Total	45	45	39	31	39	39	31
Weightage	**5.56**	**5.56**	**6.21**	**4.95**	**7.09**	**5.79**	**5.66**

***S-Strong(9); M-Medium(3); L-Low(1).**

CC04 : ELECTRONICS PRACTICAL

SUB.CODE: 21PPHN4P

Course objectives:
The main objectives of this course are

1. Give hands on training in the construction of simple electronics circuits.
2. To make the students understand the students understand practically the characteristics of transistors,amplifiers.
3. To motivate the students to apply the practically the characteristics of oscillators and filters.
4. To give exposure in understanding digital to analog conversion using binary weighted and R-2R ladder.
5. To make the students understand practically the characteristics of frequency divider and shift register.

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LIST OF EXPERIMENTS
(ANY 15 EXPERIMENTS)

1. Design and study of monostable multivibrator (IC 555).
2. Design and study of bistable multivibrator (IC 555).
3. Astable Multivibrator by 555 timer.
4. Characteristics of UJT.
5. Characteristics of SCR.
6. MOSFET Amplifier.
7. Construction of dual power supply using ICs (78XX and 79XX).
8. Half and Full adder.
9. Half and Full Subtractor.
10. K- Map.
11. Operational amplifier - Waveform generators.
12. Operational amplifier - Active Filters.
13. Operational amplifier - Digital to analog conversion by Binary weighted method.
14. Operational amplifier - Digital to analog conversion by R-2R ladder method.
15. Operational amplifier - Simultaneous equations.
16. Frequency divider using IC 555.
17. Design and study of Wien's oscillator (using IC).
18. Design and study of Phase shift oscillator (using IC).
19. BCD to seven segment display.
20. Multiplexer and Demultiplexer.
21. One bit comparator.
22. Encoder and Decoder.
23. Shift register.
24. Flip flops (RS,D,JK and T flip-flop).

Expected course outcomes:
After end of the course the students should be able to

1. Construct simple electronics circuits.
2. Understand the theoretical concepts by doing experiments.
3. Understand the characteristics of transistors,operational amplifiers,oscillators and filters.
4. Understand the conceptual difference between analog and digital electronics.
5. Apply Boolean algebra and the karnaugh map as tools in designing and to simplify digital logic circuits.

Reference books:

1. Electronics Laboratory Manual,Department of Physics,ST.Joesph College,Trichy.(2000).
2. B.K. Jones,Electronics for Experimentation and Research,Prentice-Hall(1986).
3. Practical Physics and Electronics,C.C.Ouseph,U.J.Rao,V.Vijayendran,S.Viswanathan Publishers(2007).
4. A text book of Practical Physics,M.N.Srinivasan,S.Balasubramanian,R.Ranganathan, Sultan Chand&Sons(2017).
5. P.B.Zbar,A.P.Malvino andM.A.Miller Basic Electronics:A Text-Lab Manual,TMH,New Delhi(1994)

Mapping with programme outcomes 21PPHN4P							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	9	9	9	3
CO2	9	9	9	9	9	9	9
CO3	9	9	3	3	9	3	1
CO4	9	9	9	9	1	9	9
CO5	9	9	3	9	3	9	3
Total	45	45	33	39	31	39	25
Weightage	**5.56**	**5.56**	**5.25**	**6.23**	**5.64**	**5.79**	**4.56**

***S-Strong(9); M-Medium(3); L-Low(1).**

EC01 : ELECTRONICS AND COMMUNICATION

SUB.CODE: 21PPHE1

Course objectives:
The main objectives of this course are

1. To study the basic principles of certain electronic components which have application in the field of communication.
2. To understand the basic concepts of communication and optical communication system.
3. To gain knowledge about different antennas and waves used for communication.
4. To identify different types of modulation and multiplexing formats.
5. To enable the learners to acquire the fundamental knowledge on the colour television and various colour television displays.

UNIT - I: SEMICONDUCTOR DEVICES AND LINEAR INTEGRATED CIRCUITS

UJT - VI characteristics - Relaxation Oscillators - JFET Characteristics - DC load line - Characteristics and application - SCR- DIAC - TRIAC.

Operational amplifiers - DC Characteristics - Basic OP-AMP Application - Instrumentation Amplifier - Digital to analog conversion using op-amps - Binary weighted resistor method - R-2R ladder method - Analog to digital conversion - Successive approximation method and counter methods - IC 555 timer - Multivibrators with 555 : Astable and Monostable mutivibrator.

UNIT - II: ANTENNAS AND MICROWAVES

Terms and definition - Effect of ground on Antenna - Grounded λ/4 - Ungrounded antenna - λ antenna - Antenna arrays - Broadside and end side arrays - Directional high frequency antenna - Sky wave propagation - Ionosphere - Eccles & Larmor theory - Thin linear antenna - Non resonant antenna - Loop antenna - Power gain - Dipole arrayed VHF, UHF and Microwave antennas - Microwave generation and application - Klystron - Magnetron - Traveling wave tubes - Microwave propagation through wave guides - Detection and ranging - Transmitters and receivers - MASER - Gunn diode.

UNIT - III: COMMUNICATION SYSTEM

Introduction - Analog and digital signals - Modulation - Modulation index - AM Modulation - Frequency spectrum of the AM wave - Representation of AM - Power Relation in the AM wave - AM Transmitter - FM Modulation - Mathematical representation of FM - Frequency spectrum of FM wave - Pulse modulation - Sampling theorem - pulse position modulation(PPM) - Pulse code modulation(PCM) - Pulse width modulation (PWM) - Effects of noise on carrier.

UNIT - IV: OPTIC FIBER COMMUNICATION

Introduction of Optic fiber communication - Propagation within a fiber - Step index and graded index fibre - Modes of fibers - Fabrication fibers - Losses in fibers - Dispersion - Light sources for fiber optics - Photo detectors - Optic fiber communication systems - Fibre as a cylindrical wave guide.

UNIT - V: COLOR TELEVISION

Essential of color television - Perception - Three color theory - Luminescence - Hue saturation - TV Camera - VIDICON - Luminescence signal - CRT-LCD-LED Displays - Single transmission - Modulation of color different signals - PAL of color TV systems - PAL color receiver - Block diagram - Merits and Demerits.

Course outcomes:
At the end of course the student should be able to

1. Have sufficient understanding on the basic principles of certain electronic components which have application in the field of communication.
2. Be familiar with the basic concepts of communication for optical communication system.
3. Gain of knowledge about different antennas and waves used for communication.
4. Differentiate between different types of modulation and multiplexing formats.
5. Acquire the fundamental knowledge on the colour television and various colour television displays.

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Books for study and reference:

1. D. Choudhury Roy, Jain, Shail B, Linear Integrated Circuits,(New Age International(P)Ltd. 2018.
2. R.R Gulathi, Monochrome and color television, Wily Eastern New Delhi (1995).
3. Dennis Roddy & John Coolen, Electronic Communication, 4th edition Pearson education.(1995)
4. George Kennedi, Electronic communication system. 4th edition, (Prentice-Hall of India Private Limited, New Delhi, 1999).
5. H. S. Kalsi, Electronic Instrumentation, Tata McGraw- Hill, New Delhi, 2004.
6. Optical fibre and fibre optic communication systems - SK Sarkar - S. Chand Publication 2007 edition.

RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]

1. https://nptel.ac.in/courses/115/107/115107095/
2. https://www.youtube.com/playlist?list=PLq-Gm0yRYwTgr7v3HhdrI_Kcc38369fw

Mapping with programme outcomes 21PPHE1							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	9	9	9	3
CO2	9	9	3	9	9	9	9
CO3	9	9	9	9	1	3	9
CO4	9	9	9	3	9	9	9
CO5	9	9	3	9	9	1	3
Total	45	45	33	39	37	31	33
Weightage	**5.56**	**5.56**	**5.25**	**6.23**	**6.73**	**4.60**	**6.02**

***S-Strong(9); M-Medium(3); L-Low(1)**

CC05 : MATHEMATICAL PHYSICS - II

SUB.CODE: 21PPH5

Course objectives:
The main objectives of this course are

1. To understand the mathematical methods which are applied in physics.
2. To develop knowledge in mathematical physics and its application.
3. To enable students to formulate, interpret and draw interfaces from mathematical solutions.
4. To solving the problems that occur in various branches of physics discipline.
5. To enhance problems solving skills.

UNIT- I: COMPLEX VARIABLES

Functions of complex variables - Differentiability - Analytic function - Cauchy - Riemann necessary conditions and polar form - Line Integrals of complex functions - Cauchy's integral theorem and integral formula - Taylor's and Laurent's Series - Computations of Residues - Poles and singularities - Evaluation of integrals using residues - Cauchy's residue theorem - Liouville's theorem - Evaluation of Definite integral and contour integrals.

UNIT - II: FOURIER SERIES, FOURIER TRANSFORM, LAPLACE AND INTEGRAL TRANSFORMS

Fourier series - Dirichlet's conditions - sine and cosine series &Transforms - Fourier integrals - Perseval's Identity for sine and cosine transform - Fourier transforms and properties - Convolution theorem - Laplace transform - solution of heat and wave equation by Laplace transform - Inverse Laplace transform - Faultang's theorem.

UNIT - III: GREEN'S FUNCTIONS AND INTEGRAL EQUATIONS

Green's functions -Proof of symmetry- properties - Methods of solutions in one dimension – Applications : Green's function for poisson equation and Quantum mechanical scattering problem - Linear integral equations - Neumann series- Wronskian - Eigen function expansion of green's function - Applications.

UNIT - IV: SPECIAL FUNCTIONS

Definition of Gamma and Beta functions - Fundamental property, Transformation, Different form of Beta function and Relation between the Beta Gamma function - Legendre, Associated Legendre, Bessel, Laugerre and Hermite differential equations and their solutions - Rodrigue's formula - Generating functions - Orthogonal properties - Recurrence relations.

UNIT -V: GROUP THEORY

Basic definitions - Multiplication table - Finite and cyclic group - Subgroups - Abelian group - cosets and classes - Direct product groups - point groups - Homomorphism & Isomorphism - Reducible and irreducible representations - Schur's lemma - The great orthogonality theorem - Special unitary group - Character table for simple molecular type(C_{2v} and C_{3V}) - Elementary ideas of rotation groups.

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

1. Apply Green's functions and Integral equations to physical problems.
2. Solve problems on Complex analysis, Fourier series and Fourier Transforms.
3. Laplace transform and inverse transform of simple functions, properties and few applications.
4. Analyze gamma and beta functions and their applications.
5. Acquire knowledge about group theory with character table.

Books for study and reference:

1. M. T. Vaughn, Introduction to Mathematical Physics (Wiley India, 1st edition, 2013).
2. E. Kreyszig, Advanced Engineering Mathematics(Wiley International Student Version,10th edition, 2016).
3. D. G. Zill, Advanced Engineering Mathematics (Jones & Bartlett, 6th edition, 2017).
4. Sathyaprakash, Mathematical Physics, Sultan Chand & Sons, New Delhi. 6th edition(2012).
5. P.K.Chattopadhyay, Mathematical Physics,New Age international,NewDelhi, 1992.
6. A.W.Joshi,Elements of Group theory for physicists,Wiley EasternLtd.,New Delhi 1997.
7. V. Balakrishnan, Mathematical Physics with Applications, Problems and Solutions (Ane Books Pvt. Ltd. 1st edition, 2018).
8. G. Arfken, H. Weber and F. E. Harris, Mathematical Method for Physicists (Academic Press, 7th edition, 2012).
9. H. K. Dass and Rama Verma, Mathematical Physics, (S. Chand & Co., New Delhi, 2007)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]

1.https://nptel.ac.in/courses/115/106/115106086/
2.https://nptel.ac.in/courses/115/103/115103036/

Mapping with programme outcomes 21PPH5							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	9	9	9	3
CO2	9	9	9	9	3	9	9
CO3	9	9	3	9	9	3	9
CO4	9	9	9	1	9	9	9
CO5	9	9	3	9	9	9	3
Total	45	45	33	37	39	39	33
Weightage	**5.56**	**5.56**	**5.25**	**5.91**	**7.09**	**5.79**	**6.02**

***S-Strong(9); M-Medium(3); L-Low(1).**

CC06: QUANTUM THEORY AND ITS APPLICATIONS

SUB.CODE: 21PPH6

Course objectives:
The main objectives of this course are

1. To understand the dual nature of light and matter.
2. To gain knowledge on the application of mathematical operators to understand microscopic physics.
3. To solve problems of fundamental importance and obtain exact solutions.
4. To apply perturbation techniques for analytically unsolvable problems.
5. To differentiate between quantum theory of scattering from the classical counterpart and perceive the relativistic concepts on the wave mechanics and its applications.

UNIT - I: WAVE MECHANICS

Dual nature of light and matter - Matter waves - De Broglie hypothesis - Hermitian operators and their properties - Postulates of quantum mechanics - Schrödinger time dependent and time independent equation - Physical meaning of wavefunction - Commutator relation - Expectation values - Correspondence principle - Ehrenfest theorem - Hilbert space - Uncertainty principle - Application of Quantum Mechanics : Basic ideas about entanglement and quantum computers - Quantum confinement and quantum displays.

UNIT - II: EXACTLY SOLVABLE EIGEN VALUE PROBLEMS

Linear Harmonic Oscillator: - Schrodinger equation for harmonic oscillator - Energy eigenvalues and eigenfunctions - Abstract operator method for harmonic oscillator - Ladder operators - eigenvalue spectrum - eigenfunctions - Angular momentum operators(L^2 and L_z) - Rigid rotator problem and its solution in-terms of spherical harmonics - Particle in a central potential - Radial wave equation - Hydrogen atom - Energy eigenfunctions and eigenvalues.

UNIT - III: APPROXIMATION METHODS FOR STATIONARY STATES

Time independent perturbation theory - Non Degenerate case - Degenerate case - Time dependent perturbation and Application - Fermi's golden rule - Harmonic perturbation - Tunneling through a barrier - Sudden Approximation - Selection rules - Stark effect - Two electron atoms - Variation method - Ground state energy estimation for helium atom - The Fine Structure of Hydrogen - Hydrogen molecule - Hyperfine Splitting in Hydrogen - WKB approximation - WKB Quantization condition - WKB solution for the radial wave equation.

UNIT - IV: SCATTERING THEORY AND ANGULAR MOMENTUM

Theory of scattering - Differential and total cross section - Scattering amplitude - Born approximation - Validity - Eikonal approximation - Partial wave analysis - Asymptotic form and Phase shift analysis. Angular momentum - Matrix representation of spin angular momentum - Orbital angular momentum - Spin orbit coupling - Pauli's spin matrices - Commutation relations - Eigen values - Addition of angular momentum - Spin matrices - Clebsch Gordan coefficients - Tables of C-G coefficients - Identical particles with spin - Wigner Eckart theorem.

UNIT - V: RELATIVISTIC WAVE EQUATION

Klein Gordan equation - Charge and Current densities - Hydrogen like atoms - Non relativistic limit - Dirac equation - Dirac notation for state vectors - Position probability density - Dirac matrices - Spin of Dirac particle - Significance of negative energy states - Relativistic electron in a central potential - Electron in a magnetic field - Spin magnetic moment.

Course outcomes:
Upon completion of the course the student will able to

1. Have adequate knowledge on the application of mathematical operators to understand microscopic physics
2. Ability to solve problems of fundamental importance and obtain exact solutions
3. Find approximate solutions by using perturbation techniques for analytically unsolvable problems
4. Able to differentiate between quantum theory of scattering from the classical counterpart
5. Reckon the relativistic concepts on the wave mechanics

Books for study and reference:

1. P.M. Mathews and K. Venkatesan, A Text book of Quantum mechanics TMH, New Delhi, 6^{th} edision, 2013.
2. S. Rajasekar and R. Velusamy, Quantum Mechanics: The Fundamentals (CRC Press, Boca Raton, 2015).
3. Quantum Mechanics – Nouredine Zettili, John Wiley & Sons, Ltd, 2nd Edition, 2009.
4. Ajoy Ghatak and S.Loganathan, Quantum mechanics , TMH 6^{th} edision 2015.
5. Leonard I Schiff, Quantum mechanics Fourth Edition, Mc Graw Hill Education 2016.
6. Introduction to Quantum mechanics Second Edition David J.Griffiths,Published by Pearson Education 2015.
7. Quantum Mechanics – G. Aruldhas, PHI Learning Private Limited, 2nd Edition, 2009.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://medium.com/predict/what-is-quantum-mechanics
2. http://physics.mq.edu.au/~jcresser/Phys304/Handouts/QuantumPhysicsNotes.pdf
3. https://www.wolframalpha.com/examples/science-and- technoloquantumphysics technology/physics/quantumphysics
4. https://ocw.mit.edu/courses/physics/8quantum-physics-i-spring-2016/lecture-notes/

Mapping with programme outcomes 21PPH6							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	3	9	9	3
CO2	9	9	9	9	9	9	9
CO3	9	9	3	1	9	1	9
CO4	9	9	9	9	9	9	9
CO5	9	9	3	9	3	9	1
Total	45	45	33	31	39	37	31
Weightage	**5.56**	**5.56**	**5.25**	**4.95**	**7.09**	**5.49**	**5.66**

***S-Strong(9); M-Medium(3); L-Low(1).**

EC02 : CRYSTAL GROWTH , THIN FILMS AND NANO PHYSICS

SUB.CODE: 21PPHE2

Course objectives:
The main objectives of this course are

1. To understand the theoretical concepts involved in crystal growth, synthesizing new materials
2. To acquire knowledge about the synthesis of thin film using different techniques.
3. To understand the basic concept of nano science and techniques.
4. To gain the knowledge of different basic characteristic techniques involved in nano materials.
5. To acquire knowledge of application of nano materials in various fields.

UNIT - I : CRYSTAL GROWTH

Introduction - Crystal Growth and its importance - Nucleation - Theories of nucleation - Classical theory of nucleation - Spherical and Cylindrical shape of nucleus - Heterogeneous nucleation - Solution - Solubility and super solubility - Methods of crystallization - Slow cooling - Slow evaporation - Gel Growth - Experimental procedure - U-tube and straight tube methods - Melt Growth techniques : Bridgmann, Czochroiski - Kyropoulous methods.

UNIT - II : THIN FILM DEPOSITION TECHNIQUES

Introduction - Film Growth - Deposition parameters and grain size - Thin film structure - Substrate, Dislocation and film thickness effect - Vacuum evaporation - Hertz-Kundsen equation - E-beam, pulsed laser and ion beam evaporations - Mechanisms and yield of sputtering processes - DC, RF and magnetically enhanced reactive sputtering - Spray pyrolysis - Electro deposition - Chemical bath deposition (CBD) - Successive Ionic Layer Adsorption and Reaction(SILAR).

UNIT - III : FABRICATION OF NANO MATERIALS

Introduction - Top down and Bottom up approaches - Lithographic process and its limitations - Non lithographic techniques - Plasma Arc method - Chemical vapour deposition (CVD) - Pulsed Laser deposition (PLD) - Sol-Gel technique - Electro deposition - Ball Milling - Atomic layer deposition - Zeolite cages - Core shell structures - Co-precipitation method.

UNIT - IV: CHARACTERIZATION TOOLS OF NANO MATERIALS

X-Ray diffraction (XRD) studies - Powder and single crystal -Structural parameter analysis - Elemental dispersive X-ray analysis - Fourier transform infrared analysis - X-ray Photoelectron spectroscopy (XPS) for chemical analysis - UV-vis-NIR spectrometer - Chemical etching - Vickers micro hardness - Basic principles and operation of AFM and STM - Scanning Electron microscopy (SEM) - Atomic Force Microscopy (AFM) - Transmittance Electron Microscopy (TEM) - Photoluminescence .

UNIT - V : APPLICATIONS OF NANOMATERIALS

Molecular electronics and nano electronics - Nano boats - Biological application of nanomaterials - Catalysis by Gold nano particles - Quantum well and Quantum dots - Carbon nano tubes emitters - photoelectron chemical cells - Photonic crystals and plasma wave guides - Drug Delivery System.

Course outcomes:
After learning the course the students should be able to

1. Gained knowledge about the synthesis of crystal growth using basic concepts.
2. Learned about the various techniques of thin films and nano materials.
3. Able to know about the characterization of nano materials using various methods.
4 .Can acquire the knowledge in the field of nano materials in various fields.
5..Can acquire the knowledge about the carbon nano tubes.

Books for study and reference :

1. P. Santhana Ragavan and P. Ramasamy, Crystal Growth Processes and Methods (KRU Publications, Kumbakonam, 2001.
2. Govindhan Dhanaraj, Kullaiah Byrappa, Vishwanath Prasad, Michael Dudley (Eds.), Hand
    a. book of Crystal Growth Springer Heidelberg Dordrecht London New York, 2010.
3. A.Goswami, Thin Film Fundamentals, New Age International (P)Ltd, New Delhi 2003.
4. K. Chattopadhyay, A.N. Banerjee, Introduction to Nano Science and technology, PHI Learning Pvt. Ltd, New Delhi,2009.
5. Paras N Prasad, Nano photonics, John Wiley & Sons, Inc. New Delhi,2004.
6. Huozhong Gao, Nanostructures and Nano materials , Imperial college press (2004)
7. Nanoscience: Nanotechnologies and Nanophysics - C. Dupas, P. Houdy, M. Lahmani, Springer Verlag Berlin Heidelberg, 2007.
8. Sam Zhang, Lin Ki, Ashok Kumar, Materials Characterization Techniques, CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2009.
9. H.L. Bhat, Introduction to Crystal Growth Principles and Practice CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2015.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1. http://nptel.ac.in/courses/104104011/14.
2. https://en.wikipedia.org/wiki/Nanomaterials

Mapping with programme outcomes 21PPHE2							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	3	1	9	3
CO2	9	9	9	9	9	9	9
CO3	9	9	3	9	3	3	9
CO4	9	9	9	9	9	9	9
CO5	9	9	3	9	1	9	1
Total	45	45	33	39	23	39	31
Weightage	**5.56**	**5.56**	**5.25**	**6.23**	**4.18**	**5.79**	**5.66**

***S-Strong(9); M-Medium(3); L-Low(1).**

EDC : NUMERICAL METHODS AND SCIENTIFIC PROGRAMMING

SUB.CODE: 21PPHED1

Course objectives:
The main objectives of this course are

1. This advanced course on scientific computing using Fortran and Python will focus on programming.
2. Facilitating comprehension of object-oriented programming through Fortran and python programming languages for simulating scientific problems.
3. Understanding fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
4. Enabling the handling of arrays and related operations for advanced problems and Improving scientific data plotting and analysis.
5. Providing a working knowledge of practical numerical methods.

UNIT - I: NUMERICAL METHODS

Root finding: Newton Raphson method - System of equations: Gauss elimination - Curve fitting: Linear least squares approximation Interpolation: Lagrange and Newton - Numerical differentiation - Numerical Integration: Trapezoidal and Simpson's rules - Solving ODES: Euler and Runge-Kutta methods.

UNIT - II: FORTRAN 95 BASICS

Syntax - Data types - Variables - Constants - Operators - Branches and Loops - Strings -Decisions - Basic Input/Output - File Operations.

UNIT - III: ADVANCED COMPUTING IN FORTRAN 95

1D Arrays - Multi-dimensional Arrays - Intrinsic Array functions - Pointers - Subprogram - Functions - subroutines - Modules - Formatted Input/Output - Visualization with GNUplot - Parallel programming with Fortran - Basics - OpenMP, MPI and Coarray Fortran .

UNIT - IV: PYTHON BASICS

Python variables - Data types - Data structures: lists, dicts, tuples, sets, strings - Loops - Functions - Methods - Objects - File handling.

UNIT - V: PYTHON LIBRARIES

Basic Numpy : 2D Numpy Arrays - Pandas : Basic data manipulation - Matplotlib: basic plotting - Plot types - Image functions - Axis functions - Figure functions - 2D and 3D plots - Annotations and texts.

Course outcomes:
Upon successful completion of this course the student will be able to

1. Apply fundamental programming concepts in Fortran and Python to solve substantial scientific problems.
2. Create, implement, debug, and evaluate algorithms for solving scientific problems.
3. Utilize the various features of the Numpy, Pandas and Matplotlib Python libraries for advanced data analysis.
4. Use high-performance tools to load, clean, transform, merge, and reshape data Create data visualizations with Matplotlib or Gnuplot.
5. Use appropriate algorithmic approaches to solve numerical analyses problems.

Books for study and reference:

Unit 1,2:
1. Ed Jorgensen, Introduction to Programming using Fortran 95, 2003, 2008, (Ed Jorgensen,2018).
2. A. Singaravelu, Numerical methods, Meenakshi Agency, Chennai(2008)
3. M.K.Venkataraman, Numerical method in Science and Engineering, The National Publishing Company, Chennai,(1999)
4. T. Williams and C. Kelley, Gnuplot 5.0 An Interactive Plotting Program(Samurai Media limited, 2015).
5. J. C. Adams, W. S. Brainerd, J. T. Martin, B. T. Smith, and J. L. Wagener, Fortran 90 Handbook (Multiscience press, New York, 1992).
6. R. Chandra, L. Dagum, D. Kohr, D. Maydan, J. McDonald, and R. Menon, Parallel Programming in openMP, (Morgan Kaufmann Publishers, San Francisco, 2001).
7. S. Ray, Fortran 2018 with Parallel Programming (CRC press, New York, 2019).

Unit 3,4:

8. E. Matthes, Python Crash Course, 2nd Edition (No Starch Press, San Francisco, 2019).
9. W. McKinney, Python for Data Analysis (O'Reilly Media, Sebastopol, 2013).

Unit 5:

10. T. Sauer, Numerical Analysis, 2nd Edition (Pearson, San Francisco, 2012).
11. K. N. Anagnostopoulos, Computational Physics (National Technical University of Athens,Greece, 2014)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://onlinecourses.nptel.ac.in/noc20_ma33/preview
2. https://nptel.ac.in/course/103106074/
3. https://nptel.ac.in/course/122106033/

Mapping with programme outcomes 21PPHED1							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	3	1	9	3
CO2	9	9	3	9	9	9	9
CO3	9	9	9	1	3	3	9
CO4	9	9	9	9	9	9	9
CO5	9	9	3	9	9	9	1
Total	45	45	33	31	31	39	31
Weightage	**5.56**	**5.56**	**5.25**	**4.95**	**5.64**	**5.79**	**5.66**

***S-Strong(9); M-Medium(3); L-Low(1).**

CC07 : THERMODYNAMICS AND STATISTICAL PHYSICS

SUB.CODE: 21PPH7

Course objectives:
The main objectives of this course are

1. To acquire knowledge about law of thermodynamics.
2. To acquire knowledge about kinetic theory of gases.
3. To link thermodynamics to the micro descriptions used in classical statistics.
4. To link thermodynamics to the micro descriptions used in quantum statistics.
5. To acquire knowledge of about Einstein's & Debye's theory.

UNIT - I: REVIEW OF THE LAWS OF THERMODYNAMICS AND THEIR CONSEQUENCE

Energy and first Law of Thermodynamics - Heat content and Heat Capacity - Specific heat - Entropy - Second Law of Thermodynamics - Thermodynamic potential and the Reciprocity relation - Maxwell's relation - Deduction - Properties of Thermodynamics relation - Gibb's Helmholtz relation - Nernst Heat theorem of third law - Phase-Gibb's Phase rule - Chemical potential.

UNIT - II: KINETIC THEORY

Equilibrium state of dilute gas: Binary collisions - Boltzmann transport equation and its validity Boltzmann's H-theorem and its analysis - Maxwell Boltzmann distribution of velocities - Method of most probable distribution.

Transport Phenomena: Mean free path - Conservation laws - Zero and first order approximation - Viscous hydrodynamics - Navier-Stoke's equation - Wiedmann and Franz law.

UNIT - III: ELEMENTARY STATISTICAL MECHANICS

Micro and Macro states - Statistical equilibrium - Phase space - Partition function - Free energy - Ensembles: Micro canonical, Canonical and Grand canonical ensembles - Partition function and its associated thermodynamic quantities for all the three ensembles - Liouville's theorem - Maxwell-Boltzmann statistics - Maxwell Boltzmann Distribution function - Application to real gas.

UNIT - IV STATISTICAL MECHANICS OF IDEAL BOSE GAS

Bose - Einstein- Distribution law - Black body radiation and Planck's law - Phonons - Partition function for a harmonic oscillator - Specific heat of Solids- Einstein's theory - Debye's theory - Specific heat of diatomic molecules - Ideal Bose gas - Energy, Pressure and Thermal properties - Bose-Einstein condensation - Liquid helium.

UNIT - V STATISTICAL MECHANICS OF IDEAL FERMI GAS

Fermi-Dirac statistics and distribution law - Ideal Fermi gas - Properties - Gas degeneracy-Electron gas - Free electron model and Thermionic emission - White dwarf - Random walk problem - Brownian Motion - Diffusion Equation - First and second order phase transitions: Día, Para, Ferromagnetism - Ising model.

Course outcomes:
Upon successful completion of this course the student will be able to

1. Familarise thermodynamic quantities.
2. Calculate partition function and compute thermodynamics relations
3. Can calculate about ensembles and acquire the knowledge of ideal Fermi gas.
4. Able to know about the Bose-Einstein and Fermi-Dirac statistics according spin of the particles.
5. Apply to multi disciplinary areas.

Books for study and reference:

1. F. Reif, Fundamentals of Statistical and Thermal Physics (Waveland Press, 2010).
2. B. K. Agarwal and M. Eisner, Statistical Mechanics (New Age International Publishers, 3rd edition, 2013).
3. S. C. Garg, R. M. Bansal and C. K. Gosh, Thermal Physics: with Kinetic Theory, Thermodynamics and Statistical Mechanics (McGraw Hill Education, 2nd edition, 2017).
4. R. K. Pathria and P. D. Beale, Statistical Mechanics (Academic Press, 3rd edition, 2011).
5. D. A. McQuarrie, Statistical Mechanics (Viva Books India, Viva Student Edition, 2018).
6. .W. Greiner, L. Neise and H. Stocker, Thermodynamics and Statistical Mechanics (Springer Verlag, New York, 1st edition, 1995).

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]

1. https://nptel.ac.in/courses/115/106/115106111/
2. https://ocw.mit.edu/courses/physics/8-333-statistical-mechanics-i-statistical-mechanics-of-particles-fall-2013/lecture-notes/

Mapping with programme outcomes
21PPH7

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	3	1	9	3
CO2	9	9	3	9	9	9	9
CO3	9	9	9	3	3	3	9
CO4	9	9	9	9	9	9	1
CO5	9	9	3	9	3	9	1
Total	45	45	33	33	25	39	23
Weightage	**5.56**	**5.56**	**5.25**	**5.27**	**4.55**	**5.79**	**4.20**

***S-Strong(9); M-Medium(3); L-Low(1).**

CC08 : ELECTROMAGNETIC THEORY

SUB.CODE: 21PPH8

Course objectives:
The main objectives of this course are

1. To know the associated effects of stationary and moving charges.
2. To impart knowledge on the concept of magnetostatics.
3. To impart knowledge on the concept of Faraday's laws, induced emf and Maxwell's equations.
4. To impart knowledge on the concept of electromagnetic waves.
5. To introduce about the wave guides and their applications.

UNIT - I: ELECTROSTATICS

Coloumb's law - The electric field - Continuous charge distribution - Gauss's law and its applications - The curl of E - electric potential - Poisson and Laplace equation in three dimensions,Green's theorem - The potential of the localized charge distribution - Electrostatic boundary conditions - The work done to more charge - Energy of a point charge distribution - Continuous charge distribution - The classic image problem - The induced surface charge - Force and energy - Multipole expansion - Approximate potentials at large distances.

UNIT - II: MAGNETOSTATICS

Amperes law - Magnetic vector potential and magnetic field of a localized current distribution - Biot-Savart law - Steady current - The magnetic field of steady current - Straight line current - The divergence and curl of B - Application of Ampere's law - Comparison of electrostatics and magnetostatics - Magnetic boundary - Multi pole expansion of vector potential - Magnetic scalar potential - Ampere's theorem - Ampere's law in magnetized materials - Magnetic susceptibility and permeability.

UNIT - III: ELECTROMAGNETIC INDUCTION

Faraday's laws of induction - Maxwell's Equations: Electrodynamics before Maxwell's - Displacement current - Maxwell's equation in a matter – Maxwell's equation in free space in linear isotropic media - Lorentz invariance of Maxwell's equation - Boundary conditions on the fields at interfaces - Conservation laws: Continuity equation - Poynting theorem - Potential field: Scalar and vector potentials - Gauge transformations and invariance - Coulomb and Lorentz Gauge - Radiation from moving charges and dipole - Retarded potential.

UNIT - IV: ELECTROMAGNETIC WAVES

Plane wave in a non-conducting media - Linear and circular polarization - Energy flux in a plane wave - Radiation pressure and momentum - Plane wave in a conducting medium - Reflection and refraction of electromagnetic waves at a plane interface between dielectrics - Frequency dispersion characteristics of dielectrics - Dispersion relation in plasma - Conductor and Plasma.

UNIT - V: WAVE GUIDE AND RADIATING SYSTEM

Propagation of waves between conducting planes - waves in Guides of Arbitrary cross-section :Cylindrical - Wave Guides of Rectangular cross-section - Coaxial wave guide - Dielectric wave Guide - Resonant cavities - Field and radiation of a localized oscillating source - Electric dipole field and Radiation - Magnetic dipole and electric dipole field - Center-fed linear antenna.

Course outcomes:
Upon successful completion of this course the student will be able to

1. Understand the basic mathematical concepts related to electromagnetic vector fields.
2. Understand the concept related to faraday's law, induced emf and Maxwell's equations.
3. Apply Maxwell's equations to solution of problem relating to transmission lines and uniform plane wave propagation.
4. The have learnt about wave guides and transmission lines.
5. Understand propagation of waves through them.

Books for study and references:

1. David J. Griffiths, Introduction to Electrodynamics , Pearson, 4th Edition, 2012.
2. J.D. Jackson, Classical Electrodynamics (Wiley Eastern, 1999)
3. Classical Electromagnetism – Jerrold Franklin, Dover Publications, Inc.,2nd Edition, 2017
4. K. K. Chopra and G.C. Agarwal, Electromagnetic theory, K. Nath & Co. Meerut 2016.
5. B.B. Laud, Elctromagnetics (New Age International Publishers).
6. John R. Reitz, Fredrick, J. Milford and Robert, W. Christy, Foundations of electromagnetic Theory.
7. B.Chakraborty,principles of electro dynamics ,books and allied ,kolkatta, 2002
8. Satya Prakash, Electromagnetic Theory and Electrodynamics (Kedar Nath Ram Nath,Meerut, 2015)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]

1. https://nptel.ac.in/courses/122/106/122106034/
2. https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/

Mapping with programme outcomes 21PPH8							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	3	1	9	3
CO2	9	9	3	9	9	9	9
CO3	9	9	9	3	1	3	3
CO4	9	9	9	9	9	9	9
CO5	9	9	3	9	3	9	1
Total	45	45	33	33	23	39	25
Weightage	**5.56**	**5.56**	**5.25**	**5.27**	**4.18**	**5.79**	**4.56**

***S-Strong(9); M-Medium(3); L-Low(1).**

CC09 : ATOMIC AND MOLECULAR SPECTROSCOPY

SUB.CODE: 21PPH9

Course objectives:
The main objectives of this course are

1. To acquire knowledge about the basic concept of atomic and molecular physics of the system.
2. To describe the origin of ray, emission& absorption spectra.
3. To explain the microwave and IR Spectroscopy determining of molecules.
4. To study Raman spectroscopy,principle,instrumentation and their applications.
5. To impart knowledge about the lasers,masers in real world environment.

UNIT - I: ATOMIC SPECTRA

Quantum states of electron in atoms - Hydrogen atom spectrum - Electron spin - Stern Gerlach experiment - Spin-orbit interaction - Lande interval rule - Two electron systems, LS-JJ coupling schemes - Fine structure - Spectroscopic terms and selection rules - Hyperfine structure - Isotopic shift.

Exchange symmetry of wave functions - Pauli's exclusion principle - Periodic table - Alkali type spectra - Equivalent electrons - Hund's rule.

UNIT - II: ATOMS IN EXTERNAL FIELDS AND X - RAY SPECTRA

Zeeman and Paschen Back effect of one and two electron systems - Selection rules - Stark effect - Inner shell vacancy - X-ray- Auger transitions - Compton Effect.
Molecules: Covalent, Ionic and van der Waal's interactions - Born Oppenheimer approximation.
X - ray spectra: origin of x-rays - Emission spectra and double spectra - Absorption spectra.

UNIT - III: MICROWAVE AND IR SPECTROSCOPY

Rotational spectra of diatomic molecules - Intensities of spectral lines – The effect of isotopic substitution - the non-rigid rotator - Rotational spectra of poly atomic molecules - Linear, symmetric top and asymmetric top molecules - Experimental techniques - Vibrating diatomic molecule - Diatomic vibrating rotator: Linear and symmetric top molecules - Analysis by infrared techniques.

UNIT - IV: RAMAN SPECTROSCOPY AND ELECTRONIC SPECTROSCOPY OF MOLECULES

Raman Effect - Classical and quantum theories - Pure rotational Raman's spectrum - Vibrational Raman spectrum - Diatomic molecules - Selection rules - Structure determination from Raman & IR spectroscopy and experimental techniques.

Electronic spectra of diatomic molecules - Intensity of spectral lines - The Franck-Condon principle - Dissociation energy and dissociation products - Electronic spin resonance - Nuclear magnetic resonance.

UNIT - V: MASERS AND LASERS

Spontaneous and Stimulated emission - Ammonia maser - Interaction of radiation with atomic systems - Einsteins's coefficients - Population inversion - Laser threshold condition - Rate equations for 3 and 4 level lasers - Laser resonators and coherence length - Ruby Laser - He-Ne laser - CO_2 laser, Semiconductor laser - Laser applications.

Course outcomes:
Upon successful completion of this course the student will be able to

1. Analyze different atomic structure and will be able to understand fine structure and hyper fine structure.
2. Expiain the behavior of atoms in external electric and magnetic fields.
3. Explain rotational and IR Spectroscopy and apply the techniques of micro waves and IR Spectroscopy.
4. Apply the principle to Raman spectroscopy and its applications in various disciplines of science and technology.
5. Design various types of lasers and masers system.

Books for study and reference:

1. C,N.Banwell, Fundamentals of Molecular Spectroscopy, McGraw-Hill, New York, 1981.
2. A. Beiser, Concepts of Modern Physics (McGraw Hill, New York, 1995)
3. Manas Chanda, Atomic Structure and Chemical Bond, TMH 4th edision 2000
4. B. P. Stranghan and S. Walker, Spectroscopy Vol. 1, Chapman and Hall 1976
5. B.H. Bransden and C.J. Joachain, Physics of Atoms and Molecules, Pearson2nd edision 2003.
6. Vimal Kumar Jain, Introduction to molecular spectroscopy(Alpha science international,Ltd,2007.
7. Molecular Structure and Spectroscopy - G. Aruldhas Pearson,PHI P(V)Ltd.2nd edision 2008
8. Introduction to molecular spectroscopy - G.M.Barrow (McGraw Hill, New York, 2018.)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]

1. https://nptel.ac.in/courses/115/105/115105100/
2. https://onlinecourses.nptel.ac.in/noc20_cy31/preview
3. http://www.kinetics.nsc.ru/chichinin/books/spectroscopy/Atkins05.pdf

Mapping with programme outcomes 21PPH9							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	3	1	9	3
CO2	9	9	9	9	9	9	9
CO3	9	9	1	9	3	3	9
CO4	9	9	9	1	9	9	9
CO5	9	9	3	9	9	1	1
Total	45	45	31	31	31	31	31
Weightage	**5.56**	**5.56**	**4.94**	**4.95**	**5.64**	**4.60**	**5.66**

***S-Strong(9); M-Medium(3); L-Low(1).**

EC03 : MICROPROCESSOR AND MICROCONTROLLER

SUB.CODE: 21PPHE3

Course objectives:
The main objectives of this course are

1. To know the internal organization ,addressing modes and instruction set of 8085 microprocessor.
2. To know the various functional units of 8051 microcontroller interfacing of various peripheral devices.
3. To know the various functional units of 8051 microcontroller interfacing memory.
4. To design the architecture of 8051 microcontroller.
5. To write the simple programs for manipulating the numbers using 8051 microcontroller.

UNIT - I: MICROPROCESSOR ARCHITECTURE (8085) AND INSTRUCTION SET

Microprocessor architecture 8085 - Data instruction cycle - Timing diagram - Instruction set - Data transfer group - Arithmetic group - Logic group - Branch control group - I/O and machine controlled group - Addressing modes - Direct -indirect - Register - Relative - Indexed modes - Status flags.

UNIT - II: MICROPROCESSOR PROGRAMMING

Software programs - Debugging - Modular programming - Structured programming - Macros - Micro programming - Assembly language programming - Addition - Subtraction - Multiplication - Division - BCD arithmetic - Searching an array for a given number - Smallest and largest numbers from a list - Arranging a list of numbers in ascending and descending order - Finding the square root of a number - Multibyte addition and subtraction.

UNIT - III: INTERFACING AND APPLICATIONS

Interfacing memory and I/O devices - IC mapped I/O - Memory mapped I/O - Types of interfacing devices - 8255 I/O ports and programming - Applications: Water level indicator,Basic - Traffic control and stepper motor - Temperature measurements and control - Speed control of a DC motor - Measurement and display of speed of a motor.

UNIT - IV: MICROCONTROLLER (8051) ARCHITECTURE

8051 Architecture - Microcontroller hardware - Program and data memory - External memory - Counter - Timers - Serial data I/O - Interrupts.-Interfacing external memory and I/O - Timing and controls.

UNIT - V: MICROCONTROLLER (8051) INSTRUCTIONS, APPLICATIONS AND SIMPLE PROGRAMS

Addressing modes - Instructions - Data transfer instructions - Logical, arithmetic, jump and call instructions - Bit manipulation - Interfacing of keyboard with 8051 - Microcontroller based washing machine - Addition - Sum of N numbers, Multibyte addition - Subtraction - Multiplication - Division - Biggest and smallest numbers.

Course out comes:
Successful completion of this course student will be able to

1. Understand the architecture of microprocessor and microcontroller.
2. Understand the programming model of microprocessors and microcontrollers.
3. Interface different external peripheral devices with microprocessors and microcontrollers..
4. Develop an assembly language programme for specified applications.
5. Unterstand the simple programs for manipulated the numbers using 8051 microcontroller.

Books for study and reference:

1. B. Ram, Fundamentals of Microprocessors and micro computers (DhanpatRai and sons, New Delhi, 1995).
2. R. Goankar, Microprocessor Architecture Programming and Applications (Wiley Easter Ltd.,)
3. Kenneth J. Ayala, The 8051 Microcontroller, Architecture, Programming and Applications (Thompson, Delmer, Learning (ISE), New Delhi, 2004).
4. Microprocessor and micro controller,(Krishna kant ,New Delh,i 2014.)
5. Soumitra Kumar Mandal, Microprocessors and Microcontrollers Architecture, Programming and Interfacing using 8085, 8086, 8051, Mc Graw Hill Education (India) Private Limited, New Delhi (2015).
6. A.P. Godse and D.A. Godse-Microprocessors and Microcontrollers-TechnicalPublications,Pune (2010).

Mapping with programme outcomes 21PPHE3							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	3	1	9	3
CO2	9	9	3	9	9	9	9
CO3	9	9	9	9	3	3	9
CO4	9	9	9	9	9	9	9
CO5	9	9	3	9	1	9	1
Total	45	45	33	39	23	39	31
Weightage	**5.56**	**5.56**	**5.25**	**6.23**	**4.18**	**5.79**	**5.66**

***S-Strong(9); M-Medium(3); L-Low(1).**

CC10: PYTHON , MICROPROCESSOR AND MICROCONTROLLER PROGRAMMING (PRACTICALS)

SUB.CODE: 21PPH10P

Course objectives:
The main objectives of this course are

1. To provide the student hands-on experiences in Python programming through laboratory experiments.
2. To provide a working knowledge of practical numerical methods.
3. To a series of computer programs in C++ programming language on basic numericalmethods will be provided.
4. Students will be asked to write programs involving various mathematical and physics problems.
5. Test them in the computer of numerical problem in the rules of microprosser and micro controller.

LIST OF EXPERIMENTS

ANY 15 EXPERIMENTS(5 from each section)

PYTHON PROGRAMMING

1. Newton Raphson method
2. Simpson and Trapezoidal integration rules
3. Gauss Elimination method
4. Runge Kutta II and IV order methods
5. Newtons Forward and backward formulae
6. Bifurcation diagram of logistic map
7. Duffing Oscillator trajectory plot

MICROPROCESSOR

1. Addition, subtraction, multiplication and divison (8 bit)
2. 16 bit addition and 1's and two's complement subtraction(8 and 16 bit)
3. Conversion : Decimal to Octal and Decimal to hexadecimal
4. Searching for a number from a given list
5. Ascending and descending order
6. Stepper motor interface
7. Temperature measurement interface

MICROCONTROLLER

1. Addition, subtraction, multiplication and division
2. Fibonacci series
3. Factorial of a number
4. Square root of a number
5. Gray code to 8 bit binary number conversion
6. Ascending and descending order
7. Conversion : Decimal to Octal and Decimal to hexadecimal

Course outcomes:
Successful completion of this course student will be able to

1. Students will acquire hands-on knowledge of programming practices in python.
2. Students will learnsome of the mathematical and physics problems of numerical integration and differentiation, numerical solution.
3. Work independently and function as a team.
4. Develop communication skills (oral, microprocessor and micro controller program and written).
5. Apply a methodology for materials selection to scientific problems for locate or estimate. materials. data and information relevant to a successful design analysis.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://www.programiz.com/c-programming
2. https://www.geeksforgeeks.org/c-language-set-1-introduction/
3. https://beginnersbook.com/2014/01/c-tutorial-for-beginners-with-examples/

Mapping with programme outcomes 21PPH10P							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	3	1	9	3
CO2	9	9	9	9	9	9	9
CO3	9	9	3	9	3	3	9
CO4	9	9	9	9	9	9	9
CO5	9	9	3	9	1	9	1
Total	45	45	33	39	23	39	31
Weightage	**5.56**	**5.56**	**5.25**	**6.23**	**4.18**	**5.79**	**5.66**

***S-Strong(9); M-Medium(3); L-Low(1).**

CC11: NONLINEAR DYNAMICS AND RELATIVITY

SUB.CODE: 21PPH11

Course objectives:
The main objectives of this course are

1. To understand the integrable and non-integrable physical systems interesting behaviors in addition to the theory of relativity.
2. To understand nonlinear phenomena occur in autonomous and non autonomous systems.
3. Students will be able to make Bifurcation diagram of logistic map and henon map.
4. Indroduction to nonlinear dynamics and chaos,recent application of chaos,computer and chaos, dynamical view of the world.
5. Basics of nonlinear sciences; Dynamics,types of dynamical systems and Nonlinearity.

UNIT - I: DYNAMICAL SYSTEMS AND BIFURCATIONS

Linear and nonlinear systems, autonomous and non autonomous systems - Linear super position principle - Equilibrium points - Classification for two dimensional case - Limit cycle motion - Periodic attractor - Poincare Bendixson theorem - Bifurcations: Saddle node, Pitchfork, Transcritical and Hopf Bifurcations.

UNIT - II: CHAOS IN DISCRETE AND CONTINUOUS DYNAMICAL SYSTEMS

Logistic map - Equilibrium points and their stability - Period doubling phenomenon - Onset of chaos - Lyapunov exponent - Bifurcation diagram of logistic map - Henon map - Period doubling - Self similar structure - Duffing Oscillator - Bifurcation Scenario - Period doubling route to chaos - Intermittency transition - Quasi periodic route to chaos.

UNIT - III: CHOAS IN NON LINEAR ELECTRONIC CIRCUITS AND HAMILTONIAN CHAOS

Linear and Non linear circuit elements - Non linear circuits - Chua's diode - Bifurcations and chaos - MLC circuit - Experimental Realization - Stability analysis - Experimental and Numerical studies.

Henon - Heiles system - Equilibrium points - Poincare surface of section - Periodically driven undamped Duffing Oscillator - Standard map - Linear stability and invariant curves - Numerical analysis - Regular and Chaotic motions - Kolmogorov - Arnold -Moser theorem.

UNIT - IV: WAVES AND SOLITONS

Linear waves - Linear non dispersive system - Linear dispersive wave propagation - Fourier transform and solution of initial value problem- Wave packet and dispersion - Cnoidal and Solitary waves - Solitons - KdV equation - Fermi Pasta Ulam Paradox - Hirota bilinearization method - Lax pair - Inverse Scattering transform method for KdV equation.

UNIT - V: RELATIVITY

Basic Postulates of Relativity - Lorentz transformations - Velocity addition and Thomas precession - Vectors and the metric tensor - Relativistic Kinematics of collisions and many particle systems - Relativistic angular momentum - Lagrangian formulation of relativistic mechanics - Relativistic One dimensional Harmonic oscillator - Introduction to General theory of relativity.

Course outcomes:
Successful completion of this course student will be able to

1. The students is expected to acquire basic knowledge of non linear differential equation.
2. The students is capable of finding Linear stability and invariant curves.
3. The students is can analyze Inverse Scattering transform method for KdV equation.
4. Understanding the basic of non linearity in physical systems.
5. Can acquire the knowledge that of relativity.

Books for study and reference:

1. M. Lakshmanan and S. Rajasekar, Non Linear Dynamics,Springer Verlag(2003)(For unit I - IV).
2. H. Goldstein, C. Poole and John Safko, Classical Mechanics, 3rd Edition, (Pearson Education, New Delhi, 2004(For unit V).
3. M. Lakshmanan and K. Murali,Chaos in Nonlinear Oscillators,(World Scientific,Singapore,1996).
4. A. Fuchs, Nonlinear Dynamics in Complex Systems: Theory and Applications for the Life-, Neuro- and Natural Sciences (Springer, 2013).
5. S. H. Strogatz, Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering, II Edition (CRC Press, 2014).
6. C. Misbah, Complex Dynamics and Morphogenesis: An Introduction to Nonlinear Science (Springer, 2017)
7. S. Wolfram, A New Kind of Science, (Wolfram Media Inc., 2002).
8. H. G. Schuster, Deterministic Chaos: An Introduction (Wiley-VCH, 2005).

Mapping with programme outcomes 21PPH11							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	3	1	9	3
CO2	9	9	9	9	9	9	9
CO3	9	9	9	9	3	3	9
CO4	9	9	9	1	9	9	9
CO5	9	9	3	9	9	9	1
Total	45	45	39	31	31	39	31
Weightage	**5.56**	**5.56**	**6.21**	**4.95**	**5.64**	**5.79**	**5.66**

***S-Strong(9); M-Medium(3); L-Low(1).**

CC12: CONDENSED MATTER PHYSICS

SUB.CODE: 21PPH12

Course objectives:
The main objectives of this course are

1. Enable the students to understand about the crystals structure interaction with X-ray.
2. Helps the students to understand the interaction with lattice vibrations.
3. To understand the thermal and electrical properties in the free electron model.
4. To study the basic concepts of thermal and electrical conductivity.
5. To study the superconductivity using BCS theory.

UNIT - I: CRYSTAL DIFFRACTION AND RECIPROCAL LATTICE

Bragg law - Diffraction experiments - Laue method - Rotating crystal method - Powder method - Reciprocal lattice vectors - Condition for diffraction - Brillouin zones - Bravais lattices - Reciprocal lattice to simple cubic, face centered cubic and body centered cubic lattice - Fourier analysis of the basis - Structure factor - Atomic form factor - Temperature dependence on spectral lines.

UNIT - II: CRYSTAL BINDING AND LATTICE VIBRATIONS

van der Waals - London interaction Madelung energy and Madelung constant - Evaluations - covalent , Metal and hydrogen bonded crystals.

Vibrations of Monatomic lattices - Lattice with two atoms per primitive cell - Quantization of lattice vibration - Phonon momentum.

UNIT - III: ENERGY MOMENTUM AND SEMICONDUCTOR CRYSTALS

Nearly free electron model - Bloch functions - Kronig penny model - Wave equation electron in a periodic potential - number of orbitals in band - Energy bands in metals, insulators and semiconductors - Band gap - Equation of conductors - Effective mass of holes - Intrinsic carrier concentration - Thermoelectric effect in semi conductors - Electronic and lattice specific heat - Schottcky Barrier - Gunn - Effect Oscillators.

UNIT - IV: FERMI SURFACES AND METALS

Construction of Fermi surface - Electron orbits, hole orbits - Calculations of Energy bands - Tight binding method for energy bonds - Wigner Seitz method - Pseudo potential - Experimental methods - Quantization of orbits is a Magnetic field - De Haas - Van Alpen effect - Electrical conductivity and ohms law - Motion of electrons in magnetic fields - Hall effect - Thermal conductivity of metals - Drude model of electrical and thermal conductivity.

UNIT - V: SUPER CONDUCTIVITY

Occurrence - Meissner effect - Heat capacity Thermodynamics of super conducting transition - type-I and type-II super conductors - London equations - Coherence length and London penetration depth - BCS theory of super conductivity - Flux quantization in a superconducting ring - Josephson super conductor tunneling - AC and DC Josephson effects .

Super fluidity: Ordered phase of matter, translational and orientation order - Kinds of liquid crystalline order - Quasi crystals.

Course outcomes:
Successful completion of this course student will be able to

1. Understand the Physics behind structural properties of the solids.
2. Understand and explain the concentration of lattice in solids through different theories.
3. Tailor the properties of solids with proper understanding.
4. Able to elaborate thermal and electrical conductivity of metals, conductors and semiconductors.
5. Able to understand super conductors, types with their properties and applications.

Books for study and reference:

1. C. Kittel, Introduction to Solid State Physics, 7th Edition, Wiley Eastern, New Delhi, 2006.
2. S. O. Pillai, Solid State Physics, Seventh Edition, New Age International, New Delhi, 2014.
3. J.P. Srivastava : Elements of Solid State Physics, Prentice-Hall of India, 2006.
4. A.J. Dekker, Solid State Physics, Published by Macmillan India (2000).
5. J. R. Christman : Fundamentals of Solid State Physics, John Wiley & Sons, NY, 1988.
6. J. S. Blakemore,Solid State Physics,Second Edition,Cambridge University Press,Cambridge London.1985.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://nptel.ac.in/courses/113/104/113104014/
2. http://nptel.ac.in/courses/115105099/
3. https://nptel.ac.in/courses/115/104/115104088/

Mapping with programme outcomes 21PPH12							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	3	1	9	3
CO2	9	9	3	9	9	9	9
CO3	9	9	9	9	3	3	9
CO4	9	9	9	9	9	9	9
CO5	9	9	3	1	9	1	1
Total	45	45	33	31	31	31	31
Weightage	**5.56**	**5.56**	**5.25**	**4.95**	**5.64**	**4.60**	**5.66**

***S-Strong(9); M-Medium(3); L-Low(1).**

CC13 : NUCLEAR AND PARTICLE PHYSICS

SUB.CODE: 21PPH13

Course objectives:
The main objectives of this course are

1. To impart higher level knowledge and understanding of nuclear physics and technology.
2. To learn about the decay phenomenon and its process.
3. To gain knowledge of various models of the nucleus.
4. To understand the classification of subatomic particles and their properties.
5. To find the properties of strong and weak interactions.

UNIT- I: BASIC NUCLEAR PROPERTIES

Nuclear size, shape, mass-charge distribution - Spin and parity - Binding energy - Semi empirical mass formula - Nuclear stability - Mass parabola - Nuclear forces: Nature of nuclear force - Ground state of deuteron - Magnetic dipole moment of deuteron - Proton - Neutron scattering at low energies - Scattering length, Phase shift - Proton-Proton scattering at low energies - Properties of nuclear forces - Exchange forces - Meson theory - Nuclear models : Liquid drop model , Shell model and Collective model.

UNIT- II: RADIOACTIVE DECAYS

Alpha emission - Geiger Nuttal law - Gamow theory - Neutrino hypothesis - Fermi theory of β decay - Selection rules - Non conservation of parity - Gamma emission - Selection rules - Internal conversion- Nuclear isomerism - Detection of nuclear radiations - Interaction of charged particle with matter - Basic principles of particle detectors - Ionization chamber - Proportional counter- G.M. counter - Solid state detectors - Scintillation and semiconductor detectors.

UNIT- III: NUCLEAR REACTIONS

Types of reaction and conservation of laws energetic of nuclear reactions, Dynamics of nuclear reactions,Q value equation - Scattering and reactions cross sections, Compound nucleus reactions - Direct reactions, Resonance scattering - Breit Wigner one level formula - Reciprocity theorem - Optical model theory of nuclear reactions.

UNIT- IV: ACCELERATORS AND REACTORS

Cyclotron - Synchrocyclotron - Betatron - Synchrotron - Linear accelerators - Nuclear fission and fusion: Characteristics of fission mass distribution of fragments - Radioactive decay process - Fission cross section - Energy in fission - Bohr-Wheeler's theory of nuclear fission - Fission reactors - Thermal reactors - Homogeneous reactors - Heterogeneous reactors - Basic fusion process - Characteristics of fusion - Solar fusion - Controlled fusion - Reactors - Cold fusion.

UNIT- V: ELEMENTARY PARTICLE PHYSICS

Classification of fundamental forces and elementary particles - Basic conservation laws - Additional conversation laws: Baryonic, Leptonic, Strangeness and Iso-spin charges/quantum numbers - Gell-Mann - Nishijima formula - Multiples - Invariance under time reversal (T) - Charge conjugate (C) and parity (P) - TCP theorem - Parity non-conservation in weak interaction - CP violation - Eight fold and super multiples SU(3) symmetry and quark model.

Course outcomes:
Successful completion of this course student will be able to

1. Will have a versatile background in fundamental physics and its application.
2. Can apply the theory of nuclear physics in various fields.
3. Know about the spin parity concepts.
4. Can promote the exchange of ideas and research within the nuclear/atomic science community
5. Gain knowledge in the nuclear properties such as binding energy, spin and parity.

Books for study:

1. K. S. Krane, Introductory Nuclear Physics (John-Wiley, New York, 1987)
2. R.R.Roy and B.N.Nigan,Nuclear physics ,New age international,New delhi,1983
3. M. L. Pandya & R.P.S.Yadav Elements of Nuclear Physics 7th edition,Kedar Nath Ram Nath Delhi,1995
4. S. B. Patel, Nuclear Physics : An Introduction (Wiley-Eastern, New Delhi, 1991)
5. H.S.Hans, Nuclear Physics: Experimental and Theoretical, New Age intel, NewDelhi, 2001.
6. D.Griffths, Introduction to Elementary Particle Physics, Wiley Intel, Edition, New York, 1987.
7. A.Beiser, Concepts of Mordern Physics, 5th Ed. (McGraw-Hill, 1995)

Books for reference:

1. D.C. Tayal, Nuclear Physics (Himalaya Publishing House, New Delhi, 2004)
2. S.N. Ghoshal, Nuclear Physics (S. Chand & Company, New Delhi, 2006)
3. H.A.Enge,Introduction to nuclear physics addition -westly-Tokyo,1983.
4. J.M Longo,Elementary particles .Mc Graw -Hill,newyork,1971.
5. I.Kaplan,Nuclear physics ,narosa,new delhi,1989
6. B.L.Cohen , Concepts of Nuclear Physics, Tata McGraw Hill, New Delhi, 1988.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1. https://nptel.ac.in/courses/115/104/115104043/
2. https://nptel.ac.in/courses/115/106/115106087/
3. https://nptel.ac.in/courses/115/103/115103101/

Mapping with programme outcomes 21PPH13							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	3	1	9	3
CO2	9	9	9	9	9	9	9
CO3	9	9	3	9	3	3	9
CO4	9	9	9	1	9	9	9
CO5	9	9	3	9	9	9	1
Total	45	45	33	31	31	39	31
Weightage	**5.56**	**5.56**	**5.25**	**4.95**	**5.64**	**5.79**	**5.66**

***S-Strong(9); M-Medium(3); L-Low(1).**

CC18 : PROJECT WORK

SUB.CODE: 21PPHN4

Course objectives:
The main objectives of this course are

1. To develop abilities and skills that encourage research and development activities and are useful in everyday life and understanding and competencies required by practicing teachers for effective teaching-learning process at the secondary stage.
2. Sustained in depth study on a specific topic to enable the students to critically examine the background literature relevant to their the background literature relevant to their specific research area.
3. An environment that encourages the students originally and creativity in their research and opportunity to develop skills in making and testing hypotheses in developing new theories and in planning and conducting experiments, developing practical research skills and learn new stage of the art techniques.
4. The opportunity to expand the student's knowledge of their research area, including its theoretical foundation and the specific techniques used to study it.
5. An environment in which to develop skills in written work, oral presentation and publishing the results of their research scientific journals for future development and the students in acquiring basic knowledge in the specialized thrust areas such as Material science and Nanoscience, Theoretical physics, Crystal growth, Thin films in various fields of branch of physics.

PROJECT DISSERTATION

Course outcomes:
Successful completion of this course

1. Have some research experience within a specific field of physics, through a supervised project (Master dissertation).
2. Have a thorough knowledge of literature and a understanding of scientific methods and techniques applicable in their field of research.
3. Be able to summarize major themes and current research problems in their area of specialization and be able to explain and identify open problems and areas needing development in their fields.
4. Be able to demonstrate originality in the application of knowledge, together with a practical understanding of how research and enquiry are a used to create and interpret knowledge in their field.
5. Able to act independently in the planning and implementation of research and have carried out and presented an original work of research in their discipline.

Mapping with programme outcomes 21PPHN4							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	9	9	9	9	3	9	9
CO2	9	9	9	3	9	9	3
CO3	9	9	9	3	9	9	1
CO4	9	9	9	9	3	1	9
CO5	9	9	9	9	1	9	9
Total	45	45	45	33	25	37	31
Weightage	**5.56**	**5.56**	**7.17**	**5.27**	**4.55**	**5.49**	**5.66**

***S-Strong(9); M-Medium(3); L-Low(1).**